

Review

Digital Transformation in Project Management: A Systematic Review and Research Agenda

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Abstract

Digital transformation (DT) fundamentally reshapes how organisations operate, create value, and respond to complex environments through the integration of digital technologies. Beyond mere technical deployment, DT involves behavioural, strategic, and institutional changes. As these transformations are increasingly managed through projects and programmes, project management plays a pivotal role, not only in delivering these transformations but also in enabling them. However, the relationship between DT and project management remains fragmented and insufficiently explored. This paper addresses this gap by systematically reviewing 66 peer-reviewed articles using a qualitative thematic coding approach informed by sociotechnical systems theory. The analysis reveals four interrelated themes: methodologies and the sociotechnical integration of digital tools, misalignments in sociotechnical interfaces, governance and leadership, and industry- or project-specific transformation trajectories. Based on these findings, the paper proposes three key future research agenda: (1) embedding digital tools through methodological mediation and governance integration, (2) governance and leadership as strategic enablers, and (3) advancing sector-specific insights into DT. By offering a structured synthesis and a theory-driven research agenda, this review contributes to a more integrated understanding of how DT unfolds within project-based contexts and lays the groundwork for future interdisciplinary research.

Keywords: digital transformation; project management; SLR; sociotechnical system theory; digital tools; leadership; strategy; organisational change



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1. Introduction

Digital transformation (DT) signifies a fundamental reshaping of how organisations create value, deliver services, and respond to uncertainty through the adoption of emerging technologies such as artificial intelligence (AI), big data, cloud platforms, and the Internet of Things (IoT) [1–3]. These technologies are redefining decision-making processes, team coordination, and the capabilities required for effective project delivery [4]. For example, AI-driven transformation initiatives have led to tangible gains: 68% of surveyed organisations reported improved on-time delivery, 38% cited cost reductions, and 61% noted enhanced quality outcomes [4].

However, DT is not solely a matter of adopting new technologies; it necessitates a deeper organisational shift involving the redefinition of workflows, institutional logics, and strategic priorities [2,4–6]. The process often encounters substantial organisational challenges, including leadership misalignment [7], cultural resistance [8], governance complexity [9], and structural unreadiness [10]. For example, Sun and Tell [11] demonstrate how conflicting interpretations of DT goals across departments can hinder alignment and lead to failure. Similarly, Moschko et al. [12] identify how goal ambiguity and limited shared understanding can fragment strategic direction. As such, DT demands more than technological adaptation—it necessitates parallel transformations in leadership practices, governance models, team structures, and organisational culture [3,13–17].

Consequently, DT is increasingly delivered through projects and programmes, positioning project management as both a vehicle for DT implementation and a domain undergoing transformation itself [18]. Traditional project management approaches, often linear and control-focused, are ill-suited to the ambiguity, speed, and interdisciplinary demands of DT [19,20]. This shift calls for more adaptive methodologies such as agile, lean, DevOps, and hybrid models, which support iterative delivery, stakeholder responsiveness, and innovation at scale [8,9,21,22]. New tensions have emerged, such as misalignments between project methodologies and organisational structures, integration conflicts across planning logics, and mismatches between methodologies and behavioural or collaborative dynamics.

These challenges require more diversified leadership configurations and governance mechanisms. For example, Clausen et al. [23], in a study of 42 DT projects in a global manufacturing firm, found that project success depended less on technological sophistication and more on the alignment of social and technical complexities, especially in terms of collaboration models, team structures, and governance mechanisms.

This aligns closely with Sociotechnical Systems (STS) theory, which views DT as the result of dynamic interactions between technological systems, human actors, and organisational structures [24–26]. STS emphasizes that successful DT requires more than the deployment of tools; it relies on the effective integration of methodologies, people, organisational settings, and governance mechanisms.

Despite growing scholarly attention, the intersection of project management and digital transformation remains conceptually fragmented and under-theorised [27–30]. Recent bibliometric work by Yordanova [31] provides a high-level mapping of the field, identifying clusters such as technological innovation, managerial adaptation, and sector-specific application. However, deeper conceptual insights are still needed to explain how digital transformation is organised, managed, and governed in project-based settings.

This paper addresses this gap by answering the research question: How to achieve digital transformation in project management considering both sociotechnical and organisational factors?

Through a systematic literature review (SLR) of 66 peer-reviewed articles, we identify four interrelated themes: (1) methodologies and the sociotechnical integration of digital tools; (2) misalignments in sociotechnical interfaces; (3) governance and leadership; and (4) industry-/project-specific transformation trajectories.

Guided by Sociotechnical Systems (STS) theory, this review not only synthesises current knowledge but also proposes a structured future research agenda that highlights critical areas for further exploration. By integrating these findings, the paper contributes to both theoretical development and practical understanding of digital transformation in contemporary project environments. Specifically, the insights gained from the identified themes provide a robust foundation for project managers to navigate the challenges and leverage the enablers of DT in their projects. Additionally, the proposed future research

agenda offers a roadmap for scholars to further explore key areas in DT, facilitating the development of more adaptive methodologies and governance frameworks. This paper thus serves as a critical resource for both practitioners seeking to enhance project success and researchers looking to deepen the understanding of DT within the context of project management.

2. Systematic Literature Review Methodology

This study adopts a SLR methodology grounded in established practices for evidence-informed research in the management field. The review protocol was inspired by structured frameworks, PRISMA [32] and adapted to suit the conceptual and qualitative nature of this study. The multi-stage process was designed to ensure transparency, reproducibility, and thematic depth, aligning with interdisciplinary standards in project management and digital transformation research. The literature search was restricted to peer-reviewed English-language publications, with no temporal limits applied to allow for comprehensive historical and contemporary coverage.

2.1. Review Design and Search Strategy

This study adopts a SLR approach, which is increasingly recognised as a rigorous and transparent method for synthesising knowledge in the management field [33,34]. Building on previous SLRs in project-based and digital innovation contexts this study applies an evidence-informed review protocol to identify and evaluate peer-reviewed scholarship at the intersection of project management and DT.

The purpose of this review is to understand how project management practices are reshaped by DT. Consistent with its objectives, the study maintains a managerial rather than technical focus, seeking to contribute to the organisational and project studies literature.

The literature search was conducted using the Web of Science (WoS) Core Collection, a widely recognised academic database known for its high-quality, peer-reviewed coverage, broad disciplinary inclusion, and transparent indexing criteria. WoS is frequently used in systematic literature reviews due to its structured metadata, consistent curation standards, and compatibility with advanced academic tools [35–37].

To ensure comprehensive retrieval of scholarly work at the intersection of DT and project management, an expanded topic-based search strategy was employed. The Boolean search expression incorporated a wide range of synonyms and related terms to reflect the diversity of terminology in the field. The search was conducted in the Topic field, which includes article titles, abstracts, author keywords, and Keywords Plus[®], ensuring that thematically relevant literature was captured regardless of disciplinary framing or terminology variation.

