Proceedings of the First New Zealand IT Project Management Research Symposium: Advancing IT and Engineering Project Management

Stephen J. Thorpe
Editor

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Volume I

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Preface

Welcome to the proceedings of the first New Zealand Project Management Research Symposium (NZPMRS 2025) held on 27 November 2025, at the Auckland University of Technology, New Zealand. This symposium, organized by the Project Management Research Office at the AUT Computer and Information Sciences Research Centre, aims to provide a research platform for our postgraduate students, academic researchers, and industry practitioners to share research findings and professional insights related to project management, with a focus on IT, Agile methodologies, Engineering, and Construction project delivery.

While the field of Project Management has continued to remain focused on industry practice, accreditation and standardisation, it has also seen a growth in focus on research based on empirical investigation. High ranked research journals that focus on the science and research of project management, programme and portfolio delivery have risen in stature and we now see a growing list of highly ranked publications focusing on the field.

This is the inaugural NZPMRS and this year, 24 submissions were made and accepted for presentation or poster display at the conference. Each accepted paper had two reviewers, who each gave constructive comments and insightful suggestions to the authors, making these conference proceedings of the utmost quality. The papers in the proceedings have been classified into three sections:

Agile Methods, Frameworks and Practice: Research on Agile methodologies, hybrid delivery models, and scaling Agile in complex environments.

Digital Transformation and Innovation in IT Projects: How IT project management enables organizational change, digital adoption, and innovation.

People, Teams, AI and Leadership in IT Projects: The human organizational dimensions and human-AI of IT project management.

These tracks showcase emerging research, methods, and practices relevant to their respective domains. The key issues at the NZPMRS 2025 covered many popular topics, however, the role and influence of applications of Artificial Intelligence is at the forefront of many of the included papers.

The symposium is a milestone for AUT's growing influence in the field of project management, building visibility for both the School of Engineering, Computer and Mathematical Sciences (ECMS), and the School of Future Environments (SoFE). It provides a valuable professional development opportunity for students, early career researchers, and staff alike. Importantly, the symposium opportunities for selected contributions to be fast-tracked into the *Journal of New Zealand Project Management*, thereby offering an additional academic publishing outcome for participants. This will be the first time an event of this nature and scope has been hosted at the Auckland University of Technology, and indeed it is a unique contribution to the academic landscape in New Zealand.

To further encourage state-of-the-art research in the field of Project Management Research we are honoured to provide prizes to award excellent posters and papers, to those who have made outstanding contributions to the innovative practice and research of Project Management at this symposium. I would like to take this opportunity to thank our symposium sponsors. Platinum Sponsor, Nonsuch, Gold Sponsors, Enlighten Designs, and to our prize sponsors, the Auckland University of Technology's IT Services and Cyclone Computers, and to our host sponsor the AUT Computer and Information Sciences Research Centre. I appreciate the great support received from all members of the organizing committee, the local arrangement committee and the program committee as well as all participants.

As project management research is in continuous development and many new trends have emerged, our work needs to continue to focus on the latest in science, innovation and development so that we

can encourage greater and more innovative solutions to the challenges we face in the field. Next year, we plan to continue the innovative and successful outcomes and intend to increase our scope in improving the quality of the proceedings and to include more excellent papers for the fields of Engineering Project Management and Construction Project Delivery. I sincerely hope you can consider submitting your poster or manuscript and share your wisdom in Auckland next year at NZPMRS 2026.

18 November 2025

Stephen J. Thorpe

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The Environmental, Social, and Governance Leadership Gap: Why Women Project Managers Are Essential for Sustainability Success

Dr Olga Lozova

Abstract

Organizations often fail to translate Environmental, Social, and Governance (ESG) commitments into measurable outcomes. Despite significant investment, ESG initiatives often fail, greenwashing occurs, and stakeholders remain sceptical. This paper argues the root cause is not poor frameworks or lack of commitment, but a mismatch between project leadership capabilities and ESG demands. ESG projects involve three key paradoxes: temporal conflicts between short-term returns and long-term outcomes, integrity conflicts between compliance and genuine transformation, and cultural conflicts between global standards and local contexts. Addressing these requires integrative thinking, stakeholder coordination, and cultural bridging; skills women project managers frequently demonstrate. Drawing on organizational paradox theory, gender and leadership research, and New Zealand's climate reporting context, this paper shows that closing the ESG gap relies on strategically deploying women in project management. While board-level research provides support, this analysis extends the insights to project-level ESG implementation and develops practical frameworks for both organizations and project managers. Keywords: ESG implementation, women in project management, organizational paradox theory, sustainability leadership, climate reporting, New Zealand.

Keywords

ESG implementation, women in project management, organizational paradox theory, sustainability leadership, climate reporting, New Zealand

Introduction: The Implementation Gap That Strategy Cannot Close

Environmental, Social, and Governance (ESG) integration is one of the most significant organizational transformations of the 21st century. Regulatory requirements are expanding globally - the EU's Corporate Sustainability Reporting Directive (EU, 2022), the United States Securities and Exchange Commission's proposed climate disclosure rules (SEC, 2022), and New Zealand's mandatory climate reporting regime (MfE, 2024) illustrate the shift toward mandatory ESG accountability.

Yet, implementation lags commitment. Organizations have robust frameworks — the Global Reporting Initiative (GRI, 2021), the Task Force on Climate-related Financial Disclosures (TCFD, 2021), the Sustainability Accounting Standards Board (SASB, 2021), and the International Sustainability Standards Board (ISSB, 2023) - and face strong stakeholder and regulatory pressures (Eccles et al., 2014; McKinsey & Company, 2022).

This paper argues that the gap stems from assigning ESG projects using leadership criteria suited to traditional contexts. Conventional assessment prioritizes technical expertise, efficiency, and optimization - appropriate for projects with clear requirements, stable stakeholders, and single success metrics (PMI, 2023). ESG projects, however, involve paradoxes that resist optimization and demand leadership skills often undervalued in traditional evaluation (Alvesson et al., 2019).

Importantly, the leadership profile effective for navigating ESG paradoxes aligns closely with approaches that research shows women project managers employ more frequently. This is not an equity argument - it is a strategic imperative. While most ESG research has focused on board-level governance (Bear et al., 2010; Post et al., 2015), transformation occurs at the project level, where initiatives are scoped, stakeholders engaged, systems implemented, and outcomes measured. The project management role represents a critically underexplored domain in ESG research, yet it is precisely where leadership capabilities translate strategy into operational reality. This paper addresses

this research gap by extending board-level insights to the project management context where ESG implementation takes place.

Paper Objectives

This paper addresses three primary objectives:

1. Identify and characterize ESG-specific paradoxes that distinguish these projects from traditional contexts and explain why conventional project management approaches fall short.
2. Demonstrate how leadership capabilities for paradox navigation align with documented patterns in women's project management approaches, extending board-level evidence to the project management domain.
3. Develop strategic frameworks enabling organizations and project managers to close the ESG implementation gap through capability-aligned leadership deployment.

Contribution to Literature

This paper contributes to three literature streams: (1) organizational paradox theory, by identifying and characterizing three ESG-specific paradoxes at the project implementation level; (2) women in leadership research, by extending board-level findings to the project management domain and linking documented leadership patterns to specific organizational challenges; and (3) project management research, by theorizing the misalignment between traditional leadership selection criteria and ESG project requirements, particularly in relation to project management maturity models and governance frameworks.

The unique contribution lies in the project-level lens. While board governance sets strategic direction, project managers operationalize ESG transformation through stakeholder engagement, system design, change management, and performance measurement. This paper bridges the gap between board-level strategy research and project-level implementation practice, demonstrating why project managers - specifically those with paradox navigation capabilities - are the critical focal point for ESG success.

Theoretical Background

Organizational Paradox Theory

ESG projects differ from traditional initiatives due to structural paradoxes - contradictory but interrelated demands that exist simultaneously and persist over time (Smith & Lewis, 2011). Unlike dilemmas resolved by trade-offs, paradoxes require 'both/and' thinking to integrate opposing imperatives.

Smith and Lewis (2011) identify four paradox types: learning (building upon and destroying the past), belonging (balancing individuation and integration), organizing (controlling and empowering), and performing (meeting diverse stakeholder demands). ESG projects primarily involve performing paradoxes - satisfying fundamentally different, potentially conflicting stakeholder expectations at once.

Paradoxes cannot be resolved through traditional project management optimization. Prioritizing one dimension -profit over purpose, compliance over authenticity, global standards over local context - risks failure in the neglected area, ultimately undermining overall success. Critics of paradox theory argue that some tensions may reflect poor strategy or inadequate resources rather than inherent contradictions (Schad et al., 2016). However, in ESG contexts, regulatory requirements, stakeholder diversity, and temporal misalignments create genuine structural paradoxes that persist regardless of organizational capability.

Women and Integrative Complexity in Leadership

Studies of women in leadership and project management show they more frequently use collaborative decision-making (Eagly & Carli, 2007). Meta-analyses indicate that women leaders exhibit higher emotional intelligence, particularly in social awareness and empathy, and demonstrate greater stakeholder orientation, considering diverse interests beyond shareholder primacy. These patterns may stem from professional socialization in male-dominated fields, where women navigate the 'double bind' - simultaneously demonstrating competence and warmth, assertiveness and collaboration - developing integrative complexity as an adaptive response. This sustained practice in managing contradictory expectations develops sophisticated paradox navigation capabilities. Individual variation within gender groups is substantial, and many men develop similar capabilities through diverse professional experiences. However, population-level patterns remain relevant for strategic workforce deployment.

In project management contexts, women invest in long-term stakeholder relationships, track outcomes beyond project closeout including organizational learning, actively seek diverse perspectives to ensure marginalized voices are heard, and adapt their approaches to cultural and organizational contexts rather than rigidly following standardized methods. While often categorized as "soft skills", these capabilities reflect sophisticated paradox navigation essential for ESG projects.

Bridging Theory to Project Management Practice

The connection between paradox theory and project management practice requires explicit articulation. Traditional project management maturity models (PMI, 2023) emphasize process standardization, predictability, and efficiency optimization. These models perform well in stable environments with clear objectives and consistent stakeholder expectations. However, ESG projects operate in environments characterized by stakeholder plurality, temporal complexity, and values-based tensions; conditions where optimization logic fails (Smith & Lewis, 2011).

Project governance frameworks traditionally focus on accountability structures, decision rights, and performance metrics aligned with "iron triangle" criteria (scope, schedule, budget). ESG governance, by contrast, requires multi-dimensional accountability that balances compliance obligations, stakeholder trust, cultural authenticity, and long-term value creation. This shift demands project managers who can operate effectively in high-ambiguity contexts, synthesize conflicting stakeholder demands, and maintain strategic coherence across multiple value dimensions simultaneously - capabilities that align closely with documented patterns in women's project leadership.

The theoretical contribution extends beyond identifying this alignment: it demonstrates why traditional PM selection criteria systematically undervalue the capabilities ESG projects require, creating a structural mismatch between available leadership talent and project needs.

Approach and Methodology

This paper uses a conceptual-analytical approach, integrating organizational paradox theory (Smith & Lewis, 2011) with research on women in leadership (Eagly & Carli, 2007) to develop a framework linking ESG project characteristics to leadership capability requirements.

Source Selection and Analytical Process

Literature Selection Criteria: Academic sources were selected through structured searches in business, management, and sustainability databases (EBSCO, ProQuest, Web of Science) using search terms combining "ESG", "sustainability reporting", "organizational paradox", "women in leadership", "project management", and "governance". Inclusion criteria prioritized: (1) peer-reviewed empirical studies on women's leadership patterns and ESG performance, (2) theoretical frameworks on organizational paradox, (3) studies examining project-level implementation challenges, and (4) recent publications (2010-2024) to capture contemporary ESG contexts.

Policy and Regulatory Documents: New Zealand's climate reporting framework was selected as the primary regulatory exemplar due to: (1) recent implementation (2024) providing contemporary relevance, (2) mandatory requirements intensifying ESG paradoxes, (3) Treaty of Waitangi obligations creating unique cultural bridging demands, and (4) high environmental scrutiny making implementation challenges visible. International frameworks (TCFD, GRI, SASB, ISSB) were included to establish global standardization pressures.

Scope Boundaries: The analysis focuses specifically on project-level ESG implementation rather than board governance or organizational strategy. Geographic scope centres on New Zealand as an illustrative case while acknowledging broader applicability. The framework addresses leadership capability alignment rather than comprehensive ESG implementation methodology.

Analytical Integration Process

The analysis proceeds in four stages:

First, Paradox Identification: Examination of regulatory requirements (Financial Sector Amendment Act 2021; External Reporting Board, 2022) and sustainability literature to identify structural tensions inherent in ESG projects. Each paradox was validated against Smith & Lewis's (2011) criteria: contradictory demands that are interrelated, persistent over time, and cannot be resolved through trade-offs.

Second, Capability Specification: For each paradox, leadership capabilities required for navigation were specified through analysis of project management challenges documented in ESG implementation research and practitioner literature. Capabilities were defined operationally at the project level (e.g., "stakeholder synthesis" specified as the ability to design engagement processes that build consensus across divergent interests).

Third, Pattern Linking: Documented patterns in women's project management approaches (drawn from Eagly & Carli, 2007; Bear et al., 2010; Post et al., 2015) were systematically linked to specified capabilities. Board-level evidence was theoretically extended to project contexts through logical inference: if women directors enhance ESG strategy and women PMs exhibit similar leadership patterns, effectiveness should translate to implementation.

Fourth, Framework Development: Based on capability-paradox alignment, actionable frameworks were developed through iterative refinement, ensuring recommendations were operationally specific, addressed both organizational and individual levels, and accounted for resource requirements and evaluation criteria.

Limitations

This conceptual analysis develops theoretical frameworks that require empirical validation. The primary limitation is the lack of project-level empirical data directly linking women project managers to ESG implementation outcomes. While board-level research shows that women's presence correlates with stronger ESG performance (Bear et al., 2010; Post et al., 2015) and women' leadership patterns in project management are well-documented, establishing direct causal links between women project managers and ESG implementation success requires longitudinal, PM-specific research.

The extension from board-level evidence to project management contexts is theoretically justified but empirically unverified. The logic is defensible: boards set strategy, project managers implement it; if women enhance ESG strategy, and demonstrate similar leadership patterns at the project level, they should enhance implementation. However, contextual differences between board governance and project execution may introduce variables not captured in this analysis.

The New Zealand case provides an illustrative example but may not generalize across all regulatory contexts. Different jurisdictions have varying ESG maturity levels, stakeholder configurations, and cultural contexts that may intensify or diminish the paradoxes identified here.

This paper focuses on population-level patterns among women project managers, while acknowledging substantial individual variation within the group. The analysis does not claim all women PMs possess these capabilities or that men cannot develop them but rather identifies strategic alignment between documented patterns and organizational needs.

The Three ESG Paradoxes: Why Traditional PM Approaches Fail

Paradox One: The Profit-Purpose Temporal Conflict

ESG projects operate across incompatible timeframes: financial stakeholders focus on quarterly or annual results, while sustainability outcomes unfold over decades. New Zealand's mandatory climate reporting illustrates this misalignment. The Financial Sector (Climate-related Disclosures and Other Matters) Amendment Act 2021 requires ~200 Climate Reporting Entities to disclose Scope 1–3 emissions, governance arrangements, and climate risk management strategies (External Reporting Board, 2022). Substantial investment in measurement systems, governance processes, and stakeholder engagement is needed, yet immediate environmental benefits from disclosure are minimal; true value emerges only through strategic, sustained responses.

