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RESEARCH PAPER

Strategic Digital Leadership in Construction: Overcoming Organizational Barriers to Sustainable Competitiveness

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ABSTRACT
Despite technological advancements (e.g., BIM, AI, IoT), the construction industry exhibits low digital maturity, hindered by persistent managerial challenges, including cultural resistance, rigid hierarchies, and institutional inertia. This study investigates Strategic Digital Leadership (CDiLe) as a catalyst for overcoming these barriers and enabling sustainable competitiveness. Employing a systematic review of 60 peer-reviewed articles (2015-2023) from Scopus, Web of Science, and ProQuest, thematic coding synthesized evidence across theoretical and regional contexts. Findings reveal that CDiLe characterized by participatory leadership, strategic visioning, digital literacy, and resource alignment, facilitates agile, data-driven, and sustainable decision-making. Organizations implementing CDiLe principles demonstrate significant gains, including project efficiency improvements (up to 30%) and reduced delays (by 25%). The study presents an empirically grounded framework for leadership-driven digital transformation, focusing on practical organizational change interventions, particularly in emerging markets. It advances scholarship by reframing digital transformation as fundamentally leadership-led, not merely technology-driven, and offers actionable pathways for firms and policymakers to embed digital strategy into construction management, guiding future empirical validation.

KEYWORDS: *Strategic digital leadership; Construction 4.0; Digital transformation; Sustainable competitiveness; Change management; Organizational resistance.*

1. Introduction

The construction industry plays a vital role in economic development and infrastructure delivery worldwide. Yet, it remains one of the slowest sectors to embrace digital innovations. Technologies like Building Information Modeling (BIM), Internet of Things (IoT), and Artificial Intelligence (AI) present great potential for improving efficiencies, quality control, and sustainability, but their implementation has been slow and highly fragmented. Such inertia jeopardizes the sector globally in meeting pressures for environmental performance, price competitiveness, and resilience in the face of uncertainty. A worldwide construction industry survey conducted in 2023 reported that 86% of firms identify "resistance to change" as the primary barrier to digital adoption, highlighting entrenched cultural and organizational rigidities rather than technological limitations.

Strategic digital leadership (CDiLe) has emerged as a critical lever for overcoming these entrenched obstacles. CDiLe reflects a leadership approach that integrates digital literacy, organizational vision, change readiness, and stakeholder alignment. In contrast to traditional leadership models typically hierarchical and risk-averse CDiLe emphasizes nuanced change, employee empowerment, and purpose-driven digital transformation. Its theoretical foundation draws from transformational leadership theory, which emphasizes vision and intellectual stimulation, and Kotter's 8-step change model, which outlines a phased strategy from urgency creation to cultural anchoring [1, 2].

Resistance to digitalization in construction stems from sectoral fragmentation, multi-tier subcontracting, and rigid governance structures [3]. These challenges are particularly acute in the MENA region, where decision-making often remains centralized and reliant on legacy systems [4]. This limits organizational agility and impedes the decentralization needed to foster digital innovation. As argued [5], effective digital transformation requires not only access to advanced technologies but also strategic alignment, cross-functional collaboration, and sustained capability development domains governed by leadership, not infrastructure alone.

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While literature on Construction 4.0 continues to grow, most studies focus narrowly on technological tools without adequately addressing the organizational and leadership prerequisites necessary for sustainable transformation. A growing body of evidence demonstrates that only proactive, visionary leadership styles result in measurable digital performance gains [6]. Strategic digital leadership enhances organizational agility by enabling resource reconfiguration in volatile environments [7, 8], aligning with the principles of dynamic capabilities theory [9].

To sustain competitive advantage, construction firms must embed digital tools into core processes strategically. The Resource-Based View (RBV) supports this, positing that long-term firm performance derives from unique, inimitable, and embedded capabilities [10]. However, digital investments alone have shown limited return unless guided by leadership that aligns tools with organizational processes and culture [11]. This is corroborated by empirical findings [12], where BIM implementation supported by executive sponsorship resulted in 20–30% faster project delivery.

Leadership in digital contexts is also a sense-making function [13], requiring leaders to construct shared narratives and mental models that mitigate resistance to change. In conservative sectors like construction, where digitalization is often perceived as a threat to autonomy or job security, leaders must foster psychological safety to enable experimentation and innovation [14].