Search string:

("digital transformation" OR "digitisation" OR "digitization" OR "digitalisation" OR "digitalization" OR "digital maturity" OR "enterprise digital transformation" OR "digital innovation")

AND

("project management" OR "digital project management" OR "project delivery" OR "project governance" OR "transformation program" OR "agile project management" OR "hybrid project management" OR "DevOps in projects" OR "lean project delivery" OR "program management")

This search yielded 4852 records without date restrictions. To ensure disciplinary relevance and quality, only articles indexed in the Social Sciences Citation Index (SSCI), Science Citation Index Expanded (SCIE), and Arts & Humanities Citation Index (A&HCI) were retained, resulting in a refined dataset of 2782 publications.

The expanded topic formulation enhanced the conceptual scope of the search, facilitating the identification of a broad, interdisciplinary body of literature and supporting a structured foundation for further analysis.

2.2. Screening and Selection Process

To maintain disciplinary focus, we retained only studies within WoS categories related to Management, Business, Economics, Operations Research & Management Science, and Multidisciplinary Sciences. This alignment with the managerial and organisational literature reduced the sample to 622 articles.

An initial screening of titles and abstracts was conducted to eliminate off-topic studies. Articles focused solely on digital technologies without applying a project management lens, and those addressed peripheral domains such as logistics, general IT strategy, or digital maturity assessments that lacked direct reference to project contexts were excluded. Screening was guided by predefined inclusion/exclusion criteria. For cases where relevance was not immediately clear, a collaborative review process was undertaken: all co-authors independently evaluated the borderline cases, discussed discrepancies, and reached consensus through deliberation. This cross-checked approach ensured consistency and rigor in the interpretation of relevance across the team. As a result, 122 potentially relevant articles were retained for full-text examination.

A close reading of the 122 shortlisted articles was undertaken to assess their conceptual and empirical contributions. We retained only those studies that explicitly addressed project-based DT and provided clear theoretical framing or substantive empirical evidence. Articles that exhibited vague or incidental project framing, limited conceptual grounding, or minimal relevance to the review's thematic scope were excluded. Inclusion decisions were made through iterative discussion among the authors to ensure shared interpretation and consistency. This process resulted in a final sample of 66 articles for in-depth analysis. The final iteration of these criteria, along with the number of articles that remained after each iteration, is presented in Figure 1.

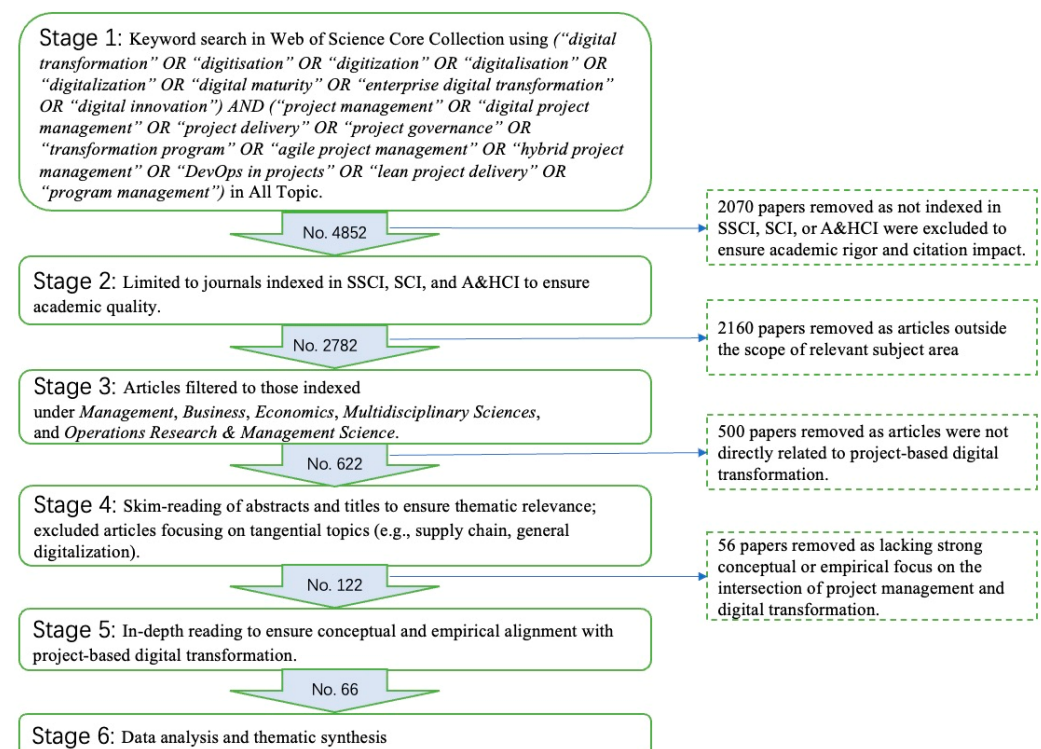


Figure 1. Article selection process.

2.3. Data Analysis and Thematic Synthesis

Prior to the thematic synthesis, a descriptive metadata analysis was undertaken to examine the structural characteristics of the reviewed literature. This included publication trends, journal distribution, and keyword co-occurrence analysis, offering foundational insights into the evolution and intellectual contours of the field.

Figure 2a illustrates the annual publication trend from 2011 to 2025. A notable increase in scholarly output is observed after 2020, signalling an accelerated research focus on DT in project management. Figure 2b presents the leading journals contributing to this domain, revealing that the literature is anchored primarily in project management and information systems outlets, such as Project Management Journal, Engineering, Construction and Architectural Management, and the International Journal of Project Management.



Figure 2. (a) Publication trend (2011–2025); (b) leading journals in the field. Data includes publications retrieved up to April 2025.

To explore the conceptual landscape, a keyword co-occurrence network was generated (Figure 3), based on keywords from the 66 reviewed publications. This analysis yielded four distinct thematic clusters, each representing a conceptual strand within the literature. These clusters were qualitatively interpreted and aligned with the six analytical themes developed through our synthesis. Table 1 provides a summary of the clusters, their representative keywords, conceptual focus, and the linked research themes. This mapping supported the development of a structured and coherent thematic coding framework.

Table 1. Keyword clusters and their thematic interpretation.