The leadership challenge: develop and communicate value propositions that satisfy stakeholders with different temporal priorities. ESG project leaders must balance short-term financial considerations with long-term sustainability, avoiding superficial "greenwashing" or initiatives that fail to secure ongoing support. Traditional business case tools - discounted cash flow or ROI -undervalue long-term, reputational, and strategic benefits. Effective ESG leadership demands multi-dimensional narratives addressing CFOs, sustainability officers, regulators, and community stakeholders simultaneously.

Paradox Two: The Compliance-Authenticity Integrity Conflict

Mandatory ESG disclosure imposes clear regulatory obligations with legal consequences, yet stakeholders scrutinize whether organizations act genuinely. Groups such as the Environmental Defence Society and Generation Zero actively critique disclosures, and research shows greenwashing damages reputation (Delmas & Burbano, 2011).

The leadership challenge: satisfy regulatory requirements while demonstrating authentic commitment. Project managers cannot rely on minimal compliance or pursue transformation without rigor. They must turn compliance obligations into genuine engagement by designing systems that meet legal standards while signalling authenticity to diverse stakeholders — employees, communities, investors, and regulators. Engagement processes should actively integrate stakeholder perspectives rather than check consultation boxes.

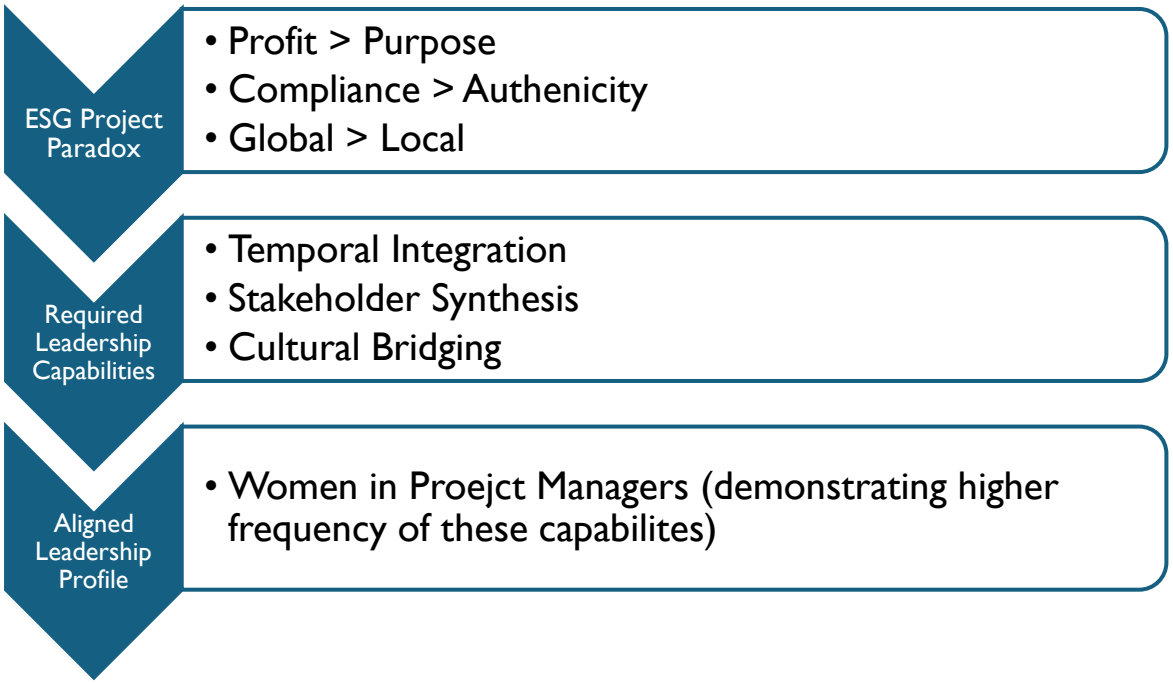
Paradox Three: The Global-Local Cultural Conflict

ESG reporting increasingly follows standardized frameworks, such as, TCFD, GRI, SASB, and ISSB, ensuring global comparability and investor transparency. Yet sustainability is inherently place-based. In Aotearoa New Zealand, kaitiakitanga - Māori principles of environmental guardianship rooted in spiritual and cultural relationships with land and water — cannot be fully captured through standardized metrics. Treaty of Waitangi obligations make these perspectives legally and culturally essential (Harmsworth & Awatere, 2013).

The leadership challenge: implement global reporting frameworks while honouring indigenous values that resist standardization. Project managers must bridge cultural and institutional logics, designing systems that satisfy global comparability while incorporating Māori environmental stewardship. This is not a matter of compromise but of holding both imperatives simultaneously through sophisticated cultural translation and integrative thinking.

Figure 1

Conceptual Framework for ESG Project Leadership



This framework posits that the distinct challenges of ESG projects (Paradoxes) demand specific leadership capabilities, which are more frequently demonstrated by women project managers, creating a strategic alignment.

Analysis: Women in PM: Capability Alignment with ESG Requirements

Board-level research provides empirical support for extending insights on women's leadership to project management. Bear, Rahman, and Post (2010) found that companies with women in board leadership achieved higher Corporate Social Responsibility ratings, particularly in industries under stakeholder pressure on environmental and social performance. Post, Rahman, and McQuillen (2015) confirmed this across 14 countries, showing that women directors positively influence ESG outcomes, in part through sustainability-themed alliances. These effects persist after controlling for firm size, industry, and profitability, suggesting a genuine relationship rather than a spurious correlation.

The logical extension to project management: Boards set strategy and allocate resources, but implementation occurs at the project level. If women board directors enhance ESG strategy through specific leadership patterns (stakeholder synthesis, long-term orientation, integrative thinking), and women project managers exhibit similar patterns in operational contexts, they should be particularly effective at translating strategy into results. This extension is theoretically justified but requires empirical validation through PM-specific research.

Temporal Integration: Navigating the Profit-Purpose Paradox

Evidence shows that women project managers frequently track long-term value beyond immediate deliverables, including relationship capital, organizational capability, and strategic positioning (Eagly & Carli, 2007). This temporal integration capability directly addresses the profit-purpose paradox, enabling ESG projects to capture both short-term compliance metrics and long-term transformation indicators, build stakeholder engagement processes that endure beyond project closeout, document organizational learning and capability transfer, and articulate value narratives satisfying both financial and sustainability objectives.

Traditional PM metrics often ignore post-implementation outcomes, but ESG success depends on sustained organizational change - precisely where women PMs' long-term orientation adds value. However, alternative explanations exist: organizations that value long-term outcomes may selectively assign women to such projects, creating selection bias rather than demonstrating inherent capability. Future research must control for assignment patterns to isolate leadership effects.

Stakeholder Synthesis: Navigating the Compliance-Authenticity Paradox

Women demonstrate advanced stakeholder synthesis capabilities, employing collaborative decision-making and high emotional intelligence, particularly social awareness and empathy (Eagly & Carli, 2007). In ESG contexts, these skills support consensus-building across diverse and sometimes conflicting stakeholders, from investors and regulators to employees, communities, and environmental advocates (Borghesi et al., 2014).

Effective ESG project leadership requires relational skill: designing engagement processes that foster genuine dialogue rather than performative consultation, building trust with sceptical stakeholders who scrutinize authenticity, managing conflicts where demands genuinely diverge, and translating technical ESG requirements into accessible language for diverse audiences.

Project management maturity models traditionally undervalue these capabilities, categorizing them as "soft skills" rather than recognizing them as sophisticated competencies essential for high-ambiguity, multi-stakeholder contexts. Organizations that continue evaluating ESG project leaders using traditional technical competency frameworks systematically overlook candidates with the capabilities ESG projects require.

Cultural Bridging: Navigating the Global-Local Paradox

Women project managers frequently develop cultural bridging capability, cultivated through navigating male-dominated technical environments while maintaining relationships with diverse stakeholder groups. This enables them to adapt communication styles across different stakeholder communities, translate across value systems without diminishing either perspective, find common ground between global frameworks and local indigenous perspectives, and facilitate dialogue between technical specialists and community representatives.

In New Zealand ESG projects, this means facilitating dialogue between auditors requiring standardized reporting and iwi representatives articulating kaitiakitanga principles, designing systems that accommodate both quantitative metrics and culturally specific narratives, and translating between Western scientific frameworks and mātauranga Māori without reducing either to the other's logic.

This advanced translation capability allows organizations to meet global ESG standards while fostering authentic local relationships — a requirement that will intensify as ESG regulation expands globally and organizations navigate increasingly diverse stakeholder ecosystems.

The Double-Bind Development Mechanism

These capabilities are reinforced by the "double-bind" pressures women face in male-dominated fields: demonstrating competence while maintaining warmth, asserting authority without appearing aggressive, and building relationships that are often undervalued (Eagly & Carli, 2007). Sustained navigation of these paradoxes develops integrative complexity (holding contradictory demands simultaneously), stakeholder navigation skill (building trust across diverse constituencies), long-term relationship capital (investing in sustained engagement), and cultural bridging (translating across institutional and social boundaries).

These are precisely the leadership capabilities ESG projects demand. Organizations that recognize and deploy this alignment strategically can close the ESG implementation gap, while those that overlook it risk failure despite having capable leaders in their workforce.

Boundary conditions: This alignment may be strongest in organizations with high stakeholder diversity, regulatory scrutiny, and cultural complexity. In contexts where ESG requirements are minimal or performative, the value of paradox navigation capabilities diminishes. Additionally, organizational culture affects whether these capabilities can be effectively deployed — hierarchical, risk-averse cultures may constrain even highly capable leaders.

The New Zealand Context: Where ESG Paradoxes Intensify

New Zealand provides an instructive case where ESG paradoxes are especially acute, making capability gaps in project leadership highly visible. The mandatory climate reporting regime, effective 2024, compels around 200 financial institutions and large companies to meet strict disclosure requirements (External Reporting Board, 2022), leaving no room for compliance-only approaches or delayed engagement.

Project managers must navigate explicit regulatory imperatives where legal obligations with enforcement mechanisms create non-negotiable compliance requirements while stakeholders simultaneously demand authentic transformation beyond minimal standards. Treaty of Waitangi obligations and the prominence of Māori perspectives intensify the global-local tension. PMs implementing international ESG frameworks must meaningfully engage with iwi, incorporate mātauranga Māori, and honour relationships that resist reduction to standardized metrics. Environmental scrutiny from New Zealand's strong environmental advocacy and high-profile environmental brand creates immediate public scrutiny. Technically compliant but performative disclosures invite critique from organizations like the Environmental Defence Society, reputational risk, and potential regulatory consequences.

Together, these factors make the profit-purpose, compliance-authenticity, and global-local paradoxes unavoidable, requiring sophisticated integrative, relational, and cultural leadership capabilities. Organizations operating in this context cannot defer ESG maturity or rely on incremental capability development — the regulatory and stakeholder environment demands immediate deployment of paradox-navigation leadership.

Strategic Framework for Organizations

Organizations must implement five strategic actions to close the ESG implementation gap through capability-aligned PM leadership deployment.

Action 1: Audit ESG Project Leadership Assignments

Assess whether selection emphasizes paradox navigation, stakeholder synthesis, and long-term thinking, rather than purely technical optimization. Specifically, examine representation of women in ESG project leadership roles, ensure ESG initiatives are recognized as advancement pathways rather than career sidetracks, confirm that PMs with strong stakeholder capabilities are not excluded due to traditional "soft skills" coding, and review whether ESG project assignments reflect strategic capability matching or default to available resources.

Action 2: Evolve Success Criteria

Traditional metrics - scope, schedule, and budget - fail to capture ESG project value. Organizations should measure both short- and long-term outcomes (immediate compliance delivery and sustained organizational capability), regulatory compliance alongside stakeholder trust (meeting legal requirements and building authentic relationships), and international comparability alongside local engagement quality (satisfying global standards and honouring indigenous perspectives).

Women PMs, whose capabilities align with these requirements, may underperform on traditional metrics but deliver superior long-term value. Evaluation frameworks must evolve to capture multi-dimensional success or organizations will systematically penalize effective ESG leaders.

Action 3: Provide Adequate Resources for Paradox Navigation

ESG initiatives require extended stakeholder engagement timelines beyond typical project schedules, dedicated budgets for cultural consultation and technical expertise (e.g., climate science, indigenous knowledge integration), protected time for integration work that synthesizes conflicting demands, and executive sponsorship to navigate organizational tensions and secure resources.

Under-resourced projects jeopardize even highly capable PMs. Organizations must recognize that paradox navigation requires investment - attempting ESG transformation on traditional project budgets guarantees failure.

Action 4: Develop ESG Leadership Pathways

Training should focus on paradox recognition and 'both/and' thinking frameworks, stakeholder synthesis and conflict navigation, cultural intelligence and values translation, and long-term value articulation across diverse stakeholder languages.

Many women PMs already possess these capabilities; organizations should leverage their expertise immediately while broader development occurs. Capability recognition, not just capability development, is essential.

Action 5: Establish Sponsorship Infrastructure

Senior leadership support ensures women ESG leaders have resources and political cover to navigate organizational tensions, visibility for contributions often undervalued in traditional metrics, and clear career advancement opportunities that recognize ESG leadership as strategic capability.

Without sponsorship, women PMs risk being penalized for inherent project tensions, while traditional project leaders advance unchallenged. Executive sponsors must actively advocate for evolved evaluation criteria and resource allocation aligned with ESG complexity.

Framework for Women Project Managers

Women project managers should implement five strategic actions to claim ESG leadership opportunities and demonstrate capability-role alignment.

Action 1: Reframe Current Skills as ESG Qualifications

Competencies often coded as "soft skills" — relationship-building, collaboration, long-term thinking, and communication — are in fact essential for ESG success, enabling stakeholder synthesis across conflicting interests, trust development with sceptical communities, temporal integration linking short-term compliance with long-term transformation, inclusive decision-making that incorporates marginalized perspectives, and cultural bridging between global standards and local values.

Document tangible outcomes: consensus-building across conflicting stakeholders, partnerships with indigenous communities, or frameworks linking compliance metrics with long-term decarbonization goals. Make these capabilities visible and credible through evidence rather than assertion.

Action 2: Combine Leadership Capabilities with ESG Domain Expertise

Targeted learning in climate science fundamentals and decarbonization pathways, ESG frameworks (TCFD, GRI, SASB, ISSB) and regulatory requirements, stakeholder theory and engagement methodologies, and indigenous environmental perspectives and cultural protocols.

The goal is integration rather than specialization, positioning the PM as the bridge between technical specialists and diverse stakeholders. Deep technical knowledge alone is insufficient for ESG project success; the value lies in synthesizing technical requirements with stakeholder needs and cultural contexts.

Action 3: Systematically Document Multi-Dimensional Value Creation

Beyond schedule and budget, track stakeholder advocacy (organizations or communities that become project champions), relationship capital (partnerships that persist and strengthen beyond project closeout), organizational learning (capabilities, processes, or insights transferred to the organization), innovation (novel approaches developed through stakeholder synthesis), and long-term outcomes (environmental, social, or governance improvements measured post-implementation).

Evidence of persistent benefits demonstrates ESG impact that traditional metrics fail to capture. Build a portfolio of multi-dimensional outcomes that makes the business case for capability-aligned deployment.

Action 4: Actively Pursue ESG Leadership Opportunities

Articulate how demonstrated capabilities match ESG project requirements, make the case for strategic deployment based on capability alignment, not just interest, lead pilot initiatives to build track record and visibility, and leverage professional networks to gain exposure to ESG opportunities.

Women socialized to wait for selection must recognize that in ESG contexts, their skills often align better than traditional PM profiles. Proactive positioning is strategic, not presumptuous.