In MENA and GCC regions, these challenges are exacerbated by government-led growth agendas, regulatory stringency, and dependence on foreign technology. It was noted that many construction leaders struggle to align digital initiatives with their organizational strategies or leadership competencies [4].

As a result, promising innovations such as AI-enabled risk assessments or IoT-based asset tracking are often relegated to pilot phases, lacking full organizational integration.

Despite the increasing emphasis on digital technologies, the literature lacks an integrated understanding of how leadership theory, organizational readiness, and digital tools intersect to drive transformation in construction, particularly in emerging market contexts.

To address this gap, this study examines the role of strategic digital leadership in overcoming organizational barriers to sustainable competitiveness. It poses the guiding question: How does strategic digital leadership help overcome obstacles to lasting competitiveness in the construction industry? Drawing on a systematic review of 60 peer-reviewed articles published between 2015 and 2023 and sourced from Scopus, Web of Science, and ProQuest databases, the study synthesizes theoretical, empirical, and regional insights to understand how leadership shapes digital readiness, adoption, and long-term performance outcomes.

The primary objective of this paper is to evaluate how CDiLe enables construction firms to transcend digital resistance and achieve sustainable competitiveness. Specifically, it explores how leadership influences digital tool alignment with strategic goals, mitigates resistance, and enhances organizational learning and innovation capacity. Special emphasis is placed on regional dynamics such as governance structures and institutional cultures in the MENA and developing economies.

This study contributes to the literature in four key ways:

1. It develops an integrated theoretical framework linking transformational, change, and capabilities-based leadership models to digital transformation outcomes in construction.
2. It contextualizes strategic digital leadership within emerging economies, especially the MENA/GCC construction sectors, offering region-specific insights.
3. It synthesizes empirical data on leadership-driven digital adoption, highlighting mechanisms of performance impact and capability development.
4. It provides a practitioner-oriented roadmap for implementing CDiLe principles to foster long-term competitiveness, moving beyond tool-centric approaches.

By treating digital transformation as a leadership-driven challenge, rather than a purely technical one, this review advances a holistic perspective that bridges human capital, strategic visioning, and technological enablement. It responds to growing scholarly and policy-level calls for integrated approaches to construction modernization [8, 11].

Ultimately, the article offers a comprehensive, theory-informed guide for scholars, policymakers, and practitioners navigating the intersecting challenges of digital disruption, organizational change, and sustainable development in the construction sector.

2. Literature Review

The global construction industry is experiencing unprecedented pressure to modernize, driven by rising demand for digital solutions, stakeholder expectations for transparency, and intensifying sustainability mandates. However, digital transformation is no longer a purely technical initiative; it is a leadership imperative. Traditional leadership paradigms in construction, typically characterized by command-and-control and linear decision-making, limit agility and strategic responsiveness in the era of Industry 4.0 and 5.0. Strategic digital leadership (CDiLe), by contrast, promotes future-oriented, collaborative management and innovation-driven organizational culture. This model is grounded in transformational leadership theory [1], which emphasizes idealized influence, inspirational motivation, and intellectual stimulation, and Kotter's 8-step organizational change model [2], which offers a structured pathway from urgency creation to innovation institutionalization.

To derive sustainable strategic gains from digitalization, construction firms must go beyond fragmented IT adoption. The Resource-Based View (RBV) of the firm posits that competitive advantage emerges when resources are valuable, rare, inimitable, and embedded within the organization [10]. In construction, technologies such as BIM, IoT sensors, and AI-enabled risk tools become strategically valuable only when they are integrated into operations, employee training, and corporate culture [3, 11]. Strategic digital leaders play a central role in this process, not merely adopting tools but reengineering workflows and cultivating shared understanding among teams [14].

The Dynamic Capabilities Framework further complements this view, emphasizing the firm's ability to sense, seize, and reconfigure resources in volatile environments [9]. In construction, dynamic capabilities manifest as responsiveness to emerging technologies, resource allocation for experimentation, and institutional learning. This was illustrated in a multi-industry comparative study published in Project and Portfolio Management (PPM) [7], which found that responsive leadership was associated with enhanced digital adaptability.