Cluster	Keywords	Conceptual Focus	Linked Research Themes
Cluster 1 (Governance & Leadership)	Dynamic capabilities, framework, governance, impact, information-systems, model, project management, strategy, technology	Strategic and institutional structures shaping project transformation; focus on managerial intent, decision frameworks, and leadership integration	Theme C: Governance and Leadership in DT
Cluster 2 (Methodologies & Technology Perspectives)	Agile, information-technology, integration, management, organizations, performance, perspective, product development, software	Operational and methodological approaches to DT; agile practices, integration processes, organizational routines, and technological innovation	Theme A: Methodologies and the Sociotechnical Integration of Digital Tools
Cluster 3 (Challenges & Barriers)	Business, challenges, digital transformation, digitalization, implementation, industry 4.0, systems, transformation	Barriers to DT implementation; technical and organizational friction, system complexity, and emergent transformation tensions	Theme B: Misalignments in Sociotechnical Interfaces of DT
Cluster 4 (Innovation, Knowledge & Sectoral Practice)	BIM, collaboration, construction, design, information, innovation, knowledge	Tools and practices for cross-functional collaboration and innovation; sector-specific applications and socio-technical integration	Theme D: Sectoral and Project-Specific Innovation Trajectories

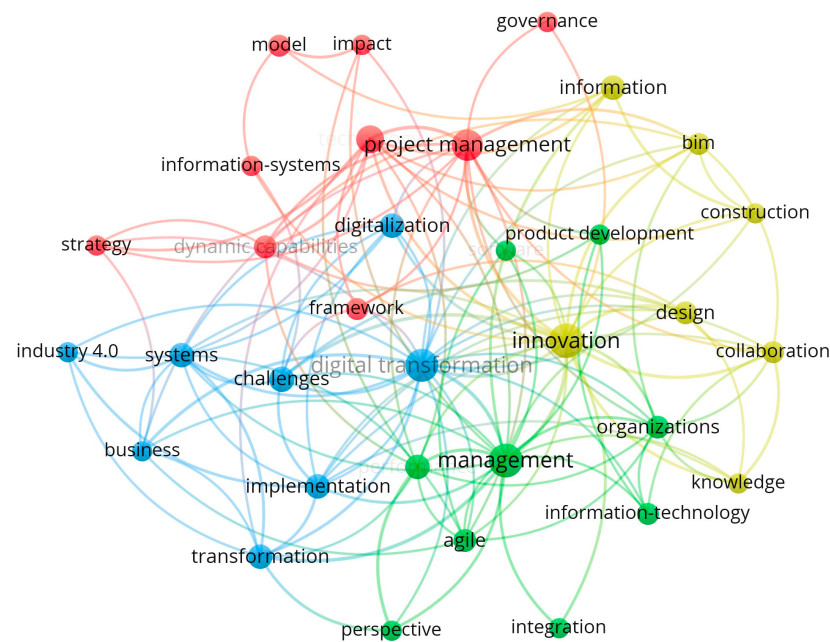


Figure 3. Keyword co-occurrence network.

The 66 articles were then analysed using a qualitative thematic synthesis approach, following established review protocols [38,39]. The process comprised three iterative stages: Open coding, where initial concepts and constructs were inductively identified; Thematic clustering, grouping similar codes to form preliminary categories; and Analytical validation, in which all authors reviewed and refined the emerging themes through discussion and consensus.

This triangulated approach ensured analytical rigour and conceptual coherence. Themes were selected based on both the recurrence of concepts across studies and their theoretical significance in explaining how digital transformation reshapes project management practice. The outcome of this process was a set of four interrelated themes, which form the analytical scaffold for the findings and discussion that follow, see Figure 4.

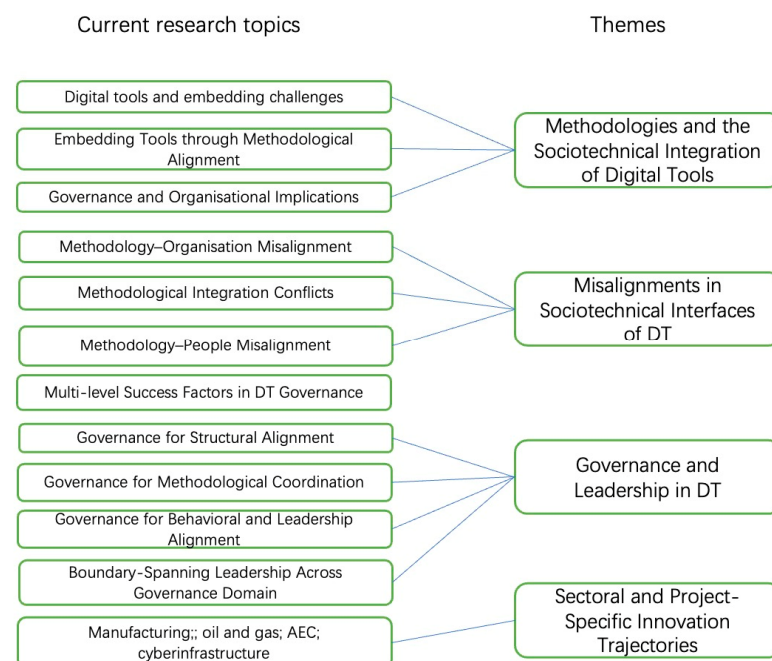


Figure 4. Mapping of current research topics to thematic categories.

The themes not only highlight distinct areas within the literature but also contribute to the evolving understanding of DT as a sociotechnical phenomenon. In this context, STS theory offers a foundational lens, viewing DT as the product of dynamic interactions between technological systems, human actors, and organisational structures [24–26]. STS highlights that successful DT requires more than the deployment of tools—it depends on the effective integration of methodologies, people, organisational settings, and governance mechanisms.

STS theory emphasizes that successful DT extends beyond mere tool deployment; it hinges on the seamless integration of methodologies, people, organisational settings, and governance mechanisms.

Building on this perspective, Figure 5 synthesizes the review’s findings into a conceptual framework that reflects the STS view of DT. This framework visualizes DT as a recursive and interdependent system, where methodologies serve as the central integrative mechanism that links digital tools with both organisational and behavioural subsystems. It introduces three primary categories of barriers: methodology–organisation misalignment, methodology–people misalignment, and methodological tensions (tool–method), which represent key friction points across these interfaces. These challenges are addressed through the mediating functions of governance and leadership, which act as critical enablers of coordination, adaptation, and alignment. Notably, boundary-spanning tools and leadership play a vital role in mediating the challenges that arise during DT.