Action 5: Negotiate Appropriate Resources and Success Criteria

Before accepting ESG project leadership, ensure evaluation frameworks recognize paradox navigation and long-term value creation, timelines accommodate authentic stakeholder engagement, not performative consultation, executive sponsorship is secured to navigate organizational tensions, and learning and capability transfer are embedded in project scope, not treated as optional.

Accepting ESG leadership without these conditions risks being unfairly blamed for complexity that is inherent to the project, not a failure of execution. Negotiating upfront demonstrates strategic understanding of ESG requirements and protects both the PM and the project.

Discussion: Interpretive Insights and Boundary Conditions

Why Project-Level Focus Matters

The extension from board-level research to project management contexts is not merely academic interest — it addresses a critical gap in ESG literature and practice. Boards set ESG strategy, but project managers implement it. The transition from strategy to execution is where most ESG initiatives fail (McKinsey & Company, 2022). Understanding leadership capabilities at the implementation level is essential for closing the ESG gap.

Project managers translate abstract sustainability commitments into concrete systems and processes, engage directly with frontline stakeholders where authenticity is tested, navigate day-to-day tensions between competing demands, build organizational capabilities that outlast individual projects, and measure and report outcomes that determine regulatory compliance and stakeholder trust.

If women directors enhance ESG strategy through specific leadership patterns, and implementation requires similar patterns operationalized at the project level, then women project managers should be strategically deployed where ESG execution occurs. This paper provides the theoretical framework for that deployment.

Boundary Conditions and Alternative Explanations

Several factors may moderate the proposed capability-alignment relationship:

Organizational culture: Hierarchical, risk-averse cultures may constrain even highly capable leaders. If organizations do not value stakeholder synthesis or long-term thinking, PMs with these

capabilities cannot deploy them effectively. The framework assumes organizational readiness to support paradox navigation.

ESG maturity: In early-stage ESG contexts where requirements are minimal or performative, the value of sophisticated paradox navigation diminishes. The alignment proposed here is strongest in mature, high-scrutiny ESG environments (such as New Zealand's mandatory climate reporting).

Selection bias: Organizations that recognize ESG complexity may selectively assign women to ESG projects, creating an association between women PMs and ESG success that reflects organizational awareness rather than inherent capability. Future research must control for assignment patterns.

Individual variation: Population-level patterns do not eliminate substantial individual variation. Many women do not possess the capabilities described, and many men do. The strategic claim is that documented patterns at the population level justify targeted talent development and deployment strategies, not that gender alone determines capability.

Comparison with Alternative Leadership Models

Transformational leadership emphasizes vision, inspiration, and change management — valuable for ESG transformation but insufficient for paradox navigation. Transformational leaders may drive commitment but struggle with stakeholder synthesis across fundamentally conflicting demands.

Servant leadership prioritizes stakeholder needs and relationship-building, aligning with ESG requirements. However, servant leadership frameworks often lack explicit mechanisms for integrating contradictory demands or navigating temporal tensions.

Adaptive leadership focuses on managing complexity and facilitating stakeholder learning in ambiguous contexts. This aligns closely with paradox navigation but lacks gender-specific analysis. Integrating adaptive leadership theory with women's documented leadership patterns could strengthen future research.

The contribution here is not that paradox navigation is the only effective ESG leadership model, but that it explains the observed gap between ESG commitment and implementation and provides a theoretically grounded rationale for strategic PM deployment.

Link to Project Management Maturity and Governance

Traditional PM maturity models (PMI, 2023) emphasize process standardization, predictability, and efficiency. These models perform well in stable environments but systematically undervalue capabilities essential for ESG contexts: stakeholder synthesis, integrative thinking, and cultural translation.

ESG project governance requires multi-dimensional accountability frameworks that balance compliance obligations (regulatory reporting, audit requirements), stakeholder trust (authentic engagement, transparent communication), cultural sensitivity (indigenous perspectives, local values), and long-term value (sustained capability, strategic positioning).

Current governance frameworks often treat these as competing priorities requiring trade-offs. The paradox navigation perspective reframes them as interrelated demands requiring integration. Project managers who can hold multiple accountability dimensions simultaneously are essential for effective ESG governance.

Organizations with high PM maturity but low ESG maturity face particular risk: sophisticated project processes may be applied to ESG initiatives, but if leadership capabilities do not align with ESG demands, process rigor alone cannot compensate. Maturity in traditional PM is necessary but insufficient for ESG success.

Future Research Agenda

This conceptual analysis establishes theoretical foundations that require empirical validation and extension. Future research should pursue the agenda outlined in Table 1.

Table 1

Proposed Future Research Agenda

Research Stream	Exemplary Research Questions	Potential Methods
1. Empirical Validation	Do ESG projects led by women PMs achieve higher scores on multi-dimensional success criteria? Does the double-bind mechanism actually develop paradox navigation capabilities?	Comparative case studies; Longitudinal studies; Quantitative surveys with SEM
2. Mechanism Studies	How are paradox-navigation capabilities developed and sustained? How do men and women PMs acquire these skills differently? Do these capabilities transfer from non-ESG contexts?	Longitudinal interviews; Ethnographic observation; Comparative studies
3. Boundary Conditions	Does the framework hold across different national cultures and regulatory contexts? How does industry variation affect paradox intensity? At what ESG maturity threshold does paradox navigation become critical?	Cross-national comparative studies; Industry-specific case analyses; Meta-analysis
4. Intervention Studies	How effective are training programs designed to build paradox navigation capabilities? What organizational interventions most effectively support capability-aligned leadership deployment?	Quasi-experimental designs; Action research; Pre-post intervention studies

Conclusion

The ESG implementation gap stems not from insufficient frameworks or commitment, but from leadership misalignment. Organizations continue assigning ESG projects based on traditional criteria, technical expertise and execution efficiency, while ESG success demands paradox navigation, stakeholder synthesis, and cultural bridging.

This paper identified three structural ESG paradoxes: the profit-purpose temporal conflict requiring integration across short- and long-term horizons; the compliance-authenticity integrity conflict requiring regulatory satisfaction alongside genuine stakeholder trust; and the global-local cultural conflict requiring standardized frameworks to be implemented while honouring indigenous perspectives.

Evidence shows women project managers more frequently possess the capabilities these paradoxes demand: integrative complexity for temporal tensions, authentic relationship-building for compliance and trust, and cultural intelligence for bridging global and local contexts. While board-level research demonstrates women directors improve ESG strategy, this paper extends those insights to the project management level, where strategy is translated into operational reality through stakeholder engagement, system design, change management, and performance measurement.

The New Zealand context - with mandatory climate reporting, Treaty obligations, and sophisticated environmental scrutiny - intensifies these paradoxes, making capability gaps immediately visible. Project managers navigating these tensions gain transferable advantages as ESG regulation expands globally.

Closing the ESG implementation gap requires coordinated action. Organizations must audit ESG leadership assignments, evolve success criteria to capture multi-dimensional value, provide adequate resources, develop ESG leadership systematically, and establish sponsorship for women PM advancement. Women project managers should reframe existing skills as ESG qualifications, build domain expertise, document multi-dimensional impact, actively seek ESG roles, and secure the resources and evaluation frameworks necessary for success.

The climate crisis creates urgency that will not wait for organizational adaptation. ESG transformation increasingly drives competitive advantage, stakeholder trust, regulatory compliance, and long-term viability. Women project managers are a proven, underutilized leadership resource. The question is not whether they have the capabilities, evidence confirms they frequently do, but whether organizations are strategic enough to deploy them where they matter most. Assigning ESG

initiatives to traditional PM profiles while overlooking women PMs with demonstrated stakeholder synthesis and cultural bridging is, fundamentally, a leadership deployment failure.

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The IT Project Manager: Benefits of a Technical Skill Set

Livia Krstić
Project Management Research Office, AUT Computer and Information Sciences Research Centre, Auckland University of Technology

Stephen J. Thorpe[1]
Project Management Research Office, AUT Computer and Information Sciences Research Centre, Auckland University of Technology

[1]Email: stephen.thorpe@aut.ac.nz

Abstract

Internationally recognized frameworks and accreditations define the core competencies required of IT project managers. Among these, technical skills are often cited as important, particularly in IT-focused projects. However, the specific technical competencies required, and the extent to which project managers should possess them, remain unclear. The literature on this topic is limited, though existing studies indicate that technical proficiency contributes to project success in technical domains. To explore this gap, this study employed semi-structured interviews with IT project managers and key project participants to examine perceptions of the importance of technical skills. Findings reveal a clear divide: participants with technical education emphasized the necessity of technical expertise, whereas those without technical qualifications highlighted communication, motivation, and attitude as most critical. The study contributes new insights into the strategic value that technical capability adds to IT project management effectiveness.

Keywords

Information Technology Project Management, Project Manager, technical skills, certification, competencies, attributes.

Introduction

Project management is widely accepted as a domain requiring a suite of skills and specialized competencies applicable across diverse industries (Carter, 1988; Hodgson, 2008; Reed, 1996, 2007). However, in the context of IT project management, a duality often arises wherein project managers are expected to possess not only generalist competencies but also sufficient technical expertise to engage meaningfully with complex systems and technical teams. These skills and capabilities have been increasingly standardized, refined and credentialized to acknowledge both the threshold, and the higher functioning, capabilities common to the project management skill set. This distinction has become increasingly pronounced with the rise of agile methodologies and the proliferation of digitally intensive projects.

Although frameworks such as the Project Management Institute (PMI) *Project Manager Competency Development Framework* (PMCDF) and the International Project Management Association (IPMA) *Individual Competence Baseline* (ICB4) offer comprehensive models of project management competence, they tend to be domain-agnostic and arguably underemphasize the role of technical skills in complex IT environments. The PMI PMCD explicitly describes the framework as "designed to apply generically to all project managers, regardless of the project's nature, type, size or complexity" (Cartwright & Yinger, 2007). IPMA's ICB4 describes a global, cross-domain competence baseline of people, practice and perspective (de Rezende & Blackwell, 2019). Delphi and empirical studies of IT project managers by Keil et al. (2013), Ahmadi-Eftekhari et al. (2022) reveal IT-specific skills and complexities as critical

for IT project success. These authors highlight the need for targeted competence research and argue for competency models that capture the special demands of IT projects.

There is a noticeable gap in empirical research detailing the *specific technical skills* required of project managers operating in IT environments. Competency studies tend to generalize competencies across sectors (e.g., construction, healthcare, general business), failing to account for the distinct demands of technical IT projects that involve complex systems, evolving technologies, and interdisciplinary coordination. Despite widespread recognition of the importance of technical fluency, few studies have yet examined the extent to which such expertise contributes to project outcomes or team effectiveness in IT contexts.

A study was therefore undertaken to address the following research question: *To what extent is technical expertise required of an IT project manager?* Our aim was not only to explore this question empirically through interviews with professionals in the IT sector, but also to address a notable gap in the literature. Specifically, the lack of research specifying the technical skill requirements of project managers operating within the IT domain. By doing so, we intend to support both theory development and practical applications for competency assessment, recruitment, and training.

Ultimately our exploratory study argues that in the context of IT project management, technical expertise is not merely a desirable attribute but a *strategic capability* (Jugdev, 2004; Weritz et al. 2024) that enhances credibility, communication, decision-making, and project success. While soft skills and management frameworks remain vital, technical fluency arguably enables project managers to reduce ambiguity, better coordinate with technical stakeholders, and make informed decisions—ultimately improving project performance in environments characterized by complexity and uncertainty.

Literature Review

There are many different types of Project Managers in related fields (Sydow et al. 2004). The role of a project manager has an extremely wide and influential scope which includes, financial analysis, risk management, stakeholder analysis and communication. When looking specifically at Project Managers in the IT field, there are many areas that rely on technical knowledge as they have a large decision-making component in terms of budget, staffing and technology related decisions. Project management, as a profession, is well-documented through international competency frameworks. The Project Management Institute (PMI) and the International Project Management Association (IPMA) each provide widely used models (PMI, 2021; IPMA, 2018) that describe core competencies such as leadership, communication, and planning. However, both frameworks underrepresent the role of domain-specific technical expertise, particularly in IT project environments.

General Project Management Competency Frameworks

Turner and Müller (2007) emphasized the significance of aligning project managers' leadership styles with project types, but technical skills are only implicitly discussed. Crawford (2005) similarly argues that project success is influenced by competence alignment yet provides no granularity on technical requirements. An earlier version of the PMI *Talent Triangle* included technical project management as one pillar, however, the interpretation broadly included skills such as scheduling and risk analysis rather than technology-specific fluency.

Gaps in Current Standards

Certification schemes such as *PRINCE2*, *ITIL v4*, and the *Scrum Guide* define roles and processes, yet generally assume a separation between project leadership and technical execution. *PRINCE2*, for example, focuses on process governance rather than content expertise. *ITIL v4* introduces service management fluency but does not delineate specific technical proficiencies required of project leaders. Scrum roles often require working knowledge of development practices, but even here the expectations are variable and context dependent.

Technical Credibility

Despite these frameworks, practitioners frequently highlight the importance of technical skills in IT projects. Pant and Baroudi (2008) suggest that technical competence is a critical success factor, yet they do not define what constitutes technical competence or how much is necessary. Gillard (2009) identifies technical credibility as essential to stakeholder trust but also fails to specify thresholds or evaluation methods. Case and Piñeiro (2009) argued that relationships can become unstable between software developers and project managers as developers believe they are more superior in regard to their respective intellectual and capability standpoints. They also continue to mention that non-technical project managers appear to have a lower value to a project as they are non-technical. Goodwin (1993) identified that when working with technical specialists, the project manager should be able to understand the nature of the project and be able to communicate with the team at a technical level. Authors earlier, such as Mantel and Meredith (1986), posited that some of the overriding factors leading to successful project management included technical credibility amongst the team and an ability to use a systems approach for completing tasks that met performance standards on time and within planned costs.

When looking at developing project competence, Andersen and Soderlund (2008), mention that the lack of technical knowledge triggered behaviors that led to a strong desire in project managers to access and develop technical skills in order to achieve these competencies. Pant and Baroudi (2008) state that in order to manage projects somewhat successfully, one of the core skills required is technical competence. However, the extent of that technical competence was not clear, nor how a lack of it may impact on any given project.

Agile and Hybrid Project Environments

The rise of agile has arguably transformed the boundary between technical and managerial roles, transforming the way projects are managed and delivered. Highsmith (2009) noted that agile project leaders must often operate with cross-functional awareness and technical grounding. Moe, Dingsøyr, and Dybå (2010) describe agile leaders as boundary spanners who bridge communication gaps between developers, stakeholders, and executives. In such environments, a lack of technical fluency may reduce the effectiveness of a project manager, resulting in communication breakdowns, slower decision cycles, and reduced team cohesion.

These authors highlight the importance of technical knowledge of a project manager working in an IT context as critical, both in order to be able to communicate, and to generate trust and confidence from the technical team. Insights suggest the importance of having technically competent project managers as an advantage in areas. Whether that advantage lies in a project manager's ability to gain credibility and support from their team, or to develop trust from stakeholders.

Need for further Empirical Investigation

Although the literature suggests that technical fluency can improve project outcomes, there remains little empirical research to date that explores what technical skills are necessary, to what extent, and under what conditions. This lack of clarity undermines efforts to recruit, train, and develop effective IT project managers. Riaz, Abbas, and Irshad (2017) further call for context-specific evaluation frameworks to assess team expertise in software development environments, underscoring the need for detailed competency taxonomies.