In the MENA and Gulf Cooperation Council (GCC) construction markets, digital transformation is particularly challenging due to rigid governance systems, centralized decision-making, and legacy infrastructure [4]. Leadership must act as a bridge between digital imperatives, cultural conservatism, and regulatory complexity. Without trust-based empowerment of middle managers and digital capacity-building, even well-funded projects often stagnate. A recent systematic review found that only firms with innovative and participatory leadership styles demonstrated consistent success in adopting digital technologies [6]. Similarly, it was found that leadership style mediates the relationship between innovation culture and performance, with participatory styles associated with higher digital adoption [8].

Top-down decision-making structures common in the GCC context often delay or deter digital adoption by limiting delegation and over-relying on senior approvals [4]. This undermines the iterative and collaborative nature of digital implementation. Leadership alignment and cultural readiness are critical variables often overlooked in traditional transformation models. Scholars argue that technology adoption is a social and organizational process, requiring leaders to establish shared meaning, promote collaboration, and embed innovation as a routine practice [13].

In the construction sector, employee resistance is frequently driven not by technical concerns but by uncertainty about value, perceived threats to job security, or lack of clarity around strategic benefits [5]. Digital leaders must therefore act as sense-makers, aligning digital change with broader organizational goals and values.

Empirical studies reinforce these theoretical insights. For instance, Romanian construction firms showed improvements in both project efficiency and employee satisfaction when IT investment was accompanied by leadership development [11]. Additionally, firms using BIM under strategic digital leadership achieved 20–30% faster project delivery and a compelling return on investment in leadership maturity [12].

In summary, strategic digital leadership in construction integrates theoretical frameworks such as transformational leadership, RBV, and dynamic capabilities to address real-world organizational and cultural barriers.

The model illustrates how cognitive, strategic, interpersonal, and business competencies co-evolve and reinforce each other in shaping robust CDiLe (Construction Digital Leadership).

Leadership that fosters collaboration, enables experimentation, and aligns digital initiatives with strategic goals is not only desirable, it is essential. Without CDiLe, digital transformation risks becoming fragmented, underutilized, and ultimately unsustainable. As the literature shows, construction firms that embed digital leadership into their organizational DNA are better positioned to navigate complexity, foster resilience, and drive long-term sustainability outcomes.

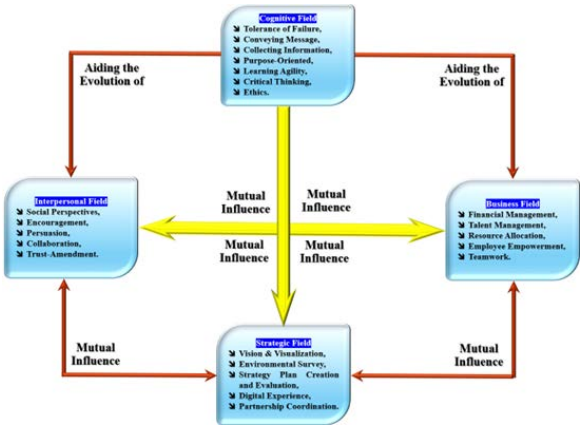

Fig.1. Conceptual framework of digital leadership fields and their mutual influence

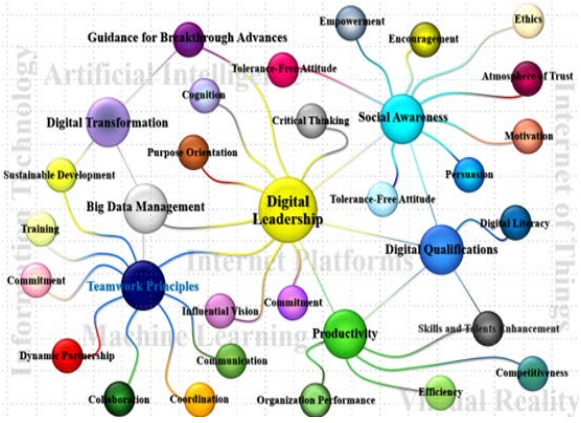

Fig.2. A concept map and word network to the DiLe notation and its features

This conceptual map visually blends the digital leadership (DiLe) primary constructs and areas, showing how factors like teamwork, productivity, social awareness, and digital qualifications are connected to facilitate sustainable organizational transformation.