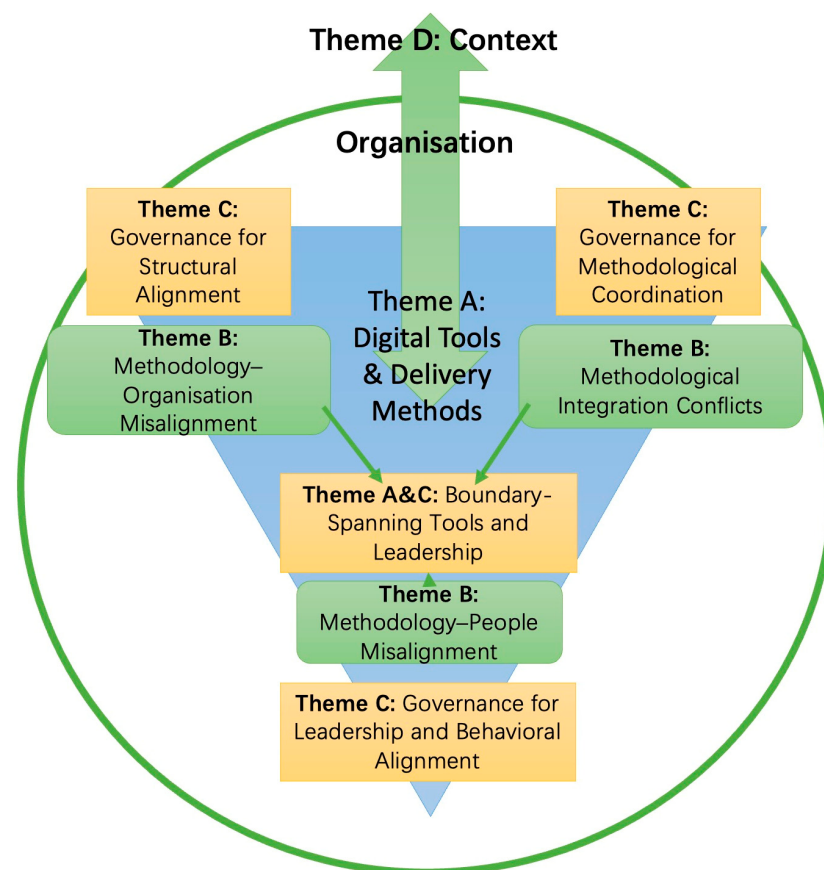


Figure 5. Sociotechnical alignment framework of Digital Transformation.

Furthermore, the framework highlights the external influence of industry-specific contexts as a shaping force, emphasizing the importance of sector-specific operational models, regulatory pressures, and innovation patterns in guiding the trajectory of DT initiatives.

3. Thematic Analysis

3.1. Theme A: Methodologies and the Sociotechnical Integration of Digital Tools

Digital tools play a central role across all stages of DT, enabling both operational improvements and strategic shifts in project delivery. While often introduced to enhance task-level efficiency during the digitisation phase [40,41], these tools increasingly reshape project workflows and coordination mechanisms. Their transformative potential lies not in automation alone, but in how they interact with organisational routines and project delivery methods to enable sustained innovation and change [14,42,43]. However, embedding these tools into practice has proven complex, with many initiatives encountering resistance or fragmentation. This highlights that digital innovation alone is insufficient: the effective integration of tools into organisational routines requires purposefully designed project methodologies. In parallel, project management methodologies, such as agile, hybrid, and structured approaches, are central to enabling this integration and sustaining long-term transformation.

3.1.1. Digital Tools and Embedding Challenges

The literature identifies a diverse range of digital technologies in project contexts. These include data-driven tools such as artificial intelligence, machine learning, and analytics platforms [10,44]; modelling environments like Building Information Modeling (BIM) [45]; real-time coordination platforms such as Autodesk BIM 360 [46]; and emerging technologies including blockchain, valued for ensuring traceability and data integrity across organisational boundaries [47]. Document and information management systems, particularly Digital Construction-phase Information Management (DCIM) platforms, are gaining traction in public construction projects for improving traceability, standardisation, and workflow efficiency [48]. These technologies are often complemented by cloud infrastructure, mobile applications, and videoconferencing tools that support flexibility and distributed collaboration [10].

Despite widespread adoption, several studies highlight persistent challenges in effectively embedding digital tools into project environments. Shen et al. [49] report that project analytics are frequently implemented in an ad hoc manner, limited by inconsistent terminology and fragmented data strategies. Kiani [50] similarly identifies barriers in the use of AI for entrepreneurial project coordination, often stemming from data quality issues and internal capability gaps. These limitations underscore the need for contextual adaptation. A case study by Kudyba and Cruz [44] illustrates how a multinational firm developed a decision-support dashboard using Tableau and SAP-HANA. The tool enabled real-time spend tracking and resource forecasting, but its effectiveness hinged on iterative refinement, stakeholder engagement, and strategic alignment.

3.1.2. Embedding Tools Through Methodological Alignment

Agile methodologies are among the most widely cited in the context of DT, valued for their adaptability, responsiveness, and user orientation. Kudyba and Cruz [44] describe how a multinational firm used Scrum to develop a financial decision-support dashboard. Operating in two-week sprints and guided by user stories, the team produced a Minimum Viable Product (MVP) early in the process and refined it iteratively based on stakeholder feedback. This approach allowed alignment with evolving business needs while promoting collaboration between technical teams and end-users, demonstrating agile's capacity to integrate human insight into tool development.

Multiple studies highlight the broader importance of methodological flexibility in enabling DT. Shaba et al. [51], Sun and Tell [11], and Przybilla et al. [52] emphasise prototyping as a critical practice within agile and design thinking frameworks. Shaba et al. show

how these practices structure participatory change, support collaborative problem framing, and facilitate experimentation across internal and external actors. Sun and Tell [11] identify three types of prototypes that help bridge temporary project structures with permanent organisational systems: stimulators, demonstrators, and validators. Przybilla et al. [52] extend this view to digital innovation, showing how the intangibility of digital artefacts complicates stakeholder alignment, feasibility assessment, and user testing. They advocate a dual-prototyping approach, combining low-fidelity models for desirability with technical proofs-of-concept to assess feasibility.

Agile approaches also face systemic challenges. Aoufi et al. [53] identify five key barriers in outsourced DT initiatives: cultivating an agile mindset, method selection, organisational preparedness, contractual flexibility, and sustaining commitment. These challenges underline that agile's success depends not only on team-level practices but also on organisational readiness.

DevOps extends agile principles across the full delivery lifecycle by merging development, operations, and maintenance into unified, cross-functional teams [9]. Wiedemann et al. [9] propose a DevOps control model that treats governance as dynamic and participatory. This model includes shared vision, co-determination rights, and mutual accountability, enabling high-performing teams to coordinate autonomously while remaining aligned with organisational objectives. DevOps thus embeds digital capabilities into long-term workflows, linking method, technology, and structural design.

To reconcile the tension between exploratory innovation and structured execution, hybrid methodologies are increasingly used in DT contexts. Brock et al. [54] examine an Agile–Stage-Gate model adopted by a lighting manufacturer during a transition from analogue to digital products. Agile principles were effective during early innovation, but transferring results to structured development required careful management of “transfer scope,” “transfer timing,” and “synchronisation.” These mechanisms helped bridge exploratory teams and formal organisational units, showing how hybrid approaches can navigate structural boundaries.

Digital product management represents another hybrid model that blends agile and DevOps principles within long-term, outcome-driven frameworks. Nelson [8] presents this as a shift from temporary IT projects to persistent cross-functional teams accountable for delivery, discovery, and lifecycle management. This model requires structural change, such as reorganising work around value streams and clarifying ownership, and reframes project governance around continuous iteration and customer value.

Structured methodologies also play a role in DT, particularly in industries requiring quality assurance, standardisation, and systemic alignment. Lean project delivery methods, grounded in principles such as value specification, flow, and continuous improvement, are increasingly combined with digital tools. Koseoglu and Nurtan-Gunes [46] describe how mobile BIM was integrated into lean practices in an airport construction project, enhancing design coordination, resource use, and on-site management. Their case highlights how behavioural change and process reconfiguration are necessary to translate digital tools into operational value.