The literature demonstrates a significant shortfall in empirical, domain-specific research on the technical competencies of IT project managers. Frameworks and certification bodies acknowledge technical competence as important, but provide little guidance on what skills are needed, how they vary by context, or how they influence project outcomes. The present contributes to exploring this gap from the perspectives of professionals directly involved in IT project work, as an exploratory foundation for future competency model refinement.

Method

The present study adopted a qualitative, interpretivist methodology (Guba, 19954) suited to exploring the subjective perspectives of IT professionals on the role of technical expertise in project management. The goal was to understand the lived experiences and contextual meanings that practitioners assign to technical competence within IT project environments.

The approach aligned with the idea that participants involved in IT projects would have constructed intersubjectively through the meanings and understandings they had developed both socially in terms of the roles that they had performed in relation to either being a project manager or working with project managers on a technical project. It was also hoped that an informed understanding of the social world of the IT project could be uncovered through exploring the subjective views of those pragmatically linked to the context of IT project delivery.

Competencies are individual and perceptions of them can be highly subjective (Thorpe, 2016). In the context of the uncertainty and complexity of an IT project they were likely to be socially constructed based upon the stakeholder perspectives and particular needs of the project as it transitions through the phases of the product life cycle. Interviewing project managers and collecting perspectives on aspects of technical competencies needed at the various phases of a project provided a rich data set for uncovering the important factors from individual perspectives.

Research Design

Given the exploratory nature of the study, semi-structured interviews were selected as the data collection technique. This approach allowed for both consistency in core questions and flexibility to probe individual experiences and viewpoints in depth.

Participant Selection

A purposive sampling strategy was used to recruit participants with direct experience in IT project environments. Nine professionals were interviewed, including project managers, software and network engineers, a product manager, and a CEO. This range ensured a balance between those managing projects and those working closely with project managers. Participants had at least two years of professional experience and represented varied educational and certification backgrounds.

Data Collection

Interviews were conducted in-person, via telephone, and through video conferencing platforms, depending on participant availability. Each interview lasted between 60 and 120 minutes. Interviews were audio-recorded with consent and transcribed for analysis. Interview questions were piloted with two doctoral students and two IT professionals to refine clarity and relevance of the questions.

Data Analysis

Thematic Analysis (Braun & Clarke, 2021) was used to identify recurring patterns and insights across the transcripts. Initial coding was inductive, allowing themes to emerge from the data without preconceived categories. Codes were then refined iteratively, and themes were grouped into broader categories reflecting the major factors influencing perceptions of technical competency in project management.

Researcher Reflexivity and Trustworthiness

Given the lead researcher's background in IT and project delivery, reflexivity was also central to the analysis. This involved reflecting on potential biases throughout the coding process. To enhance credibility, findings were triangulated by comparing perspectives across roles and validated with two participants through member checking.

Findings

The findings are structured around five high0level themes identified from categorizing and grouping analysis of the interview data from the nine participants. These themes include: 1) Perspective differences between higher educated and non-higher educated, 2) Perceived benefits of industry qualifications, 3) Importance on practical hands-on experience versus a narrower academic specialized approach, 4) Perceived skills required of an IT project manager, and 5) Perceived benefits of an IT technical skillset.

Perspective differences between higher educated and non-higher educated

There was a mix of both higher educated and non-higher educated interviewees. Due to this, there were differences in opinion of what was considered important in IT project management when discussing the best fit for a Project Manager. While three interviewees stated that almost everyone in their workplace holds at least one university qualification, five of the interviewees believed that higher education qualifications although not a must have for the role, demonstrated that a person had applied themselves to a course of study and were able to meet the challenge and complete tasks in order to obtain a qualification. This in turn showed the individual had tenacity and could follow a path to a defined objective. Others mentioned that completing a higher education qualification teaches people how to think and helps to aid problem solving once they are in the workplace. Participant 4 stated,

> Tertiary qualifications provide a good indication that someone has applied themselves to a course of study and completed the tasks required to obtain that qualification. Therefore, they have a level of tenacity and can follow a path to a defined objective. (P4)

On the whole, participants with a higher education degree, particularly in a technical field, confirmed that they believed technical knowledge was highly important in an IT project manager, while the less technical or non- higher education educated participants looked at interpersonal skills as being more important.

Perceived benefits of industry qualifications

One question asked was about the importance and relevance of an industry certification for project management. From the data gathered, it appears that participants who have held a long-term role as a Project Manager have stated that at some point during their career, they studied and gained an industry qualification. There were various comments including where certain organizations required the participant to upskill due to company policy, others wanted to learn and upskill on the latest techniques. As stated by participant 1,

> I think industry certifications are very important. They are quite often difficult to obtain and require constant 'maintenance' to keep the qualification current. The ideal is to have both a tertiary qualification as well as industry certifications, along with experience. (P1)

It was mentioned numerous times that industry qualifications were highly regarded overseas and participants who had worked out of the country and held these qualifications found it much easier to obtain work.

All participants that held industry qualifications agreed that they felt more empowered to succeed in their roles with the knowledge gained and when looking for other work, they were held in higher respect compared to their counterparts that did not hold any industry qualifications. Participant 2 confirmed that,

> I certainly agree that when I have been looking for new project management roles it has been much easier to get on to shortlists and receive job offers not only based on my previous experience but with strong and relevant industry qualifications. I found this particularly beneficial when I worked in England and found that it was a mark of immediate credibility and really assisted in allowing me to stand out versus other candidates. (P2)

Practical hands-on experience versus a narrower academic approach

The question *How do you balance between qualifications and hands on experience?* had varied answers which both followed the same theme of experience being perceived as higher rated over technical skills. Most of the participants (8/9) had well over the minimum of two years industry experience for the study and had held multiple project related roles such as, Project Manager, Network Engineer, Software Engineer, Product Manager, and CEO. Some had initially started with no formal project management experience and have gained the skills predominantly through the various projects they had delivered throughout their careers.

A perspective described was when working with technical specialists who had little project management experience, the project was likely not running smoothly or was not as successfully executed compared to working with a Project Manager that had more experience in running projects over a long period of time, even without a strong technical skill set. However, when comparing the feedback of more technically focused participants and reflecting on their experiences, they noted that they had experienced difficulties dealing with a non-technical Project Manager due to the lack of understanding of what needs to be achieved from a technical standpoint.

Perceived important skills required of an IT project manager

Table 1 below shows that there are two skills that all interviewees agreed were important in a successful IT Project Manager working on a technical project. These skills are their *technical* and *communication* skills. These are followed by *analytical* and *leadership* skills (5 of the 9), then *financial competency*, *relationship building*, and *motivation* skills (4 of the 9).

Table 1

Important Skills Required of an IT Project Manager

Skill	P1	P2	P3	P4	P5	P6	P7	P8	P9
Technical	✓	✓	✓	✓	✓	✓	✓	✓	✓
Communication	✓	✓	✓	✓	✓	✓	✓	✓	✓
Decision Making	✓								
Problem Solving		✓							
Time Management				✓	✓				
Relationship Building	✓						✓	✓	✓
Analytical	✓	✓	✓	✓		✓			
Financial Competency	✓		✓	✓		✓			
Critical Thinking	✓						✓		
Motivation		✓			✓			✓	✓
Leadership		✓			✓	✓		✓	✓
Organisation								✓	✓

Given the often highly technical nature of IT project management, participants stated that clear communication, be that either verbal or written, was essential to ensure that all parties on a project could have a clear understanding of the direction and objectives to be achieved. Interviewees also confirmed that financial competence was perceived to be important as most IT projects run to a specific budget and Project Managers are measured against KPIs to achieve this. Participants confirmed that there had been massive cost overruns resulting from IT projects which they had been involved in.

One participant had recently hired an IT project manager to help implement a cloud-based IT system into a medical organization. They discussed that being able to hire someone who had an IT degree but also a decade-long career in project management allowed the company to really excel. They were able to train all staff in the medical organization who were non-technical in technical skills and help them to transition to the new software platform all while having that same person discuss technical details with the new software vendors.

Interestingly, only two of the nine participants saw time management as a vital skill. This may be due to the difficulties of complexity and uncertainty inherent in IT projects, perhaps also due to the iterative cycles inherent in the adoption of Agile approaches to project delivery, however, it was unexpected given the prominence of managing time, planning and scheduling as a first principle of the project manger's role in first order project management.

Perceived benefits of an IT technical skillset

When analyzing the responses from a majority of the participants (7/9), there was one common theme about the benefits of an IT technical skillset. The theme was that having technical knowledge that a project manager knew and could do something with, that didn't rely on other's technical expertise, was seen as a major advantage to the project success. With an IT technical skillset there was the ability for better decision making as the technical subject matter expertise meant that the project manager knew what was required in every aspect whether it was technical, financial, people or process management. Not needing to rely on others' expertise to find the key elements of the project delivery meant that the technical knowledge empowered a project manager to make decisions with some confidence.

Participants in technical IT roles stated that IT Project Managers who had a high level of IT understanding found it easier to discuss important project details with than a generalist project manager, who would not necessarily know the technical details. With a generalist project manager, significant time was considered wasted having to involve many people in identifying the complexity of work needed. Also, with a generalist project manager the meaning of a message could get lost. The project could then suffer due to the very technical nature of the project leading to misunderstandings of what work was actually involved or required to meet objectives.

Overall, when dealing with technical staff, a project manager who had familiar technical skills was able to take control and be in charge of the project without needing to get many extra technical advisors involved. This was seen to help cut down on time and budget bringing the project manager up to speed technically. As commented by Participant 2,

> Technical ability is vital. Especially when the person is more interested in keeping the budget down than actually making decisions based on non-technical priorities. You can waste time bringing someone up to speed, which in some cases is as valuable as money. I have had suggestions for solutions from our IT project manager that resulted in a cheaper and better solution than our original ideas. (P2)

Discussion

The mix of respondents allowed multiple views and different perspectives on the research question *to what extent is technical expertise required of an IT Project Manager?* The first area examined was to identify if there were any differences between those with higher education and non-higher education which might influence their views on the importance of higher education for those involved in IT project management.

The findings highlight a divergence in how technical expertise is perceived by IT professionals depending on their educational and experiential backgrounds. While some respondents emphasized generic interpersonal and leadership skills, others see technical competence as essential for project success. These findings reinforce and expand on previous literature that acknowledges a need to define technical skill requirements for IT project managers.

Those with a less technical non-tertiary education felt that soft skills more related to people management, leadership and managing teams were more important. Of interest is that participants with no higher education but practical experience believed that qualifications were not required to be successful, whilst on the other hand, participants with a higher qualification are adamant that it has helped them in the areas of discipline and problem solving.

Although there is no direct literature linked with tertiary education and IT project management, in a research paper conducted by Harvey (2000), he states that tertiary education is very important as it enhances knowledge, skills, attitudes and abilities all while empowering students as lifelong critical, reflective learners. From this we might conclude that employers do have a preference for tertiary education and respect for students that have completed advanced levels of study.

The findings affirm the argument that technical expertise should not be perceived as simply a complementary skill in IT project management but present it as a strategic capability. Interviewees consistently noted that a project manager with technical fluency was better able to interface with technical teams, identify and mitigate risks early, and reduce miscommunication and rework. This aligns with Moe et al.'s (2010) depiction of agile leaders as cross-functional communicators and Highsmith's (2009) argument for integrated technical awareness in project leadership roles.

There is a risk that if non-specialist Project Managers are engaged, the project may go off track from a financial, leadership, technical and implementation viewpoint simply because of the lack of technical experience in the industry and the lack of having 'seen' or 'done' this before. This is also confirmed by Gamester's (2020) editorial on technical skills vs managerial skills, which stated that specialist technical project managers also have the ability to have an objective outlook and rise above the details as well as creating an atmosphere of technical credibility with their team members. Having an experienced IT project manager puts the expertise 'in house' potentially negating the need or other specialist individuals to be engaged.

The study adds empirical support to critiques of competency frameworks for under-specifying technical proficiencies. Respondents viewed project management certifications as valuable for credibility and standardization, but insufficient to guarantee effectiveness without accompanying technical knowledge or experience. This suggests a need to evolve such frameworks to reflect hybrid competencies required in digitally intensive, agile-driven projects.

The study also offers actionable insights for project management hiring and potentially training practices. For roles in highly technical project environments, selection criteria should include demonstrable technical expertise or domain knowledge, in addition to traditional project management competencies. Training programs could be enhanced by incorporating technical upskilling pathways for aspiring IT project managers.

Limitations

It is acknowledged that the sample of nine interviewees is small and therefore the comparison of data is limited, identifying participants for the survey was challenging given the often highly confidential nature of technology driven projects.

Future Research Directions

Building on the findings, several areas warrant further investigation. Comparative studies of IT project manager competency expectations across regions could be undertaken. Longitudinal studies could also examine how technical skills correlate with project outcomes across different IT domains. Empirical mapping of the minimum technical knowledge required at various project phases (e.g., initiation, development, deployment). Research into effective upskilling strategies and learning pathways may also be of benefit for non-technical project managers transitioning into IT contexts.

These lines of inquiry will further refine our understanding of hybrid technical-managerial roles and help ensure that future project management practice is fit for purpose in a rapidly evolving digital world.

Conclusion

The study explored the extent to which technical expertise was required of IT project managers. Through semi-structured interviews with professionals across various technical and managerial roles,

it became clear that technical fluency was seen to significantly enhance project management effectiveness in IT contexts. While general competencies like communication and leadership remain core to project delivery, the ability to understand and contribute to technical discussions was seen to empower project managers to lead with greater authority, reduce delays, and improve outcomes.

Current frameworks and certifications acknowledge the importance of technical competence but stop short of specifying what it entails. This study contributes to exploring that gap by offering grounded perspectives. We propose that future frameworks develop detailed, domain-specific technical skill maps. Doing so will help align educational, professional, and organizational expectations and lead to improved project outcomes.

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An Investigation of Teamwork in the Era of AI: Challenges and Opportunities

Thatiane Palumbo Ascar

Project Management Research Office, AUT Computer and Information Sciences Research Centre, Auckland University of Technology

Stephen J. Thorpe[1]
Project Management Research Office, AUT Computer and Information Sciences Research Centre, Auckland University of Technology

[1]Email: stephen.thorpe@aut.ac.nz

Abstract

Artificial Intelligence (AI) is playing an increasingly transformative role in reshaping conventional teamwork practices, from resource allocation to creative collaboration. To examine the emerging dynamics of AI-mediated teamwork in the IT sector, a mixed-methods study was undertaken to identify the challenges and opportunities faced by practitioners. A survey of 41 IT professionals gathered quantitative usage patterns and qualitative narratives regarding their lived experiences. Findings reveal a critical duality: while AI redefines performance by enhancing productivity and task distribution, it simultaneously introduces frictions regarding trust, role ambiguity, and the erosion of interpersonal cohesion. By analysing these tensions through Socio-Technical Systems and Adaptive Structuration lenses, the study offers actionable guidance for navigating the human-AI partnership, suggesting that successful integration requires a shift from 'manual execution' to 'strategic oversight'.

Keywords

Agile Teams, IT Project Management, Team Dynamics, Performance Evaluation, Conflict Resolution, Artificial Intelligence, Agentic AI.

Introduction

Advances in Information Technology, specifically Large Language Models (LLMs) and Machine Learning (ML), are reshaping the fundamental structures of teamwork. Teamwork has traditionally relied on shared goals, coordinated activities, and rich interpersonal communication (Katzenbach & Smith, 1993). AI is now augmenting these aspects by automating routine work, supplying predictive analytics, and offering algorithmic decision support (Huang et al., 2021). However, this integration creates significant organizational friction, including decision-authority ambiguity, perceived threats to professional autonomy, and overreliance on automated outputs (Shrestha et al., 2019).