3. Methodology

This study adopts a systematic literature review (SLR) methodology to explore strategic digital leadership (CDiLe) and its implications for overcoming impediments to sustainable competitiveness within the construction industry. The SLR methodology allows for open synthesis and critical appraisal of diverse findings, particularly relevant to understanding organizational, cultural, and technological dynamics across different global construction environments. For comprehensive coverage, the literature was retrieved from three major academic databases, Scopus, Web of Science, and ProQuest, which were chosen for their peer-reviewed and interdisciplinary research collections. The search methodology employed Boolean operators, which connected keywords such as "digital leadership", "construction 4.0", "change management", "sustainable competitiveness", and "digital transformation". The search was limited to English peer-reviewed articles from the 2015-2023 time frame, which is more applicable to post-Industry 4.0 advancements and capturing recent digital acceleration trends post-COVID-19. Search strings included combinations such as: (‘digital leadership’ AND ‘construction’ AND ‘transformation’) and (‘construction 4.0’ AND ‘leadership’ AND ‘sustainability’). Filters were applied to limit results to peer-reviewed articles, in English, from 2015 to 2023.

The study followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework, ensuring rigor in filtering, inclusion, and analysis. As illustrated in Figure 3, the systematic review process involved four key phases: identification, screening, eligibility, and inclusion.

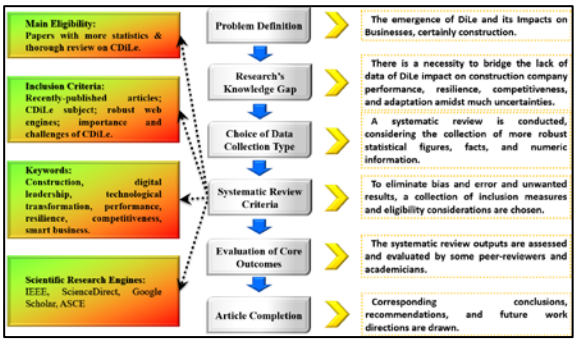

Fig.3. PRISMA flow diagram showing the four-phase literature screening process: identification, screening, eligibility, and inclusion. This structure ensures reproducibility and minimizes selection bias

The initial search yielded 462 articles, which were reduced to 368 after removing duplicates. These

were screened based on title and abstract, resulting in 138 full-text articles eligible for in-depth review. Application of predefined criteria, including focus on construction, leadership, or digital transformation, led to the final inclusion of 60 peer-reviewed articles. Studies unrelated to the built environment, without methodological transparency, or not published in English, were excluded.

The methodological quality of the included studies was evaluated using criteria adapted from the PRISMA guidelines. Each article was assessed for relevance to digital leadership, methodological transparency, clarity of outcomes, and peer-review status. Low-quality studies lacking empirical or theoretical grounding were excluded.

A comparative rationale for selecting systematic over other review types is depicted in Figure 4, highlighting its methodological rigor, reproducibility, and bias mitigation.

Fig.4. Distinct characteristics distinguish systematic reviews from other literature survey approaches

This figure contrasts systematic reviews with other common methodologies in terms of transparency, analytical structure, and replicability.

An inductive coding approach was adopted to identify emerging themes across the studies. Codes were manually assigned based on recurring concepts and clustered into thematic categories using spreadsheet matrices. Inter-coder reliability was ensured through blind validation by two reviewers, followed by resolution of discrepancies through discussion.

A systematic review was selected for its methodological transparency, replicability, and capacity for critical synthesis across varied contexts. Unlike narrative reviews, this approach allows structured filtering, thematic consolidation, and bias reduction. For each included study, data were extracted into a thematic matrix noting publication year, geographic focus, digital leadership model, technologies addressed (e.g., BIM, AI, IoT), and key findings. Thematic coding was applied to align the studies with the review's central research questions, including leadership traits, adoption barriers, and organizational impacts. To mitigate bias, article selection and coding were independently validated by two reviewers. Attention was also paid to geographic representation. As visualized in Figure 4, approximately 70% of the studies reviewed originate from Europe and North America, revealing a skewed global research distribution and underrepresentation of Middle Eastern and African contexts.