Continuous Improvement (CI) offers another structured pathway to embed digitalisation into organisational routines. Kokkinou et al. [55] show that successful CI depends on strategic alignment, leadership engagement, and cross-functional coordination. Rather than treating digitalisation as an overlay, their study positions CI as a vehicle for iterative integration of tools and practices across organisational layers.

The RRPR framework (R&D Roadmap for Process Robotisation), proposed by Barbosa et al. [56], illustrates a process-oriented model for industrial automation. Based on the PDCA cycle (Plan–Do–Check–Act), RRPR includes stages for process analysis, technology

selection, implementation, and validation. While less iterative than agile, it shows that disciplined methodologies can support digital integration when aligned with internal quality systems and collaborative structures.

3.1.3. Governance and Organisational Implications

Digital tools increasingly function beyond their technical roles, becoming embedded within governance frameworks that shape coordination, accountability, and strategic alignment. For example, BIM has evolved into a prominent digital infrastructure in construction-related projects. No longer limited to its origins in design, BIM now facilitates common data environments, real-time collaboration, and project execution planning across multiple phases [45,57]. As Keskin et al. [58] note, BIM increasingly serves as an orchestrator for a broader construction technology ecosystem—connecting 4D scheduling tools, GIS data, inspection applications, and asset management systems. Its successful deployment, however, is not guaranteed by technical capacity alone. Shojaei et al. [57] and Liu et al. [59] emphasise that effective BIM implementation depends on leadership commitment, workflow redesign, inter-organisational coordination, and usability. Araujo and Alves [60] further stress that BIM's impact materialises only when supported by internal capability development and organisational alignment during early project phases.

Extending this infrastructure logic, Zhang et al. [61] demonstrate how BIM integration with Product Lifecycle Management (PLM) systems enhances project performance in large-scale construction initiatives. Through the 3DEXPERIENCE platform, they report improvements in collaboration, quality, and cost control—although challenges such as training and platform adaptability highlight the complexity of implementation. Rowe, Te'eni, and Merminod [62] emphasise that PLM can support boundary spanning and governance functions, but its effectiveness relies heavily on contextual factors such as trust-based interpersonal networks, informal coordination routines, and a supportive team atmosphere.

Other studies extend this sociotechnical framing. Braun et al. [63], drawing on structuration theory, show how tools like BIM can act as boundary objects in inter-organisational projects, bridging disciplinary divides or, when misaligned with stakeholder capacity and project context, reinforcing fragmentation. These findings underscore a critical insight: digital tools are not neutral carriers of efficiency. Their functionality and impact are contingent on how they are socially embedded, governed, and interpreted within organisational routines.

Taken together, the literature reveals that digital tools are more than technical artefacts. Their successful use in DT depends on how well they are embedded into both the organisational systems that support execution and the relational dynamics that enable coordination and shared understanding across project actors.

3.2. Theme B: Misalignments in Sociotechnical Interfaces of DT

DT projects often encounter barriers not due to technological failure, but because of misalignments between methodologies, organisational systems, and human actors. Based on this review, three primary categories of friction can be observed: (1) misalignment between project methodologies and organisational structures, (2) integration conflicts across methodologies and planning logics, and (3) misalignment between methodologies and the behavioural, professional, or collaborative dynamics of people. These categories reflect critical sociotechnical interfaces that shape the outcomes of DT initiatives.

3.2.1. Methodology–Organisation Misalignment

Project methodologies frequently conflict with legacy organisational structures, governance mechanisms, and resource allocation systems. These frictions emerge when delivery

approaches designed for iterative, cross-functional transformation meet environments optimised for stability, hierarchy, and performance predictability.

Sun and Tell [11] describe how “strategic tensions” emerged when different departments interpreted Model-Based Definition goals inconsistently, reflecting a lack of shared vision and undermining project coherence. Similarly, Moschko et al. [12] report goal ambiguity and limited understanding of business model transformation, leading to fragmented efforts and weakened strategic alignment. These cases illustrate how a lack of overarching transformation logic can disrupt project direction.

Wiedemann et al. [9] highlight governance misalignment in DevOps settings, where development and operations teams report to different hierarchies and are evaluated by incompatible metrics. This structural disconnect complicates coordination and slows decision-making. Brock et al. [54] report similar issues, showing how unclear scoping and performance misalignment between R&D and delivery teams disrupted project transitions. Nelson [8] adds that traditional PMOs and digital teams often operate with conflicting success criteria, cost and schedule adherence versus customer value and innovation, which weakens cross-unit alignment and strategic coherence.

Korotkova et al. [64] extend this analysis, demonstrating how deeper institutional logics, such as managerial control and professional autonomy, constrain collaboration in digital projects. These logics embed vertical resistance into organisations, limiting openness and coordination. More tangible resource misalignments are also prevalent. Szalavetz [65] shows that underinvestment in workflow redesign, training, and IT integration undermines digital tool adoption, even in technically mature firms. Tsai et al. [66] describe “IT resource dilemmas” where departments compete for limited implementation capacity, reflecting fragmented governance.

Together, these studies show that DT often falters when organisational structures are not strategically aligned, structurally integrated, or adequately resourced to support the collaborative demands of transformation.

3.2.2. Methodological Integration Conflicts

A second category of misalignment arises from internal tensions between coexisting project methodologies and planning systems. These include mismatched delivery logics, incompatible timeframes, and differing assumptions about control and accountability—challenges that are methodological rather than technical in nature.

Sun and Tell [11] introduce the concept of temporal tensions, showing how agile sprint cycles conflicted with stage-gate planning systems, resulting in coordination breakdowns. Brock et al. [54] similarly note that R&D outputs were transferred without synchronisation with downstream delivery teams, leading to delays and abandonment. These studies underscore the difficulties of navigating between exploratory and execution phases.

Nelson [8] observes that traditional teams often struggle to adopt iterative, outcome-focused models, while Wiedemann et al. [9] highlight tensions between agile and ITIL routines in DevOps environments. Their notion of “time rhythm” captures how contrasting planning cycles create frictions in integration and governance. Moschko et al. [12] report that many firms deploy digital tools using legacy routines and linear models, which restrict adaptive learning.

Tsai et al. [66] and Liu and Zhang [67] describe “design incongruence,” where teams or partner organisations bring incompatible assumptions about how systems should function. Liu and Zhang [60] reinforce this with examples of digital maturity mismatches, incompatible tool ecosystems, and the absence of shared language across collaborating organisations. These factors disrupted system design coordination and reduced knowledge cooperation.

Collectively, these findings reveal that methodological integration challenges stem not from technical capability gaps, but from a lack of shared frameworks, temporal alignment, and epistemological coherence. They highlight the need for governance structures that can mediate between differing planning approaches and support collaborative system development.

3.2.3. Methodology–People Misalignment

The third form of misalignment occurs at the interface between project methodologies and the behavioural, professional, and collaborative routines of people. These include frictions around roles, values, expectations, and capabilities that constrain the social embedding of DT practices.