To analyse these complexities, this study applies two complementary theoretical lenses to provide the focussed theoretical scaffold requested by contemporary scholarship. First, Adaptive Structuration Theory (AST) (DeSanctis & Poole, 1994) is used to examine how AI technologies interact with established team structures, emphasising that technology's impact is not deterministic but emerges from how teams adapt it into their workflows. Second, Socio-Technical Systems (STS) Theory (Trist, 1981) provides a framework for understanding the friction between the technical system (AI efficiency, automation) and the social system (trust, cohesion, empathy).

Despite the proliferation of AI tools, empirical evidence on how professionals experience this duality in real-world teams remains limited. Practitioner issues such as trust, leadership redefinition, and ethical responsibility are underexplored. To address this gap, this study investigates:

- How team members view AI integration in collaborative tasks.
- The specific friction points and challenges experienced during integration.

- The impact of AI on the qualitative aspects of team dynamics, roles, and communication.

Literature Review

The integration of Artificial Intelligence is transforming the landscape of team interactions. Organizations now leverage AI-driven tools to gain insights into communication patterns and identify collaboration bottlenecks (Lee et al., 2022). Functionally, AI improves team operations by enhancing coordination (Al-Sumir et al., 2021) and automating resource management, such as assigning tasks based on member strengths (Smith & Johnson, 2023). The automation of data processing accelerates decision-making, allowing human members to focus on high-priority strategic tasks (Kim & Patel, 2023).

However, a critical tension emerges in the literature. AI analytics, while providing objective data, may obscure qualitative features essential for team efficacy, such as emotional intelligence and social cues (Robinson & Garcia, 2023). Furthermore, ethical concerns regarding data privacy, algorithmic bias, and transparency pose an ongoing risk to team trust (Uddin, 2023). Reitz and Higgins (2024) recently observed that employees under AI surveillance often exhibit 'performing' behaviours-modifying communication to satisfy AI metrics rather than engaging authentically. This study sought to empirically explore this tension between technical efficiency and social erosion within the specific context of New Zealand IT professionals.

Consequently, while the functional benefits and social risks of AI are documented, a significant theoretical gap remains regarding the structural adaptations required to sustain this collaboration. The existing literature has yet to fully articulate the theoretical proposition that AI functions not merely as a tool, but as a non-human agent that forces a renegotiation of the socio-technical contract within teams. This underscores the need to examine teamwork through the lenses of Adaptive Structuration Theory (AST) and Socio-Technical Systems (STS), specifically investigating how the 'spirit' of AI efficiency is appropriated in practice when it clashes with the necessity for human cohesion. By addressing this gap, this study moves beyond descriptive accounts to analyse how IT professionals structurally evolve their roles and relational boundaries to accommodate the distinct duality of algorithmic logic and human empathy.

Methodology

The study followed a mixed-methods approach, utilizing an anonymous online survey as the research instrument. The design was chosen to g ain a multifaceted and holistic understanding of AI's impact on teamwork, allowing quantitative data to map usage patterns while qualitative data provided rich, explanatory context for those patterns.

Participants

A total of 41 participants completed the anonymous online survey between May and June 2025. Participants were recruited based on two key eligibility criteria: (1) a minimum of two years of work experience in the IT sector, and (2) current workplace use of AI tools in their teamwork. A purposive sampling approach captured a variety of organizational roles to ensure diverse perspectives and resulted in a non-probability, voluntary response sample. While the sample size (N=41) limits broad statistical generalisability and represents a non-probability convenience sample, it provides a focused, exploratory dataset of early adopters in the IT context, offering valuable qualitative depth.

Data Collection

Data was collected via the Qualtrics online survey platform. The survey contained 28 questions. 20 closed-ended and 8 open-ended questions that were developed and drawn from existing literature on virtual teams and technology adoption (e.g., Al-Surmi et al., 2021; Smith & Johnson, 2023). Closed questions, the quantitative data, measured AI tool use frequency, perceived effectiveness, and impacts

on collaboration metrics and satisfaction. While open questions, the qualitative data, elicited narrative experiences regarding how AI shapes team dynamics, challenges, and benefits.

Data Analysis

Quantitative data were analysed using descriptive statistics to identify adoption trends. Qualitative responses from open-ended questions underwent a rigorous Thematic Analysis following the six-step framework by Braun and Clarke (2012). This involved an iterative process of familiarisation, initial coding, and theme refinement. To ensure interpretive rigour, initial codes were reviewed against the raw data to verify that the emerging themes, specifically the tension between efficiency and cohesion, accurately reflected participant sentiment.

Ethical Considerations

Ethics approval was obtained from the AUT Ethics Committee (Application 25/167) on 28 May 2025. All participants provided informed consent via confirmation on the survey's first page, which detailed the study's purpose and data use. To ensure confidentiality and anonymity, no personally identifiable information was collected.

Research Design

The choice of a mixed-methods approach was motivated by its ability to validate evidence and improve research credibility (Denzin, 1978). Combining descriptive statistics with qualitative themes allowed for a deeper exploration of how AI is perceived to influence teamwork dynamics. Quantitative data from closed-ended questions were analysed using descriptive statistics. This identified key trends and provided summaries of the sample's technology use frequency, perceived tool effectiveness, and satisfaction levels. For the qualitative data, the six-step Thematic Analysis process from Braun and Clarke (2012) was followed. This systematic method flowed from data familiarization, abstraction of participant perspectives, coding, through to theme definition and reporting. The resulting themes allowed for a comparison of common challenges, benefits, and feedback regarding AI integration in teamwork.

A theoretical lens guided the analysis. The Unified Theory of Acceptance and Use of Technology (UTAUT) model (Venkatesh et al., 2003) was used to assess factors influencing technology acceptance, such as performance expectancy and social influence. This was complemented by a Design Thinking approach (Brown, 2009) to emphasize human-centred innovation, along with concepts from Complex Adaptive Systems (CAS) (Uhl-Bien et al., 2007) that acknowledged the interconnected nature of teams. Together, these theories provided a framework for exploring the changing user experience with AI in collaborative contexts.

Findings

Views on the Integration of AI Technologies in Collaborative Tasks

The study showed that AI was already a foundational element in the collaborative practices of IT teams. A significant majority of respondents (70%) reported using AI tools daily or several times a week. This usage spanned a diverse range of tasks, most commonly transcription and summarization (53%), content generation (46%), and brainstorming assistance (39%). Attitudes were overwhelmingly positive, with over 80% of respondents describing AI as a 'productivity multiplier, collaboration enhancer, and time saver'. 63% rated AI's effect on teamwork was ‘extremely positive' or 'strongly positive', while 26% on moderate and only 1% selected no positive or limited positive effect. These perceptions varied by role:

- Technical roles reported the most daily use, focusing on code quality with tools like GitHub Copilot.
- Project Managers primarily used AI for meeting summaries and documentation.

- Leadership roles viewed AI strategically, focusing on it within a 'culture of experimentation'.

Challenges Faced When Integrating AI

Despite the evidence of positive perceptions, participants reported significant barriers to adoption. The most common challenge was insufficient training (44%). This is a critical gap, as the majority of participants described themselves as self-taught (61%) or had learned 'by practice on the job' (31%), leading to uneven adoption. One participant noted this fragmented learning "can slow down adoption and lead to inconsistent results", while another participant noted, "Not everyone on the team is comfortable or skilled... which can slow down adoption and lead to inconsistent results." This lack of formal structure exacerbates the risks of automation bias.

The other major challenges were Security (39%), followed by Resistance to Change (24%) and Ethical Concerns (24%). Participants highlighted the critical nature of "corporate data security" and data quality, with one warning that "without clean, structured data, AI output can be misleading". This directly feeds into issues of trust, with one participant stating, "it breaks team trust when team members blindly trusted AI recommendations without reviewing and produced output that is not useful".

Most Common AI Tools Used to Enhance Teamwork and its Adoption

Tool adoption was highly concentrated. ChatGPT was the dominant general-purpose AI tool, with 66% of respondents reporting frequent use for content generation, summarization, and brainstorming, while GitHub Copilot (34%) was preferred by developers, who used it for improving code quality and to run unit tests. Project management platforms like Trello and Miro were used less for their AI features (10-15%). It was also noted that when selecting tools, the primary criteria for choice was cost-efficiency and perceived accuracy.

The qualitative data provided vivid scenarios of how these tools are reshaping workflows, moving beyond simple automation to strategic enablers:

- **Transcription and Summarization**: Automation of meeting notes was a primary use case. One participant noted, "Reduced time spent in meeting minute taking and accuracy, increased speed on content creation based on trained/curated content."
- **Content Generation**: Teams leverage AI to accelerate documentation. A project manager shared: "We've leveraged generative AI to accelerate the development of presentations, architectural diagrams, and initial drafts for RFP responses." Another noted that "…staff use ChatGPT to prepare agendas and "review long written reports," significantly reducing cognitive load.
- **Brainstorming**: AI is used to overcome creative blocks. A respondent noted: "AI suggestions are always reviewed before implementation, but they're an excellent starting point for brainstorming and save a lot of time on research, "specifically citing its utility when the whole team is creatively blocked."
- **Development Support**: GitHub Copilot (34%) was the standard for developers. One software engineer provided a vivid example: "My dev team is using GitHub Copilot every day to improve our unit tests for every application they build, ensuring code quality and fewer problems in our deploys."
- **Task Management**: AI is driving strategic shifts. As one participant explained, "With AI automating routine tasks, team members can focus more on strategic and creative work," effectively reallocating human cognition to higher-value problems.

The Duality of AI impact

This area revealed the study's central contradiction. On the one hand, AI was seen as providing a significant benefit to performance; on the other hand, AI was seen as a direct threat to the quality of that performance.

The Positive Duality: When asked what the AI positive effects 65% identified productivity as the primary benefit, followed by 41% speed of decision making, and 29% for quality of outputs. One participant noted that AI "reduced the time required to generate insights, allowing us to make faster and more informed decisions", and another explained "AI has enhanced cross-functional collaboration by making information more accessible and reducing communication gaps across departments.". Another one said, "AI suggestions are an excellent starting point for brainstorming and save a lot of time on research."

The Negative Duality: Conversely, when asked what the AI negative impacts 78% selected quality of outputs and deliverables and 35% collaboration, but not due to the AI's failure, but due to human complacency. The erosion of critical thinking was a major theme. A participant warned that "it breaks team trust when team members blindly trusted AI recommendations without reviewing and produced output that is not useful." Another respondent described the psychological impact of this shift, noting that while junior staff gain confidence using tools, there is a risk of "tech dependency" where outputs are "not considered real enough to be valid" by senior stakeholders.

The consensus was that AI outputs still required human input for final decision making.

Influence of AI on Team Dynamics

Work arrangements were a key determinant of AI use. The majority of the sample (86%) consisted of hybrid and fully remote teams. These teams reported the highest frequency of AI use, relying on it to "bridge physical gaps" and automate asynchronous communication like meeting summaries. In contrast, in-office teams (11%) focused more on task management and performance analytics. The remaining 3% did not specify their work arrangement. The influences described were:

Performance Metrics: The top AI-enhanced strategy used to improve performance was data analysis (51%), with the primary metric for measuring AI's contribution being productivity levels (41%). This heavy reliance on quantitative output reinforces the "efficiency" side of the duality but risks obscuring qualitative team health.

Conflict Resolution: Surprisingly, AI is mediating interpersonal dynamics. 44% of respondents reported using AI to manage team conflicts by providing data-driven insights to objectify disagreements, while 36% used it for facilitating communication (e.g., tone-checking messages). This suggests a structural shift where conflict is managed through 'objective' data rather than subjective empathy, a finding that directly correlates with the 'social erosion' theme identified in the literature.

Roles: Participants described a fundamental transition from "manual execution" to "AI oversight." One respondent articulated this clearly: "With AI automating routine tasks... some roles have evolved to emphasize AI oversight, data analysis, and optimization rather than manual execution." However, this structural shift creates role ambiguity for junior staff. Qualitative feedback highlighted a concern: if AI handles the "learning" tasks, junior developers may struggle to acquire the foundational skills necessary to perform the oversight now required of them.

Responsibilities: Responsibilities are shifting toward quality assurance and validation. One software engineer provided a vivid example of this new responsibility using GitHub Copilot: "My dev team is using GitHub Copilot every day to improve our unit tests for every application they build, ensuring code quality and fewer problems in our deploys." This illustrates that responsibility is no longer just about writing code, but about auditing AI-generated code.

Communication: While AI enhances information accessibility, it has altered the nature of team interaction. 42% of respondents expressed concern over declining informal communication. Participants noted that while AI helps "bridge physical gaps" in hybrid teams, the reliance on automated summaries and chatbots risks making communication transactional. One respondent observed a 'diminished interpersonal engagement', suggesting that efficiency is being prioritized over the social connection that builds trust.

Educational Background and AI Readiness

The study identified a divergence in AI readiness based on educational background. Respondents with a Master's or PhD degree (51%) expressed higher confidence in assessing AI tools and were more likely to raise ethical and security concerns. In contrast, those with Bachelor's degrees (37%) focused more pragmatically on immediate productivity benefits. This indicates that higher educational attainment correlates with a more critical, risk-aware approach to AI integration. The remaining 12% did not provide information about their educational background.

AI's Role in Fostering Innovation vs. Standardization

Participants described AI as playing a paradoxical dual role: fostering innovation while simultaneously driving standardization. On one hand, AI helps teams identify unseen patterns and overcome creative blocks (innovation). On the other, it enforces best practices and templates (standardization). Participants did not view this as a conflict but as a necessary balance, reaching a consensus that teams must balance AI automation with human judgment, viewing AI as a 'co-pilot'. to achieve the best outcomes.

Discussion

Team Member's Perceptions of AI Integration

The findings suggest that IT professionals meet AI integration with a cautious optimism. The primary positive perception was that AI enhanced efficiency by automating repetitive tasks, freeing human teams for more strategic work. This aligns with other literature highlighting AI's productivity gains (Smith & Johnson, 2023). However, the optimism is tempered by important concerns about overreliance. The finding that "blind trust" breaks team dynamics reinforces the relevance of Adaptive Structuration Theory (AST), as the technology's impact is showing to be dependent on how teams adapt it into their workflows' specifically, whether they retain human critical judgment as a gatekeeper. Moreover, participants warned that uncritically trusting AI outputs could quickly erode critical human skills and break team trust. This finding also supports existing concerns in the literature that AI analytics may obscure the emotional and social cues necessary for team efficacy (Robinson & Garcia, 2023; Rapisarda, 2002).

Main Challenges in Integrating AI

The widespread skills gap (64% insufficient training) and reliance on self-teaching (61%) intersect with human anxieties about job security and role ambiguity. Furthermore, ethical concerns regarding data privacy are prominent. These anxieties underscore the principles of Socio-Technical Systems Theory (STS), which argues that sustainable implementation depends on aligning the technical system with the team's existing needs and culture (Trist, 1981). If the technical system (AI) advances faster than the social system (training and ethics), the team's structural integrity is compromised (Hinds et al., 2019; Schmidt et al., 2020).

AI Tools Used to Enhance Teamwork

The high adoption of Generative AI (66% for ChatGPT) reflects a broader industry trend seen in recent studies (Lee et al., 2022), where AI is integrated into knowledge work to streamline communication. However, this study adds nuance by identifying these tools as 'cognitive amplifiers' that also introduce the risk of automation bias (Parasuraman & Riley, 1997).