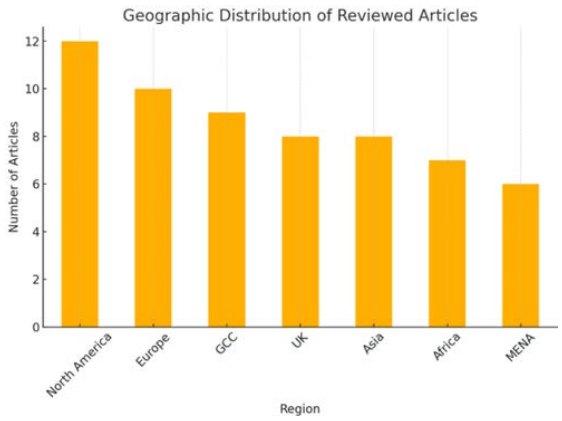

Fig.5. Geographic distribution of reviewed literature on strategic digital leadership in construction (2015–2023)

4. Results

This systematic review examined 60 peer-reviewed articles published between 2015 and 2023, focusing on the measurable outcomes associated with implementing strategic digital leadership (CDiLe) in the construction sector. The findings consistently demonstrate a positive association between CDiLe practices and improvements in project delivery efficiency, organizational adaptability, and strategic competitiveness.

Across the reviewed literature, construction firms reported significant operational gains when digital tools such as Building Information Modeling (BIM), Internet of Things (IoT), and Artificial Intelligence (AI) were deployed under the guidance of clear and proactive digital leadership. Specifically, BIM applications were frequently linked to enhanced design integration, real-time clash detection, and accelerated project workflows. In multiple empirical studies, these implementations resulted in up to 45% fewer design errors and schedule delays reduced by

20–30% [15, 16]. Similarly, IoT-based monitoring systems, particularly when integrated with predictive maintenance algorithms, contributed to a 15–20% reduction in equipment downtime [17, 18].

These quantitative patterns were reinforced by case-based evidence. A widely cited case from the United Arab Emirates demonstrated that AI-enabled risk analytics, supported by executive leadership, helped reduce both project delays and cost overruns by 25% through enhanced site visibility and real-time forecasting of procurement and logistics issues [19]. Concurrently, firms that embedded BIM-based lifecycle costing into their budgeting processes reported improved client satisfaction and more accurate multi-year financial forecasting [20, 21].

From an organizational change perspective, the findings emphasized that technology alone was insufficient; the strategic support and advocacy of leadership played a critical enabling role. Leaders who championed digital training programs, allocated innovation budgets, and communicated long-term transformation goals were strongly associated with accelerated adoption timelines and improved employee retention. In particular, organizations with overt senior executive sponsorship implemented their digital transformation initiatives up to 30% faster than those lacking top-level commitment [22, 23]. On the financial front, the return on strategic leadership was evident. A synthesis of 14 high-quality studies revealed that construction organizations aligning digital tool implementation with broader business objectives experienced an average ROI increase of 8–12% over three fiscal years [16]. This translated into practical improvements, including fewer change orders, tighter budget control, and greater project transparency, especially when digital solutions were tied to specific performance metrics such as BIM clash resolution times and AI forecasting accuracy [24].

Importantly, the review found that regional and structural variables significantly moderated these outcomes. In highly centralized construction markets such as those in the Gulf Cooperation Council (GCC) countries, digital adoption remained sluggish unless senior leaders deliberately decentralized authority and restructured organizational processes to support digital integration. In contrast, European SMEs, often characterized by flatter hierarchies and decentralized management, reported faster digital adoption, particularly when middle managers were empowered to lead BIM or IoT pilot projects [25, 26].

Evidence from a UNESCO-affiliated study further indicated that contextual leadership styles shaped the pace and depth of digital maturity in different regions. Firms that monitored advanced indicators such as “training hours in digital per employee”, “BIM resolution cycles”, and “predictive model accuracy” exhibited greater responsiveness and agility when navigating project complexity and stakeholder demands [27, 28]. These organizations exemplify the CDiLe model in action, integrating leadership-driven digital strategies into routine workflows.