Sun and Tell [11] describe how cross-functional tensions arose when engineering, IT, and manufacturing professionals were required to collaborate under new methodological conditions. Resistance emerged when individuals were asked to adopt unfamiliar responsibilities or shift established workflows. Korotkova et al. [64] similarly report fragmented “ambient awareness”, a lack of recognition of expertise within or across teams, and divergent logics of action, with some actors embracing digital openness and others resisting it due to concerns about control or stability.

Brock et al. [54] and Moschko et al. [12] also report weak cross-functional coordination, pointing to the absence of structured transition management and shared responsibility. Szalavetz [65] shows that experienced shop-floor workers often disengage from digital initiatives when excluded from planning or overwhelmed by technical complexity. Resistance to change, in these cases, is not simply attitudinal but reflects broader misalignments in trust, involvement, and role clarity.

Taken together, these studies suggest that without shared understanding, trust, and behavioural alignment, project methodologies struggle to take root. Misalignment at the people level undermines the collaborative routines required to embed DT meaningfully into practice.

3.3. Theme C: Governance and Leadership in DT

3.3.1. Multi-Level Success Factors in DT Governance

Effective DT requires more than adopting tools or restructuring teams—it calls for multi-level governance systems that span organisational readiness, delivery methods, team capabilities, and digital infrastructure. Governance in this sense is not a singular mechanism, but a layered and adaptive coordination framework that aligns digital ambitions with operational capacity, ensuring transformation is both technically feasible and organisationally sustainable.

At the organisational level, Gertzen et al. [10] show that governance must evolve with digital maturity: evaluation criteria shift from financial metrics toward broader indicators such as customer experience and cultural adaptability. Cordeiro et al. [68] reinforce this by presenting a maturity assessment model that evaluates digital readiness across seven dimensions, including IT architecture, workforce skills, and business model viability. Applied in three Brazilian firms, their model revealed consistent deficits in digital culture and staff preparedness, underscoring the need for early governance interventions that align strategy with internal capabilities.

Extending this view, Bandara et al. [69] and Baier et al. [70] argue that DT success depends on a constellation of socio-technical factors, from stakeholder engagement and tool integration to cultural alignment and strategic coordination. Their findings suggest that governance must operate as a cross-functional enabler, ensuring that strategic direction is translated into team-level processes and decision-making routines.

Ngereja et al. [71], Jia et al. [72], and Takagi et al. [73] each highlight governance needs tied to human and infrastructural dimensions. Ngereja et al. stress the importance of absorptive capacity—the ability to transform and apply external knowledge, while Jia et al. show that digital collaboration platforms only improve performance when supported by knowledge integration and collective efficacy within teams. Takagi et al. add that successful DT requires managing internal complexity and aligning digital infrastructure with strategic goals through pre-execution planning and coordination.

Together, these studies depict governance as a multi-scalar, socio-technical function—one that spans readiness assessment, organisational configuration, and knowledge mobilisation. This sets the stage for understanding how governance plays out across three key domains: structural alignment, methodological coordination, and behavioural engagement.

3.3.2. Governance for Structural Alignment

Structural governance focuses on aligning organisational systems, roles, and resources to support DT at the institutional level. It addresses how governance frameworks enable strategic coherence, capability readiness, and value delivery across shifting project environments.

Simard and Aubry [74] show how the project management office (PMO) evolves through phases of DT, shifting from a strategic actor to a tactical role as new transformation offices emerge. Wu et al. [75] frame this as ambidextrous governance—balancing centralised oversight with local flexibility to maintain alignment while supporting adaptability. Hoffmann et al. [76] similarly describe how overloaded project portfolios and cultural misfits lead to governance breakdowns, calling for adaptive mechanisms such as dynamic prioritisation and short-cycle planning.

Moody et al. [77] and Shaba et al. [51] extend this thinking beyond individual organisations. Their studies highlight governance in distributed environments, where alignment is achieved through shared vision and iterative coordination rather than centralised command. Liu, Chen, and Chou [78] add a resource orchestration lens, arguing that governance must enable internal and external capability integration to maintain transformation agility.

In high-complexity environments, governance may take more formalised forms. Whyte et al. [79] show that in infrastructure projects, DT increases the need for configuration management and oversight to manage asset traceability and technical interdependence. Badewi [80] reinforces this with evidence that benefits management frameworks institutionalised through PMOs and TMOs improve transformation outcomes. These structures ensure that strategic goals are operationalised, and value realisation is monitored. As Kamdjoug [81] notes, change management capabilities, especially clear project objectives and skilled team leadership, are crucial in SMEs and resource-constrained settings.

Together, these studies suggest that structural governance must be both adaptive and institutionalised, capable of coordinating transformation across formal structures, distributed systems, and evolving maturity levels.

3.3.3. Governance for Methodological Coordination

Methodological governance shapes how project delivery models, such as Agile, DevOps, Lean, and BIM, are integrated into practice and aligned across organisational boundaries. It is particularly critical in contexts where multiple methods, tools, and project logics coexist.

Wiener et al. [82] distinguish between governance for value appropriation (risk and compliance) and value creation (innovation and learning), advocating a balance between control and adaptability. Wiedemann et al. [9] elaborate this in their DevOps control model, where participation, co-determination, and ethical responsibility replace hierarchical oversight. Hendler [83] shows how coordination routines, like sprint meta-planning and

dependency mapping, enable cross-functional teams to bridge agile and linear workflows in hybrid environments.

In construction and asset-based industries, methodological governance must also interpret and stabilise digital tool integration. Papadonikolaki et al. [45] highlight the role of BIM managers as boundary spanners, adapting their coordination role to integration levels. Kassem and Louay [84] show that top-down mandates (e.g., policy-driven BIM adoption) risk symbolic compliance unless paired with internal readiness, clarified roles, training, and cross-functional support.

Nelson [8] and Gemino and Reich [43] suggest that governance is evolving toward product-based models, where value delivery is continuous, and teams are empowered through outcome metrics (e.g., OKRs) and value management offices. These configurations enable methodological flexibility while maintaining strategic focus.

Overall, methodological governance requires coordination mechanisms that are context-sensitive, participatory, and flexible, ensuring coherence in delivery while enabling experimentation and cross-boundary collaboration.

3.3.4. Governance for Behavioural and Leadership Alignment

People governance within DT refers to the leadership strategies and behavioural mechanisms that influence how individuals and teams engage with change processes. It emphasizes the human dimension of transformation—ensuring that governance frameworks cultivate trust, collaboration, psychological readiness, and inclusive participation across organisational settings.

This form of governance has gained recognition as a critical enabler of DT. It includes leadership behaviours, support systems, and institutional frameworks that collectively shape employee engagement and capability development. For instance, Liu, Li, and Liu [85] show that digital capability mediates the relationship between team knowledge heterogeneity and performance, with internal and external knowledge conversion further strengthening this effect—highlighting the essential role of leadership in fostering high-performing teams.