The concern regarding transparency and fairness, ethical concern, is also discussed by O'Neil (2016) and Binns (2018), where they suggest that while the tools are effective for tasks, they are viewed with suspicion for judgment-based decisions. This confirms that tool adoption is not just a technical choice but an ethical negotiation within the team.

Positive and Negative Impacts of AI on Teamwork Characteristics

The study confirms a central contradiction inherent in the STS framework. While a majority of participants (76%) reported increased task efficiency, supporting findings from Al-Surmi et al. (2021), a significant portion also noted a decline in informal communication. This trade-off between the technical system (efficiency) and the social system (cohesion) validates literature warning that over-automation can erode empathy and trust (Kirkman et al., 2020; Robinson & Garcia, 2023). The finding that concerns about deskilling and blind reliance were prevalent (Kremer et al., 2021) further emphasizes that the "efficiency" gains of AI are currently being purchased at the cost of the team's long-term resilience.

Influence of AI on Team Dynamics: Roles, Responsibilities, Communication, and Satisfaction

AI appears to be actively reshaping team structures. The significant shift from 'execution to oversight' described by participants aligns with similar findings from Huang et al. (2021) and Smith and Johnson (2023), suggesting that AI is freeing teams for higher-order strategic work. However, this transition also creates ambiguity and anxiety, as seen in other studies (Kremer et al., 2021; Hinds et al., 2019). The observed change in communication patterns, specifically the decline in spontaneous interactions, echoes warnings by Kirkman et al. (2020) about the 'hollowing out' of social connection. Despite this, the finding that 58% of participants reported increased satisfaction suggests that positive outcomes are strongly associated with structured support, reinforcing the core tenets of Adaptive Structuration Theory (DeSanctis & Poole, 1994) and STS (Trist, 1981): satisfaction depends not on the tool itself, but on the organizational structures that support its use.

Synthesis: Patterns, Contradictions, and Implications

Three key themes emerged from the analysis, each reinforcing the AST and STS frameworks. First, the most prominent pattern is AI's role in improving productivity. Teams are pragmatically adopting AI to automate routine work, freeing human members for strategic tasks. Second, a central contradiction lies in the tension seen between efficiency gains and the erosion of human connection. Participants value AI's ability to simplify processes but worry that over-automation is eroding creativity, critical thinking, and team trust. Third, the findings suggest the need for a holistic approach to AI integration, one that addresses the human, ethical, and cultural dimensions of teamwork. As an implication, the findings in this survey do also appear to reinforce the relevance of Adaptive Structuration Theory (DeSanctis & Poole, 1994), Human-AI Collaboration Theory (Huang et al., 2021), and Socio-Technical Systems Theory (Trist, 1981).

Practical Recommendations

The following practical advice is offered to organizations or team workers looking to successfully implement AI into IT their teams:

Invest in Training and Upskilling: Provide consistent and committed training to all of your team members to keep them up to date on how to use AI tools effectively. Structured training should focus not just on prompt engineering, but on AI auditing-teaching staff how to critique AI generation.

Data Governance and Security: Build a strong data strategy covering data collection, storage, access, and compliance with privacy laws and ethical standards. Assign clean responsibility regarding data governance.

Facilitate Collaboration and Knowledge Sharing: Work across silos and engage domain experts early in the AI process. This will help to ensure reasonable and business-oriented solutions.

Ethical and Transparent Use of AI: Infuse the principles of equity, transparency, and fairness into AI governance, and make sure that AI-generated results are being supervised by humans, with feedback loops integrated.

Mandate 'Human-in-the-Loop' Protocols: To combat the finding regarding 'blind trust', organizations must establish governance requiring explicit human review of AI outputs, particularly for client-facing deliverables.

Redefine Junior Roles: With AI handling routine tasks, junior roles must be formally redesigned to focus on shadowing and review (apprenticeship models) to ensure foundational skills are still acquired despite automation.

Limitations

The first of the study's limitations was that the sample was constrained to IT professionals, which may not fully capture the diversity of AI experiences in other workplace sectors. The survey only had 41 respondents captured in the period of one month; representing a small sample, which restricts statistical generalisability. Also, while the open responses were rich and participants were able to provide insights and examples about AI, undertaking interviews could provide deeper insights and two-way opportunities to discussion the topic. Additionally, the rapid pace of AI development means that these findings may quickly become outdated, underscoring the need for ongoing research in this area.

Future Research

Future research could consider the long-term impact of AI in teamwork focusing on team satisfaction, creativity and cohesion over time. It could also include different organisational contexts and people from all around the world to get a bigger range of data for comparation. Future studies need to look at the specific collaborative roles within teamwork, such as Team Leader, the Scrum Master and Team Facilitator to establish the role-specific impact of AI adoption in role-specific teamwork.

Conclusion

This study investigated the transformative role of Artificial Intelligence in IT teamwork, providing empirical insight into how professionals navigate the intersection of algorithmic efficiency and human collaboration. By synthesizing quantitative usage patterns with qualitative lived experiences, the research uncovers a defining duality in the AI era: while AI serves as a powerful 'productivity multiplier'. Automating routine tasks and accelerating data-driven decision-making, AI simultaneously acts as a social disruptor, introducing friction in the form of diminished informal interaction, role ambiguity, and the erosion of critical thinking.

Theoretically, this study validates the utility of Socio-Technical Systems (STS) Theory and Adaptive Structuration Theory (AST) in the context of modern Generative AI. The findings demonstrate that the introduction of AI is not merely a technical upgrade but a structural intervention that forces a renegotiation of team norms. The observed tension between the technical system (speed, accuracy) and the social system (trust, empathy) confirms that efficiency gains cannot be sustained if they come at the expense of the social fabric that binds a team together. Furthermore, the study illustrates AST in action, showing how teams are actively restructuring their roles, shifting from 'doers' of tasks to 'overseers' of AI agents and outputs, to accommodate these new non-human agents in the mix.

Practically, the research challenges the prevailing "efficiency-first" narrative of AI adoption. It suggests that the most successful teams are not those that simply automate the most tasks, but those that implement robust "human-in-the-loop" governance to mitigate the risks of 'blind trust' and automation bias. The study offers actionable guidance for organizations, advocating for a shift from purely technical training to holistic AI literacy that prioritizes critical evaluation, ethical oversight, and the intentional preservation of human connection.

Ultimately, the integration of AI into teamwork represents a paradigm shift from manual execution to strategic oversight. As AI continues to evolve, the competitive advantage will belong to teams that can balance the computational power of algorithms with the irreplaceable depth of human connection, presence and judgment. This study contributes to this evolving discourse by providing a grounded,

sociotechnical perspective on how IT professionals can harness the power of AI without losing the human essence of collaboration.

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Global Knowledge Management Practices in Information Technology: A Multivocal Literature Review

Deepa Veerabhadrachar
Computer Science and MITPM Graduate, Auckland University of Technology

Ramesh Lal
Department of Computer and Information Sciences, AUT Computer and Information Sciences Research Centre, Auckland University of Technology

Abstract

The rapid pace of technological advancement has created a notable readiness gap within organizations. On one side, are experienced professionals who bring invaluable expertise yet often struggle to adapt to emerging technologies; on the other are recent graduates who possess up-to-date technical skills but lack practical organizational knowledge. This imbalance is frequently reflected in cycles of layoffs and new hires triggered by technological transitions. To mitigate this challenge, knowledge management must adopt specialized strategies that support both the upskilling of new entrants and the reskilling of seasoned employees, thereby strengthening project outcomes and sustaining competitiveness in the marketplace. This study examines the frameworks required for effective knowledge capture and dissemination, with attention to both explicit and tacit forms of knowledge. It highlights the critical role of technological tools and the value of diverse learning environments in facilitating the transfer of tacit knowledge, widely recognized as a key source of competitive advantage. Furthermore, the research explores how organizations can refine their knowledge management approaches to improve workforce performance, drawing on contemporary literature at the intersection of technology and knowledge management. The findings underscore the need for organizations to continuously align their knowledge management systems with evolving business objectives and technological innovations, including cloud computing and artificial intelligence. By systematically identifying, assessing, and enhancing knowledge management practices within project management, this research seeks to bridge existing knowledge gaps and ensure that organizations remain agile and responsive to shifting market demands and technological change.

Keywords

Knowledge workers, Knowledge Management, Tacit Knowledge, Explicit Knowledge, Codifiable knowledge, Social Intelligence.

Introduction

Technological trends evolve rapidly, often shifting every decade, and these changes create a significant readiness gap within organizations. Experienced professionals remain valuable assets due to their expertise, yet they may struggle to immediately adapt to modern technologies. Conversely, fresh graduates bring current technical skills but lack organizational process knowledge. This imbalance is frequently reflected in widespread cycles of layoffs and new hires that accompany each major technological transition.

What is knowledge management? According to Hamel (2006), knowledge management is recognized as a critical asset for organizational success across diverse industries, including information technology. It encompasses the systematic accumulation and dissemination of knowledge not only within individual IT projects but also across the broader organizational portfolio. Effective knowledge management begins with mastering discipline-specific skills and extends to capturing and sharing best practices within communities of practice. This process ensures the strategic alignment of the

workforce with organizational objectives, thereby enhancing both adaptability and long-term competitiveness.

In the information technology sector, rapid adoption of emerging technologies is essential both to retain the experienced workforce and to deliver products that meet market demands. Consequently, knowledge management must embrace agile practices to bridge the gap between graduate upskilling and the reskilling of senior professionals, ensuring continuity in project delivery. To achieve this, organizations require a robust platform or framework for knowledge capture, training facilitation, and progress tracking. Such a system should support employees in acquiring relevant skills, monitor the impact of training initiatives, and provide mechanisms for continuous upgrades and adaptation to technological change.

Deloitte (2020) emphasizes that knowledge remains a critical competitive differentiator in driving organizational performance. The convergence of human capability and machine intelligence presents an unprecedented opportunity for knowledge creation in history. Yet, the rise of advanced technologies, evolving work practices, and shifts in workforce composition are challenging traditional approaches to knowledge management. To fully harness these changes, organizations must redefine their strategies for fostering knowledge creation, thereby enabling the maximization of human potential in the workplace (p. 1).

Knowledge is classified into two categories. The first is explicit knowledge, which is straightforward, easily articulated, and codified for transfer through documents, procedures, and instructions. The second is tacit knowledge, which is complex, subjective, and experiential in nature, making it difficult to replicate or transfer. Tacit knowledge is widely regarded as a source of competitive advantage because it is acquired through informal learning derived from personal and professional interactions. Its uniqueness to individuals has made it a central focus of contemporary practice, where observing and learning from experience enriches market understanding and informs the design and release of products that align with user needs.

The diffusion of tacit knowledge requires both formal and informal learning practices, often facilitated through social interactions (Ritchie & Jorgensen, 2007). Informal knowledge management processes rely on supportive infrastructures for assimilation, communication channels, and links to organizational processes. Specific mechanisms such as mentoring, "lunch-and-learn" sessions, orientation programs, and early training initiatives are particularly valuable for new graduates to assimilate corporate practices. Communities of Practice (CoPs) further enable semi-formal and informal exchanges of ideas, though capturing tacit knowledge remains a significant challenge due to its nuanced and context-dependent nature.

While existing studies emphasize the necessity and dimensions of KM practices, they often lack clarity on the processes and possibilities for transforming tacit knowledge into explicit forms. Because tacit knowledge is dynamic and shaped by cultural contexts, the adoption of suitable knowledge capture and management processes varies according to an organization's maturity level and the workforce's awareness of KM requirements.

Literature Review

Evaluating the performance of knowledge management systems involves collecting data through interviews and discussions, and benchmarking against organizational KPIs. Regular performance analysis is essential to ensure that KM systems remain relevant and effective in capturing social behaviour and emerging forms of knowledge. Over time, these systems are expected to mature through continuous evaluation and upgrades, including the integration of IT management processes and advanced technologies such as cloud storage and artificial intelligence (AI). The literature review highlights key insights into the importance and adoption of technology in KM, particularly in response to shifting socio-economic behaviour that influence IT demands.

Seidenfuss and Storm (2022) highlight the importance of knowledge management (KM) in IT projects, emphasizing the need to align KM processes with stakeholder expectations. Their study in southern Australia illustrates how project management methods must be adapted to team culture and regional toolsets to ensure effective outcomes. Similarly, Bitkowska et al. (2022) examine KM integration within Polish organizations, revealing how IT systems can strengthen business processes, improve quality, and respond to market demands.

Wang et al. (2013) propose a structured KM framework for IT service management, designed to address the challenges of heterogeneous and incomplete information. Their model incorporates knowledge acquisition, extraction, and refinement, demonstrated through an analysis of Cisco's VoIP system. Trusson et al. (2014) explore tensions between ICT-based knowledge sharing and actual workplace practices, finding that IT service support staff often prioritize self-reliance and interpersonal skills over prescribed KM processes, exposing a significant awareness gap.

Del Giudice and Della Peruta (2016) show that KM fosters innovation by enabling the accumulation and reuse of structured knowledge, thereby enhancing business performance and supporting new product development. Murnane and Browne (2016a) extend this perspective to IT management education, arguing that professional knowledge is shaped through social interaction and identity formation rather than static transfer, with classroom settings offering valuable opportunities for experiential learning. Heripracoyo et al. (2016b) further demonstrate that KM effectiveness in a telecommunications company depends on the integrated implementation of people, processes, and technology, rather than isolated efforts.

Khuong et al. (2014), inspired by institutional theory, investigate misalignments between KM software design and organizational use in a global IT firm. Their findings underscore the importance of user experience (UX) in bridging expectations and practice, with implications for decision-making processes. Lisanti et al. (2014) focus on SMEs in Indonesia, noting that outdated management practices and limited workforce capacity hinder competitiveness. They argue that KM systems, particularly those supported by SME associations, are essential for modernization and performance improvement.

Gemino et al. (2015) compare plan-based and people-based KM approaches in IT-business projects, concluding that while plan-based methods emphasize documentation alignment, people-based approaches foster shared team knowledge. Both are complementary, though performance validation remains a limitation. Aprirashka et al. (2019) discuss KM in the Indonesian audit institution BPK RI, stressing the need for externalization and socialization processes to strengthen knowledge sharing and infrastructure. Garcia-Gonzalez et al. (2021) present a theoretical model of dynamic capabilities, showing how KM enables organizations to acquire, generate, and combine knowledge to adapt to environmental changes.

Hemmati and Hosseini (2016) examine KM's impact on employee well-being in Sri Lanka, finding that well-designed systems reduce stress and knowledge gaps, though outcomes vary with working conditions. Baradari et al. (2023) integrate IT service management (ITSM) with KM, using fuzzy logic and analytic hierarchy processes to demonstrate how ITSM KPIs influence KM activities. Their proposed joint ITSM-KM model enhances efficiency and effectiveness in digital environments. Finally, Lee et al. (2021) investigate KM's role in enabling business agility in Western firms. They argue that KM supports sensing capabilities, while process integration enables responsive action, together fostering strategic decision-making and competitive advantage in dynamic markets.

Methodology

The Multi-Vocal Literature Review (MLR) is selected as the methodological approach for this study because it extends beyond traditional literature reviews by incorporating peer-reviewed academic sources alongside grey literature, white papers, blogs, and organizational publications. Given the disciplinary focus on modern project management, evidence is drawn from company websites, annual reports, and white papers to support both the theoretical and empirical design of KM system integrations across firms. KM research has emerged as a significant field over the past decade,

particularly within large-scale organizations, as it examines interactions and behaviour through the lens of Grounded Theory.