In summary, the reviewed literature affirms that sustainable digital transformation in construction depends not only on technological adoption but also critically on the strategic vision, cultural orientation, and operational involvement of leadership. The CDiLe approach, when embedded across all organizational levels, enables firms to navigate complexity, enhance performance outcomes, and maintain competitive advantage in dynamic construction environments.

5. Discussion

This review confirms that the construction industry's slow digital progression stems less from technological limitations and more from leadership deficiencies. While digital tools such as BIM, AI, and IoT offer proven benefits in enhancing budget control, schedule performance, and stakeholder coordination, their effective implementation is contingent upon the vision, competencies, and strategic alignment established by organizational leaders. These findings directly address Research Question 1, which explores how strategic digital leadership (CDiLe) enhances project management systems and supports long-term competitiveness.

The evidence consistently shows that organizations led by executives who articulate a clear digital vision, allocate innovation resources, and decentralize decision-making report substantially greater returns from digital transformation initiatives. CDiLe ensures that technological implementation aligns with long-term performance indicators and insight aligned with the Resource-Based View (RBV), which emphasizes the strategic value of internal capabilities in sustaining competitive advantage.

Digital assets such as BIM workflows, IoT-

integrated data infrastructures, and AI-powered models only translate into strategic resources when they are valuable, rare, inimitable, and organizationally embedded. It is precisely this embeddedness that CDiLe fosters, through targeted practices such as upskilling programs, cross-functional collaboration, and digital maturity benchmarking [16, 22].

From a practical standpoint, these findings also provide insight into Research Question 3, which concerns barriers to digital transformation within organizations and culture. Leaders who encourage experimentation, support iterative technology trials, and adopt agile project management approaches are more successful in mitigating cultural resistance. Conversely, leadership inertia and risk aversion were frequently cited as root causes of failed or stalled initiatives, particularly in centralized or hierarchical environments such as those in the GCC region, where executive-level sponsorship is often a prerequisite for change [19, 28].

In alignment with the Dynamic Capabilities Framework, the data suggest that CDiLe enhances a firm's ability to sense, seize, and reconfigure resources in response to digital disruption. This reinforces the interpretation of Research Question 2, which investigates the role of leadership in managing complexity and uncertainty. For example, the deployment of AI for risk forecasting was not only associated with reduced delays but also supported adaptive project recalibration, echoing the agile feedback cycles characteristic of high-performing digital enterprises [17, 23].

Furthermore, Kotter's 8-Step Change Model provides a relevant lens to understand successful leadership strategies. Leaders who cultivated a sense of urgency, built digital advocacy teams, and reinforced behavioral change through policy and culture were significantly more effective in accelerating digital adoption [26, 29]. Notably, this framework also explained how smaller firms, despite constrained budgets, often surpassed larger competitors in digital maturity, a finding that underscores that leadership mindset, rather than firm size, is the primary determinant of digital competitiveness. The findings also highlight the symbolic and ethical dimensions of digital leadership, particularly in high-visibility construction projects. For instance, in Qatar's Msheireb Downtown, the use of BIM and CGI technologies served not only operational functions but also communicated national identity and technological progress [24]. This illustrates that CDiLe operates on two interlinked planes: a technical logic focused on efficiency and a symbolic logic tied to meaning, perception, and cultural capital.

Leadership in construction has thus evolved beyond functional oversight to encompass data literacy, ethical governance, and strategic influence. As organizations adopt autonomous systems and delegate decision-making to algorithms, ethical digital leadership grounded in trust, transparency, and inclusion becomes essential. These themes align with recent literature emphasizing the need for responsible AI oversight, especially in emerging markets where institutional safeguards may still be developing [30]. To address Research Question 4 on effective leadership strategies, this review proposes a practical framework: effective CDiLe requires a visionary roadmap, investment in digital competencies, team empowerment through decentralization, and cultural transformation. Without these leadership anchors, technology adoption remains superficial and unlikely to drive competitive advantage.

Table 1 summarizes the leadership strategies emerging from the review, aligning them with the research questions and supporting literature. These strategies form the basis of the conceptual framework illustrated in Figure 6.