Kohnke et al. [86] demonstrate that management interventions—such as top management and supervisor support, transparent communication, and training—shape key psychological conditions (e.g., social influence and perceived usefulness) that mediate technology adoption. These mechanisms foster employee readiness and reduce resistance, reinforcing the importance of human-centred governance in DT. While top management commitment is widely acknowledged as foundational to legitimacy, strategic alignment, and resource mobilisation [7,87], and Newman [7] caution against “hyperopia”, where excessive strategic optimism undermines mid-level empowerment and adaptive execution. This underscores the need to balance top-level vision with contextual responsiveness.

Leadership styles also matter. Huang et al. [88] show that transformational leadership (TRL) enhances innovation and absorptive capacity, while adaptive leadership (ADL) supports incremental adjustments in volatile environments. Yang et al. [89] demonstrate that TRL strengthens the connection between DT goals and organisational resilience by facilitating knowledge flows. These findings collectively suggest that effective digital leadership requires dynamic calibration based on context, maturity, and transformation stage.

Collaborative and distributed leadership models further enhance DT outcomes by enabling cross-functional coordination. Wiedemann et al. [9] introduce the concepts of “shared vision participation” and “co-determination rights,” shifting leadership from a command-control paradigm to one grounded in co-responsibility. Guinan et al. [90] emphasise servant leadership practices—iterative goal setting, psychological safety, and inclusive talent management—as vital to team cohesion and digital collaboration. Syed et al. [91]

propose “control-style ambidexterity,” balancing formal controls (rules, monitoring) with informal mechanisms (autonomy, team-led decisions) to enhance team performance. Finally, Badewi [80] provides an institutional lens, demonstrating that formalized project and benefits management frameworks elevate the strategic role of managers, improving DT effectiveness through structured leadership engagement.

3.3.5. Boundary-Spanning Leadership Across Governance Domain

Boundary-spanning leadership represents a critical intersection of structural alignment, methodological coordination, and people governance within DT. In increasingly hybrid and networked environments, leaders must operate across organisational boundaries—linking formal governance structures with emerging project methodologies and dynamic team configurations.

Mueller et al. [92] illustrate this complexity through the role of IT project managers (ITPMs), who often experience role identity tensions when managing agile teams within traditional hierarchies. These ITPMs act as “boundary spanners,” translating between agile workflows and institutional protocols. Similarly, Papachristos et al. [87] frame senior managers as knowledge brokers who help organisations navigate inertia and adapt strategically to evolving digital imperatives.

Simard and Aubry [74] expand this boundary-spanning logic to the project management office (PMO), which increasingly functions as a bridging mechanism between agile practices and formal governance systems. Rather than enforcing rigid control, these leadership entities mediate across governance layers, supporting methodological experimentation while maintaining strategic coherence.

Collectively, these studies underscore that successful DT governance demands leadership that is not confined to a single domain. Instead, it requires structurally embedded, methodologically fluent, and behaviourally attuned leaders who can orchestrate alignment across complex and evolving systems. This boundary-spanning capacity is foundational to integrating digital tools, coordinating hybrid delivery models, and sustaining transformation outcomes.

3.4. Theme D: Industry-/Project-Specific DT

DT is not uniform across sectors. Instead, it reflects industry-specific operational models, regulatory frameworks, delivery logics, and technological priorities. This section reviews how transformation dynamics are shaped by contextual conditions in key sectors.

In manufacturing, DT is closely tied to Industry 4.0 (I4.0) technologies, including cyber-physical systems and real-time data exchange. Richard et al. [93] note that manufacturers often lack structured criteria for selecting and evaluating I4.0 initiatives. In response, Dreyer et al. [94] propose a project selection model balancing traditional KPIs with digital capabilities such as decentralisation and interoperability. Strategic alignment and coordinated portfolio management are identified as critical enablers of I4.0 value creation [56].

In oil and gas, DT unfolds within highly capital-intensive, vertically integrated structures. Rauniar et al. [95] observe that firms tend to act as adopters rather than developers of digital technologies, progressing through pre-adoption, assimilation, and implementation phases. Adoption depends heavily on absorptive capacity and executive commitment, and is shaped by both long-term regulatory pressures (e.g., energy transition policies) and short-term volatility (e.g., market shocks), demanding continuous realignment of technology strategy with external dynamics.

In the AEC (Architecture, Engineering, and Construction) sector, DT is shaped by project-based delivery, long asset lifecycles, and multi-stakeholder complexity. Keskin

et al. [58] show how BIM operates not only as a modelling tool but as a central platform for lifecycle coordination. Papachristos et al. [87] conceptualise large AEC projects as “speciation” zones where technologies like BIM and digital twins are tested, scaled, and institutionalised by incumbents rather than niche innovators. Yet sectoral fragmentation and delivery fragmentation slow widespread adoption. Ye et al. [96] and Papadonikolaki et al. [45] show that while BIM enables cross-disciplinary collaboration, persistent issues, interoperability, unclear responsibilities, and skill gaps hinder implementation. Koseoglu et al. [46] highlight the uneven integration of mobile BIM between field and office environments. Institutional mandates (e.g., BIM Level 2 in the UK) offer structural support, but practical effectiveness depends on role clarity, partner prequalification, and workforce training [59,84]. Jahanger [48] adds that public-sector digital systems like DCIM offer strategic oversight and automation but face barriers tied to user readiness and inter-organisational coordination.

In scientific research and cyberinfrastructure, DT unfolds under distributed, non-hierarchical conditions. Moody et al. [77] examine large-scale research platforms (e.g., NEES, GENI), which rely on field control, a governance model grounded in shared vision and normative alignment rather than centralised authority. These contexts involve cross-institutional collaboration, long-term uncertainty, and multi-actor governance without formal ownership structures.

Taken together, these cases illustrate that DT is not solely an outcome of technological strategy or internal capability. Rather, it is shaped by sector-specific delivery models, institutional logics, capital structures, and regulatory contexts. As such, transformation must be approached through context-sensitive frameworks that account for variation in how technologies are prioritised, implemented, and institutionalised across different project environments.

4. Discussion

Guided by the STS framework, three interrelated future research agenda are proposed. The following sections elaborate on these research directions, with a focus on advancing a more integrated, context-sensitive understanding of DT in complex project settings.

4.1. *Embedding Digital Tools Through Methodological Mediation and Governance Integration*

Future research should deepen our understanding of how digital tools are not only adopted but effectively embedded into the sociotechnical fabric of project organisations. This involves two interrelated dimensions: infrastructural integration and relational embedding. First, more work is needed on how digital tools, such as BIM and PLM, interact with organisational IT architectures, workflows, and governance frameworks. These tools are increasingly positioned as infrastructures that coordinate multi-phase project activities across distributed actors (e.g., [45,57,61]). Yet questions remain regarding system interoperability, organisational readiness, and alignment with evolving delivery logics. Research should examine how digital tools support or constrain coordination, stakeholder engagement, and project responsiveness, especially under conditions of complexity, institutional fragmentation, or technological volatility [97].