KM has also become an interdisciplinary area of inquiry, frequently discussed in international conferences such as the IEEE International Conference on Communication Systems and Network Technologies (CSNT), the International Conference on Information and Communication Technology (ICoICT), the Annual International Conference on Enterprise Marketing and Globalization, the Conference on Information Systems and Technologies (CISTI), and the International Conference on Information Management and Technology (ICIMTech). These forums provide case studies and collaborative discussions that influence IT practices worldwide, offering insights into implementation strategies tailored to organizational models and maturity levels. MLR thus enables a holistic exploration of diverse perspectives, maximizing the scope and depth of research within the KM domain.

The MLR approach facilitates extensive engagement with a wide range of databases and journals, including the Journal of Modern Project Management, IEEE Transactions on Services Computing, Knowledge Management Research & Practice, Engineering, Technology & Applied Science Research, Journal of the Association for Information Systems, Irish Journal of Management, Industrial Management & Data Systems, Journal of Knowledge Management, Issues in Information Systems, Information Systems Journal, and the International Journal of Project Management. These sources provide evidence of KM practices across varied organizational contexts, highlighting both established systems and their adaptation to contemporary project management requirements, such as managing global IT workforces.

According to Petter (2023), MLR enables systematic collection, synthesis, and evaluation of diverse research outputs, offering valuable insights into KM, discipline with limited academic coverage in the IT industry. By formulating targeted research questions and applying a structured search and selection protocol, MLR ensures methodological rigor and reproducibility, supporting future investigations in this area.

Moreover, MLR strengthens research quality by incorporating case studies, surveys, and technical reports, enabling the identification of patterns, themes, and research gaps. This approach accommodates qualitative, quantitative, and mixed-method analyses, ensuring comprehensive coverage of KM practices. As technological innovation increasingly outpaces formal academic publication, MLR provides a mechanism to capture broader perspectives from diverse sources.

For this study, reflection from IT professionals was prioritized, with many of the reviewed works employing surveys and interviews as qualitative methods. Building on prior comprehensive reviews, this MLR analysed the top 30 selected articles including the most recent literature review covering KM research published between 2010 and 2024 (see Table 1). The selection spans Asia, Australia, Europe, and the USA, encompassing scientific studies, conference proceedings, and findings across systems engineering, informatics, IT services, innovation, business management, and knowledge management. This ensures a robust and high-quality literature base for the study.

Table 1

Search Criteria

Lookup	Search Criteria	Search Results
KM Books	High level concepts for keyword search	Top 10
KM as general practice		110
KM for IT		70
Year of publication	1995-2000	2 +
	2000-2010	10+
	2010-2024	50+

	2015-2024	30+
Keyword inclusion search specific to KM in IT	Knowledge workers Knowledge Management process/frameworks/models/systems Tacit Knowledge Explicit Knowledge Codifiable knowledge/information Knowledge sharing Social Intelligence/socio-political knowledge Community of Practice Cognitive knowledge Functional knowledge Cultural knowledge Training /shadowing workforce performance	65+
Keyword exclusion search specific to KM in IT	Quality management Human resource management	
Conference articles	Year: 2015-2024	10+
DB Libraries	IEEE ACM Digital Library ResearchGate Sage publications Emerald publications PMI	10+ 14+ 32+ 27+ 49+ 5+
Conference articles	IEEE, ICIMTech, ICoICT, CSNT, CISTI, etc.,	12+
Industry papers	Visiting their website AWS-Infosys, IBM, Deloitte	3
Qualitative research methodology by academic literatures - survey/interview	Infosys, IBM, Deloitte, Accenture, Microsoft, Google, Apple, Hewlett & Packard, Oracle, SAP, Dell, Intel, Teltech, Ernst & Young etc.,	12+
Finally shortlisted literature	Academic papers -30 Profound IT Industrial publications: IBM, Infosys-AWS, Deloitte	33/53

Findings

KM Lifecycle and Tools

According to the findings of Agnes et al. (2023), small and medium-sized enterprises (SMEs) across both IT and non-IT sectors adopt a wide range of knowledge management (KM) and knowledge management systems (KMS) practices. Among these, formal mechanisms such as face-to-face or distance training, meetings and phone calls, shared information sessions, knowledge repositories, and research studies are the most widely utilized techniques. In contrast, informal practices including communities of practice (CoPs), external and internal benchmarking, organizational newsletters, internal newspapers, video conferencing, brainstorming, mentoring, competency and performance assessments, big data management systems, informal conversations, knowledge mapping, teamwork culture, adoption of best practices, peer review, expert systems, lessons learned, coaching, electronic discussion forums, intranet use, telephone directories, creative spaces, staff mobility across teams and

activities, handbooks or manuals, blogs, wikis, and business process management (BPM) systems are comparatively less prevalent.

Karsen (2018) examines the existing knowledge management (KM) practices within an IT consulting company, analysing current challenges, and proposing the design of a KM system to address identified gaps. The study applies the Socialization - Externalization - Combination - Internalization (SECI) model to explain how knowledge is acquired and transformed within the organization. Building on this framework. Several approaches have been identified in the literature that follow the SECI model (Baradari et al., 2023; Karsen, 2018; Sadri et al., 1999; Tingwei et al., 2018), as illustrated in Figure 1.

Figure 1

Processes in KM Lifecycle

Processes in KM Lifecycle
Storage or retention - Transfer or diffusion - Application or use
Creation - Retention - Transfer
Capture- Elaborate- Transfer- Storing- Share
Creation – Accumulation – Sharing – Utilization – Internalization
Creating- Gathering- Organizing- Storing-Diffusing – Using - Exploitation
Identification and capture – Creation - Classification and storage - Circulation and distribution- Application
Creation-Storage- Distribution- Utilization
Creation or acquisition- Storage- Dissemination or transfer- Application
Capturing- Describing-Organizing-Sharing
Creation- Storage- Transfer
Capture- Store- Share-Use
Creation- Internalizations- Acquisition- Refinement- Utilization
Capture- Share-Develop-Use

Svetsky et al. (2019) sought to identify gaps in software support for knowledge workers within knowledge-based organizations, particularly in the transfer and exchange of knowledge. Their study compared existing practices with state-of-the-art KM software, emphasizing the critical role of information systems (IS) in managerial decision-making. By focusing on the extraction of key data from organizational IS, the study proposed advanced KM software designed to process knowledge, information, and data according to the hierarchy of data–information–knowledge–wisdom (DIKW), thereby mirroring the way knowledge workers and individuals naturally conceptualize information.

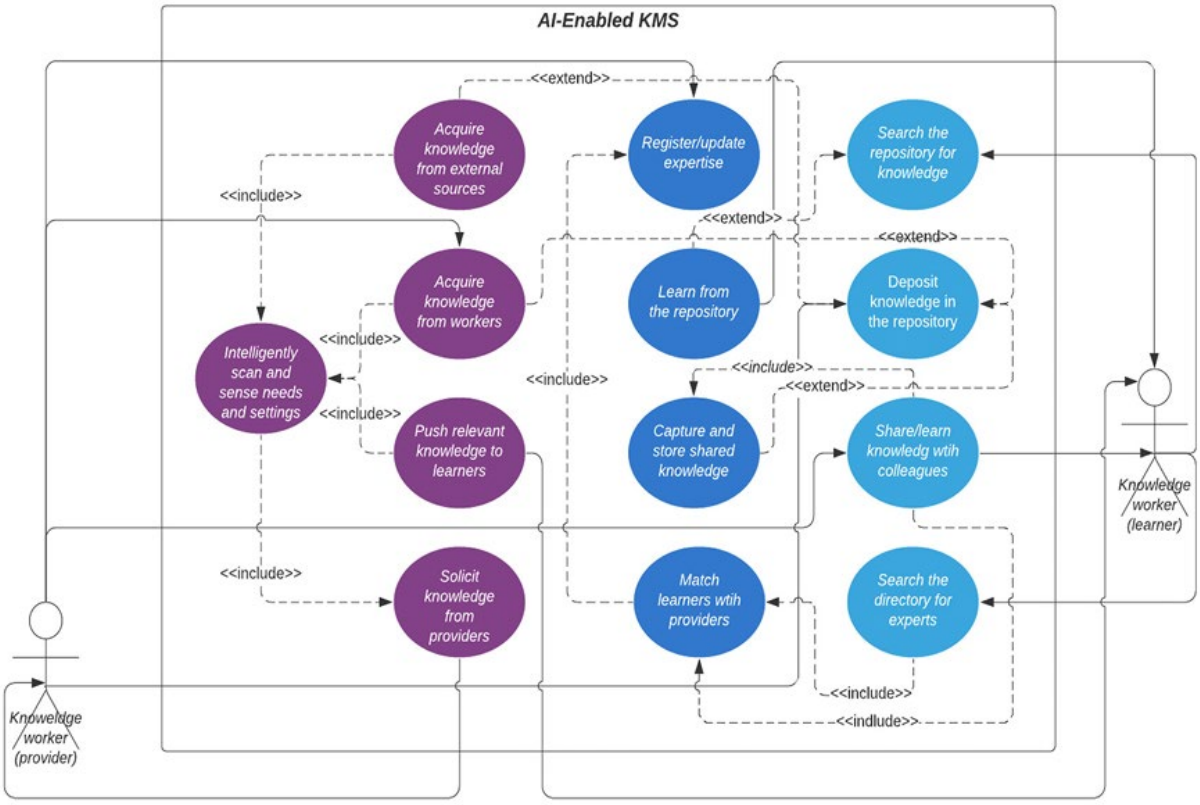
Building on this perspective, Sundaresan and Zhang (2022) investigated the role of artificial intelligence (AI) in facilitating knowledge sharing and organizational learning, while also examining the redesign of AI-enabled roles and processes for knowledge workers. Their study advocates linking KM activities with systems thinking and organizational strategies, categorizing KM into three core activities: knowledge creation and acquisition, knowledge sharing and transfer, and knowledge learning and application. AI functions: learning, understanding, reasoning, and interacting are found promising to enhance prediction capabilities and improve the performance of crowdsourcing platforms.

The study further identifies three primary applications of AI in business: automating processes, generating insights through data analysis, and engaging with customers and employees. Examples include centralized analytics hubs, talent analytics, insight generation from historical data, stakeholder integration, and task simplification. Evidence suggests that AI significantly amplifies KM effectiveness, as human expertise complements machine capabilities through training, explanation, and sustainability, while AI augments human potential by amplifying, interacting, and embodying knowledge processes.

Sundaresan and Zhang (2022) propose a framework to explore AI's role in KM, based on an analysis of 50 leading companies and their AI applications. Using Word Cloud analysis, the study categorizes AI systems, KM activities, and AI-human interactions across four groups of knowledge workers: front-line staff (FLS), client-facing managers (CFM), process-improvement experts (PIE), and top-level managers (TLM). The evaluation of this model (Figure 2) demonstrates that tailored AI systems can support knowledge workers in their distinct roles and processes, depending on the intensity of their knowledge requirements. Ultimately, the study provides managerial insights into how AI can be strategically adopted for effective organizational asset management.

Figure 2

AI Enabled KMS



Accenture, Cap Gemini, Ernst and Young, Deloitte and Touché have found KM IT as responsive & as their intellectual capital (Chugh & Bhadoria, 2021). Summary of IT tools for KM for knowledge creation, storage & retrieval, collaboration is in Table 2.

Table 2
IT Tools for KM

KM Tools	Employed	In Plan	Not in Plan
Company Intranet	89	11	0
Data Mining and Knowledge Tools	34	21	45
Document Management Systems	70	30	0
Groupware	24	54	22
Data Repositories	9	62	29
AI/ BI	4	18	78
Extranet	22	35	43
Teleconferencing/Videoconferencing	27	18	55
Workflow Management	0	10	90
Company blogs	53.25	4	
Cloud computing	52.31	5	
Grid computing	20.78	8	

Jamal and Narumon (2019) highlight the difficulties associated with managing tacit knowledge and propose categorizing it into distinct knowledge types as a means of facilitating effective externalization and measurement. Their study emphasizes the value of tools and transformation mechanisms that enable organizations to utilize tacit knowledge effectively. Such practices are considered essential for building core competencies and fostering value co-creation through both formal and informal learning. Among these mechanisms, communities of practice (CoPs) emerge as a particularly significant approach, consistently identified across multiple studies as a cornerstone of modern KM practice (Agnes et al., 2023; Aprirashka et al., 2019; Jamal & Narumon, 2019; Jarrahi et al., 2021; Rostamy et al., 2015; Sadri et al., 1999; Sundaresan & Zhang, 2022).

KM Critical Success Factors (KM - CSFs)

Aratthanage and Wijekoon (2023) evaluated the impact of organizational knowledge management systems (KMS) on the psychological well-being of employees in large-scale private IT organizations in Sri Lanka. Their study found that insufficient knowledge contributes to frustration in professional life, highlighting the need to address knowledge gaps within the IT sector. The implementation and effective use of KMS functionalities were shown to help stabilize employee's mental health conditions, thereby offering professional benefits. The study further emphasizes that the quality of KMS is critical: poorly designed systems can create inconsistency and confusion, whereas high-quality systems support organizational goals and business objectives. From a business perspective, maintaining a robust KMS establishes a sustainable mechanism for the efficient creation, storage, retrieval, and distribution of knowledge. Findings also suggest that key KMS quality parameters are linked to psychological well-being, though the relationship is nonlinear. Moreover, these parameters are associated with both software quality dimensions and employees' psychological characteristics.

Rostamy et al. (2015) emphasize that Critical Success Factors (CSFs) are essential for business growth and for achieving managerial objectives. Their study highlights that CSFs are fundamental to the success of knowledge management (KM), as they ensure organizational competitiveness through the integration of human, structural, and technological dimensions. Tingwei et al. (2018) provide a comprehensive theoretical review of KM, analysing key domains such as KM processes, knowledge sharing, and performance measurement techniques.

In a similar vein, Agnes et al. (2023) investigate the adoption approaches and CSFs for implementing KM and knowledge management systems (KMS) within small and medium-sized enterprises (SMEs).

Their findings reveal that the five most utilized tools in SMEs are training, meetings, knowledge-sharing sessions, repositories, and research activities. The study further identifies critical success factors for KM/KMS adoption (see Table 3), including organizational culture, the quality of knowledge, effective communication across organizational units, and teamwork. Additionally, the authors propose that employee experience and competencies should be considered as supplementary CSFs. Collectively, these factors contribute to the development and strengthening of intellectual capital, thereby enhancing organizational competitiveness.

Table 1

KM/KMS CSFs

Entity	Factors
Organizational	Top management commitment to support KM adoption, Organization structure and flexibility, Organization culture towards KM adoption, best practices, and benchmarking towards another organization for KM adoption
Strategy	Planning strategic of KM, General definition of knowledge within the organization, Change management strategy after KM adoption
Resource	Cost Factors for KM adoption which includes the availability of human resources (Teams that will implement the process of KM Adoption, the availability of infrastructure resources that will be needed for KM Adoption), the quality of the knowledge
People	Communication within and across all the business units in the organization, Team works within and across the areas in the organization, Resistance towards change (KM Adoption in the organization), Employee experience, Employee competency

Case Studies: Deloitte, Indian IT Industry, IBM, and Infosys

The following four case studies collectively illustrate the evolving landscape of knowledge management (KM) across diverse organizational contexts, highlighting both challenges and innovative practices (Deloitte, 2020; Chugh & Bhadoria, 2021; IBM; AWS, 2023). Deloitte's global survey reveals a significant readiness gap, with most organizations recognizing the importance of knowledge creation yet lacking the workforce preparedness, incentives, and infrastructure to act on it. This underscores the need for KM to be reframed as a driver of innovation and organizational resilience rather than a narrow process of information dissemination. The Indian IT industry demonstrates how technology serves as a critical enabler of KM, particularly in software development, where tools such as document management systems, expert networks, and cloud computing enhance knowledge capture, storage, and contextualization. However, the findings emphasize that technological infrastructure alone is insufficient; KM success requires balancing organizational culture, behavioural practices, and IT capabilities. IBM's approach reinforces this integration by embedding learning into organizational culture, rewarding knowledge sharing, and fostering communities of practice. Through its AI-powered Watson platform, IBM showcases how advanced KM systems can streamline onboarding, improve access to critical information, and enhance customer self-service, thereby reducing costs and increasing efficiency. Infosys extends this trajectory by leveraging AWS infrastructure to support enterprise-wide agile adoption and value co-creation. Its platforms - Wingspan, living labs, and digital innovation centres demonstrate how hybrid learning, automation, and experimental ecosystems can address workforce skill gaps, foster collaboration, and accelerate innovation. Taken together, these cases suggest that successful KM requires a holistic alignment of technology, organizational culture, and workforce development, with AI and cloud-enabled platforms acting as accelerators of collaboration, agility, and sustained competitive advantage.