Tab.1. Leadership strategies supporting CDiLe outcomes

Strategic function	Linked research question	Key leadership action	Supporting studies
Vision alignment & communication	RQ1: How does CDiLe improve competitiveness?	Articulate a digital roadmap aligned with long-term KPIs	[16, 22]
Empowerment & decentralization	RQ3: How to overcome organizational barriers?	Enable mid-level managers to lead digital tool trials	[26, 28]
Change management & culture shift	RQ4: Which leadership strategies mitigate resistance?	Apply Kotter's 8-step model; reward adaptive behaviors	[29, 30]
Risk navigation & agility	RQ2: Can CDiLe manage uncertainty and complexity?	Use AI and IoT for real-time risk forecasting and decision loops	[17, 23]
Symbolic and ethical leadership	RQ5: Broader implications in emerging economies.	Use digital tools to signal innovation and build trust	[19, 24]

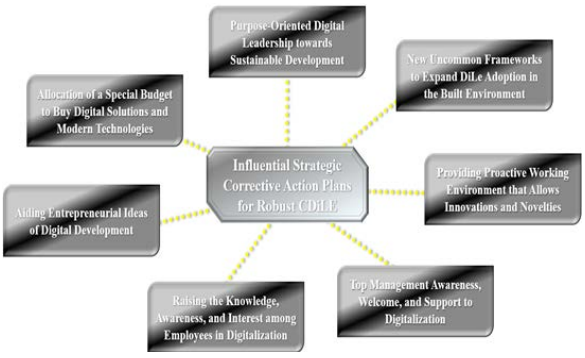

Fig.6. Influential strategic corrective action plans for robust CDiLe

This model shows important steps like leadership with a clear purpose, setting aside budgets, creating workplaces that support innovation, and backing from top management. These steps are needed to maintain strong digital leadership in construction companies.

6. Conclusion

This systematic review explored the strategic role of digital leadership (CDiLe) in advancing sustainable competitiveness in the construction sector. Analyzing 60 peer-reviewed studies published between 2015 and 2023, the findings consistently demonstrate that leadership, not technology alone, is the pivotal driver of successful digital transformation in construction. The review addressed five core research questions. First, it confirmed that CDiLe enhances competitiveness (RQ1) by aligning digital initiatives with long-term strategic objectives, particularly through vision communication and digital roadmap development. Second, the findings show that CDiLe enables organizations to manage complexity and uncertainty (RQ2) by fostering adaptive capabilities, such as AI-driven risk forecasting and agile project recalibration key elements of the Dynamic Capabilities Framework. Third, the review illuminated that organizational and cultural barriers to digital transformation (RQ3) are best overcome when leaders decentralize authority, empower middle managers, and actively cultivate innovation-friendly environments. Fourth, Kotter's Change Model and RBV helped identify the leadership strategies that mitigate resistance to transformation (RQ4), with evidence showing that change management, resource commitment, and symbolic signaling are critical. Finally, the review revealed the broader implications of CDiLe in emerging markets (RQ5), where digital leadership takes on both a technical and symbolic function, signaling national progress and ethical stewardship in the face of growing automation.

Theoretical contributions include the integration of RBV, transformational leadership, Kotter's change process, and dynamic capabilities theory into a unified lens for understanding CDiLe. Practically, the study provides a framework for construction executives to institutionalize CDiLe through vision-setting, investment in skills, decentralization, and ethical digital governance.

Moreover, findings underscore the urgent need for firms particularly in centralized markets like the GCC to move beyond pilot projects and build organizational structures that embed digital leadership at all levels. Without this strategic alignment, technological investments risk remaining fragmented and underutilized.

Future Research Directions

Further studies are encouraged to:

- Conduct empirical testing of the proposed CDiLe framework in varied regional contexts
- Explore CDiLe's impact on environmental sustainability and decarbonization targets
- Investigate ethical dilemmas in AI governance in construction decision-making
- Examine the role of gender, generational differences, and leadership diversity in digital transformation outcomes

In sum, CDiLe emerges not merely as a facilitator of innovation but as a foundational capability essential for guiding organizations through digital disruption, organizational complexity, and competitive transformation.

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