Second, digital tools function not only as technical artefacts but also as relational mechanisms that shape authority, collaboration, and meaning within project environments. As Rowe et al. [62] and Braun et al. [63] show, successful tool implementation depends on informal routines, trust, and shared interpretation. Future studies should investigate how tools influence boundary-spanning practices, inter-professional coordination, and knowledge integration across stakeholder groups. Special attention should be given to

how tools are appropriated within different cultural or institutional settings, and how they mediate tensions between formal structures and informal collaboration.

Addressing these embedding challenges requires revisiting the methodological foundations that guide project delivery. While agile, DevOps, lean, and structured approaches each offer distinct strengths, their limitations in isolation have prompted growing interest in hybrid methodologies. Future research should explore how hybrid models, such as Agile—Stage-Gate [54] and digital product management, are configured, institutionalised, and scaled to balance flexibility and control. Open questions remain about how these models evolve across project lifecycles, how they interface with governance structures, and how digital tools influence their adaptation in complex, multi-stakeholder settings (e.g., [9,98]). Methodologies should also be viewed as sociotechnical artefacts that embed behavioural norms and coordination routines. Longitudinal studies could trace how these frameworks evolve, support collaboration, and enable sustained transformation.

4.2. Governance and Leadership as Strategic Enablers of Digital Transformation

Recent research signals a shift toward multi-level, adaptive governance frameworks in DT. These include formalised structures like PMOs and TMOs [74,80], distributed ecosystem models [51], and outcome-oriented formats such as digital product governance [8]. Such approaches support coordination across functional and organisational boundaries while enabling agility, transparency, and continuity. Increasingly, governance is being repositioned from a control mechanism to a strategic enabler of structural, cultural, and behavioural change.

A key dimension of this evolution is the rise of programmatic and product-based governance models. These approaches integrate agile and DevOps routines into long-term, value-driven delivery systems, as observed by Gemino and Reich [43]. Jiang [99] similarly advocates for viewing governance through a program lens—emphasising adaptability, ambiguity tolerance, and the orchestration of delivery, infrastructure, and leadership. These models redefine governance as a platform for sociotechnical alignment.

Despite these advances, governance in DT remains under-theorised. Future research should examine how governance operates across three interdependent domains:

- Methodologically, how governance mediates between hybrid project management models (e.g., Agile-Stage-Gate, DevOps) and evolving digital infrastructures.
- Structurally, how formal mechanisms (e.g., PMOs, TMOs) and informal routines interact to coordinate across distributed, multi-stakeholder environments.
- Behaviourally, how governance frameworks embed leadership practices that cultivate trust, collaboration, and sustained team engagement.

Special attention should be given to contextual moderators such as digital maturity, project complexity, and organisational form, which shape the viability and impact of governance strategies. The ways in which governance is designed, scaled, and institutionalised across sectors remain poorly understood, limiting theoretical and practical insight into DT success.

A promising direction for future research is to examine boundary-spanning leadership as a key enabler of DT. Studies increasingly highlight that leaders in DT contexts must operate across organisational, methodological, and technical boundaries—bridging agile teams, hierarchical structures, and digital infrastructures. Tools like BIM and PLM, and hybrid methodologies such as Agile-Stage-Gate, further underscore the need for such integrative roles. These tools function as boundary objects, but their effectiveness relies on leadership that aligns workflows, supports coordination, and adapts governance structures. Future research should explore how leadership, as a form of governance, can mediate frictions across methodological, structural, and behavioural domains to enable successful DT.

4.3. Advancing Sector-Specific Insights into DT

DT manifests differently across industries due to variations in regulatory conditions, delivery models, capital intensity, and organisational complexity. While studies have examined DT in sectors such as construction [45], manufacturing [85,93], and oil and gas [95], comparative and cross-sectoral analyses remain limited.

Future research should explore how sectoral contexts shape the selection of digital tools, the implementation of project methodologies, and the emergence of transformation barriers. Factors such as supply chain structure, project scale, and digital maturity affect how transformation is enacted. Gong et al. [98] and Zhang et al. [97] highlight how sector-specific dynamics influence knowledge coordination and the institutionalisation of digital practices.

Governance and leadership strategies may also vary across sectors. Regulatory environments and institutional fragmentation, especially in fields like construction or energy, affect how governance frameworks evolve, how responsibilities are distributed, and how leadership adapts to sectoral norms. Understanding these differences is key to designing context-responsive transformation strategies.

Further attention is also needed in underrepresented settings, particularly among SMEs. These organisations often face distinct constraints, including limited technical capacity and weaker institutional support [80,86]. By advancing more context-sensitive, sector-informed research, future studies can develop frameworks that better reflect the sociotechnical realities of DT across diverse project environments.

5. Conclusions

This review synthesises an emerging and increasingly diverse body of literature on DT in project-based environments. Guided by STS theory, the analysis identifies four interconnected themes towards successful digital transformation in project management: methodologies and the sociotechnical integration of digital tools, misalignments in sociotechnical interfaces, governance and leadership, and industry- or project-specific transformation trajectories.

Building on this synthesis, the review proposes three interrelated directions for future research. First, embedding digital tools through methodological mediation and governance integration. Second, governance and leadership as strategic enablers. Third, advancing sector-specific insights into DT.

However, this review has its limitations. It draws exclusively on literature from the Web of Science Core Collection and applies a qualitative synthesis approach, which may limit the breadth of coverage. Complementary use of bibliometric tools, such as co-citation or co-word analysis, as demonstrated in recent studies like Yordanova [31] could enrich the field's understanding of intellectual structure and thematic evolution. Moreover, real-world case studies and longitudinal empirical research are still needed to contextualise and test theoretical propositions in practice.

In summary, this review contributes to advancing the field by consolidating fragmented insights and proposing a structured research agenda grounded in STS theory. It reinforces that successful DT in project-based contexts depends not only on technological capability, but on the alignment of tools, people, governance, and methods within dynamic and sector-specific organisational systems.

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Abbreviations

The following abbreviations are used in this manuscript:

DT	Digital Transformation
AI	Artificial Intelligence
IoT	Internet of Things
SLR	Systematic Literature Review
SSCI	Social Sciences Citation Index
SCI	Science Citation Index
A&HCI	Arts & Humanities Citation Index
SaaS	Software-as-a-Service
PMIS	Project Management Information Systems
BIM	Building Information Modelling
MVP	Minimum Viable Product
CI	Continuous Improvement
RRPR	R&D Roadmap for Process Robotization
PDCA	Plan–Do–Check–Act
LRS	Legacy Replacement System
TRL	Transformational Leadership
ADL	Adaptive Leadership
PM	Project Management
BM	Benefits Management
TMOs	Transformation Management Offices
AEC	Architecture, Engineering, and Construction
SME	Small and Medium-sized Enterprises
PMO	Project Management Office
IT	Information Technology
ITIL	Information Technology Infrastructure Library
PLM	Product Lifecycle Management

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