Discussion

The case studies from Deloitte, the Indian IT industry, IBM, and Infosys collectively illustrate the evolving role of knowledge management (KM) across diverse organizational contexts. Deloitte's global survey highlights a significant readiness gap, with most organizations acknowledging the importance of knowledge creation yet lacking the workforce preparedness, incentives, and infrastructure to act on it. The Indian IT industry demonstrates how technology enables KM processes in software development, though success depends on balancing IT tools with organizational culture and behavioural practices. IBM reinforces this integration by embedding learning into organizational culture, rewarding knowledge sharing, and leveraging AI-powered platforms such as Watson to streamline onboarding, improve access to critical information, and enhance customer self-service. Infosys extends this trajectory by utilizing AWS infrastructure to support enterprise-wide agile adoption and value co-creation, highlighting how hybrid learning platforms, living labs, and innovation centres can address workforce skill gaps and accelerate collaboration. Together, these cases emphasize that KM must evolve beyond information dissemination to become a driver of innovation, agility, and organizational resilience.

The research further indicates that KM objectives differ across organizations, reflecting unique strategic priorities. However, findings do not conclusively demonstrate whether a standardized KM framework could resolve workforce readiness gaps. Instead, multiple theoretical models have emerged, identifying key factors driving KM/KMS and their correlation with organizational performance. These insights suggest the potential for unifying KM practices into a technology-supported framework that leverages human-AI collaboration. Emerging technologies, particularly AI and data analytics, have transformed KM from static repositories into dynamic systems capable of co-creation, contextualization, and predictive insights. By integrating infrastructure, culture, and incentives, AI-powered platforms enable organizations to identify skill gaps, personalize training, and automate performance measurement, thereby reducing managerial burden and enhancing workforce readiness.

Despite these advances, the findings highlight a critical gap in KM governance. According to PMI, effective governance is essential for IT projects to monitor, reform, and reinforce systems for budgeting and efficacy. Yet, there is limited evidence of governance strategies tailored to KM, particularly in the context of automation and AI. This raises questions about how KM/KMS performance can be measured against new critical success factors (CSFs), such as evolving technology demands, rapid market dynamics, and complex KM ecosystems. Nakash and Bouhnik (2022) emphasize the disconnect between academic research and industry practice, warning that KM risks being perceived as obsolete unless revitalized through strategic alignment. A dedicated governance model is therefore needed to ensure accountability, adaptability, and profitability. Such a model would involve expert facilitators overseeing KM programs, verifying system upgrades, balancing personalized and mandatory training, and integrating AI-driven processes to enhance efficiency and performance measurement.

Finally, the role of leadership and specialized coaching emerges as a cornerstone of effective KM. Organizations increasingly expect advanced skills such as innovation, critical thinking, collaboration, and emotional intelligence alongside technological expertise. Training and continuous learning are thus central to KM, but they require navigators, mentors or coaches to guide employees strategically and ensure alignment with organizational objectives. This mentoring dynamic reflects spatial cognition, where leaders observe internal and external environments and localize actions to situational demands (Gillett & Richard, 2019). As KM enters a new era, AI and machine learning are beginning to function as navigators in large IT organizations, complementing human leadership. The integration of coaching with AI-driven guidance ensures that workforce development remains adaptive, strategically aligned, and resilient, enabling organizations to sustain innovation and competitive advantage in rapidly changing environments.

Conclusion

The discussion across multiple sources in the IT domain emphasizes that knowledge management (KM) practices must be aligned with organizational strategy and industry-specific requirements to enable value co-creation and competitiveness. Knowledge workers play a central role in this process, with their capabilities elevated to desired maturity levels through varied practices. The findings demonstrate that people-based KM, when complemented by plan-based KM, ensures organizational success. Critical success factors (CSFs) for KM performance measurement and key challenges identified in theoretical models and case studies further reveal that KM adoption remains limited, often confined to top IT leaders, thereby contributing to organizational struggles in achieving success.

This multi-vocal literature review (MLR) thoroughly investigated the necessity of KM practices, existing frameworks, and KM dimensions through varied models, assessing their suitability and challenges from an organizational perspective. The findings indicate that KM/KMS often receive limited attention or are absent in many organizations, resulting in missed opportunities and benefits. Hypothetical models must be brought to light to help organizations understand the importance of KM and its key driving factors, thereby encouraging adoption for organizational advantage. The predominance of journal articles from the management stream also reinforces the strong link between KM and business process management.

Additionally, this research highlights the need for further investigation through qualitative approaches such as surveys and feedback from well-established organizations practicing agile methodologies. Such inquiry could uncover advanced KM practices with potential applicability for SMEs, depending on their maturity and budget. KM has consistently been identified as an essential pillar for enhancing competitiveness and market potential, particularly through the contributions of a skilled workforce. Employees must not only remain current with techno-functional and business skills to achieve agility but also demonstrate readiness to adopt emerging technologies such as AI for coding and customer service, or digital twins for accelerating IT training, business planning, and product delivery.

The proposed integration of advanced technologies into existing KM frameworks requires further research to address design complexities and evaluate performance outcomes. By embracing AI, data analytics, and other hi-tech infrastructures, organizations can strengthen decision-making, improve performance measurement, and close knowledge gaps. Ultimately, KM must evolve into adaptive, technology-enabled frameworks that unify organizational processes, empower knowledge workers, and sustain competitiveness in rapidly changing markets.

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The Effect of Digital Literacy on Digital Government Adoption in Developing Countries: A Systematic Literature Review

Alvin Dave Carmelo Joson
Project Management Research Office, AUT Computer and Information Sciences Research Centre, Auckland University of Technology

Stephen J. Thorpe[1]
Project Management Research Office, AUT Computer and Information Sciences Research Centre, Auckland University of Technology

Abstract

Despite significant investments in their digital government or eGovernment projects, developing countries continue to face low adoption rates of their digital public services. The study in this report explores the impact of digital literacy on the adoption of digital government platforms. Using a Systematic Literature review guided by Kitchenham and Charters protocol and thematic analysis using Braun and Clarke's framework, the findings show digital literacy's central role in successful eGovernment. Not only does digital literacy influence citizens' trust, but it also contributes to long-term engagement of citizens with eGovernment systems. Socio-economic factors also come into play. Income, education and location influence how prepared citizens are to use digital government services. The study provided insights on how IT project managers can enhance adoption by influencing project rollout and offering support to the most disaffected groups. The practical guidance suggests activities and considerations for IT project based on our findings and ground them in PMBOK framework developed by the Project Management Institute. It emphasizes the importance of stakeholder management throughout the different phases of the project especially when trying to address eGovernment outcomes in developing countries by promoting digital inclusivity.

Keywords

eGovernment, Digital Government, IT Project Management, Digital Literacy, Developing Countries

Introduction

With the networking technological breakthroughs of the 21st century, governments worldwide have increasingly delivered to bring public services to their citizens via eGovernment (Cahlikova, 2021). eGovernment initiatives can reduce costs, promote efficiency, engage citizens and aim to increase transparency and raise trust in the government. Cahlikova (2021) defined eGovernment in two specific ways. First is eGovernment which acts as an electronic public service delivery. It refers to the digitization of government services which allows citizens to access administrative functions online. It focuses on efficiency, accessibility and public service automation. The other component is eGovernment as an electronic practice of Democracy which involves enhancing citizen participation such as consultations, engagement platforms and electronic voting through digital tools. The main role of the said component is to strengthen democratic processes with available technology (Cahlikova, 2021).

Despite heavily investing in digital platforms to provide public services with more efficiency, transparency and equitable access, governments of developing countries still have low adoption rates in their eGovernment initiatives. Moreover, the United Nations E-Government Development Index or EGDI, shows a significant gap between developed and developing countries. This gap distinction not only applies to infrastructure but with actual digital government services usage (United Nations Department For Economic and Social Affairs, 2024). Most citizens are still relying on traditional, in-

person stations despite digital alternatives are available. Due to this behaviour, the success of the digital transformation strategies in the public service delivery is scrutinized as significant investments were made by the government (Al Hujran et al., 2013).

One possible cause of low user adoption of eGovernment is due to effects of digital literacy. A consequence of low digital literacy is the possible uncertainty of navigation in these online platforms which made would-be users less likely to engage with e-government services. This appears to be prevalent to communities where there is limited access to technology and education systems are not on par with the development of digital skills (Madaki et al., 2024). Citizens avoiding these eGovernment services can lead to underused websites, wasted public funds, missed chances for more efficient public services and a widening gap between government offerings and what their citizens use. Not being able to identify the causes that influence adoption and the effect of digital literacy risks the government doing initiatives that only look good in paper but somewhat useless in practice.

The stakes are high for the IT project managers working on such projects. Given the job is responsible for managing the project's scope, design and implementation, project managers can directly affect whether the citizens use the services. However, in most developing countries, there is obvious lack of guidance on what affects adoption rates and how to design systems based on their specific needs. According to Frost and Lal (2019), failures of eGovernment projects are usually caused by system design and stakeholder expectations misalignment. Therefore, the study presented in this paper aimed to guide how project managers can drive adoption through digital literacy and offer insights what else can they influence for a more successful eGovernment initiative.

The effect of digital literacy on lower user adoption and IT project managers' lack of guidance in eGovernment rollouts are knowledge gaps we want to address in this study.

Research Gaps

In the study, we focused on two major gaps in the research of digital literacy in developing nations.

1. Digital literacy's influence on eGovernment in developing countries specifically is underexplored and findings are fragmented.
2. Limited research exists on how IT project managers can influence digital literacy and adoption during project rollout.

Background

Digital Literacy

Tomaszewicz (2015) defined Digital literacy as "the basic and essential communication skills which include the skill to use and manage the tools and services of information society" (p. 47). It means the ability to use online services like emails, browse websites and navigate mobile applications.

Developing Countries

The study has used the OECD's framework, which is a practical method to define 'developing countries'. It identifies developing countries based on their qualification for Official Development Assistance (ODA) which is using the Gross National Income per capita measurement – consistent with World Bank classifications. The list includes Least Developed Countries (LDCs), low-income countries, and middle-income countries (OECD, 2024).

Evolution of E-Government Adoption and the Role of Digital Literacy

Over recent decades, eGovernment adoption research in the literature has changed focus from the technology used, to exploring the ways digital government services are being used. Studies focused on how users perceive usefulness and ease of use of systems which relies theoretically on the Technology Acceptance Model (TAM) (Shareef et al., 2011). People observed that technology access

was hardly enough as more services were being done online. Besides technology access, users also needed the digital skills to navigate government websites, understand online instructions and fill out forms. This shift led to new studies that explored how digital literacy impacts trust, ease of use, and overall willingness to use eGovernment services (Rana & Dwivedi, 2015)

Today, long-term engagement of users is considered one of the biggest factors for success (Indama, 2023). Researchers found out that people were more likely to trust and use eGovernment if citizens were more digitally literate and authors called for governments to invest in digital inclusivity initiatives to positively affect adoption (AbdulKareem & Oladimeji, 2024).

Limitations of Current Studies

These learnings, however, are not fully fleshed out in the context of developing countries. There is a strong call for further studies on the challenges of eGovernment in these countries (Thorpe & Pokhrel, 2024). In addition to the lack of studies, the authors also note the quality of existing research is uneven thus creating a knowledge gap on how governments can implement their eGovernment initiatives effectively. Understanding eGovernment can be implemented in developing countries can identify priority areas and distinctive gaps during project rollout. Most studies also do single-country context, which makes insights towards digital literacy and eGovernment adoption limited in generalizability. There are also limitations in our understanding of how socio-economic disparities like income, education and geographic isolation influence digital literacy levels and the ability to access and benefit from the digital government services.

With respect to eGovernment adoption, IT Project Managers also lack guidelines and best practices that they can use for IT rollouts. Several studies focus on user behavior or factors at the policy-level but offer limited support on project design, training and focus areas where Project managers may be able to influence or bridge digital skill gaps and drive adoption (Abdulnabi, 2024; Apleni & Smuts, 2020). The lack of actionable suggestions makes it challenging for eGovernment project implementations to be worth the considerable investments in developing countries.

These gaps show that it is the right time to connect digital literacy with project management practice, especially for eGovernment projects in developing countries. As more public services move online, success depends not only on having the right technology but also on helping citizens use it. Project managers play a key role during rollout, and without clear guidance, these efforts may not reach the people who need them most.

Methodology

The study employed a Systematic Literature Review (SLR) to research the effect of Digital Literacy on Digital Government Adoption in Developing Countries. The SLR methodology follows a clear protocol that ensures transparency, consistency and reduces bias in how the studies are selected, analysed, reviewed and interpreted (Kitchenham & Charters, 2007).

The approach breaks the review process down into three main stages: planning, execution and reporting. During the planning stage, review questions or research questions were formulated and criteria for inclusion and exclusion of studies were specified. After that, during the review stage, the search strategy and steps defined during the planning stage were executed – studies were searched and screened using the inclusion and exclusion criteria. The final stage involved coding and thematic analysis of the findings (Braun & Clarke, 2006). Findings were synthesized into themes, and the report and conclusion were written in a way that other researchers would be able to follow and repeat (Kitchenham et al., 2009; Wohlin et al., 2012).

Research Questions

The following questions guided the present study to address the research gaps above.

- **RQ1**: In what ways can IT project managers influence digital literacy to increase the adoption of eGovernment services when managing the project?
- **RQ2**: What is the impact of digital literacy on developing nations' eGovernment systems?
- **RQ3**: Do socio-economic levels affect digital literacy and its impact on developing nations' eGovernment adoption?
- **RQ4**: What are the key barriers preventing citizens with low digital literacy from fully utilizing eGovernment services?
- **RQ5**: What are the other factors that affect eGovernment adoption?

Study Selection

To select the studies included in the review, we used principles and guidelines from Kitchenham and Charters (2007. The study selection began with a pilot search to identify suitable databases to use and then refined the initial search string. In addition to access to publications being a crucial factor, we chose the databases based on how the pilot search fared by looking at the studies in the list of results. Scopus, Science Direct, Springer Link, IEEE and ACM databases were used in this study.

Given the research questions, the search strings were refined and finalized after five iterations, with improving the relevance and reducing the results being the main goal for refinement. Refining the search strings, decreasing the date range and applying document type filters helped decrease the results in the selected databases.

A customized data extraction form was created as the basis of the data extraction phase. Upon testing the data collection process on 5 pilot studies, we deemed it appropriate to use and subsequently applied it for further quality assessment. According to Kitchenham and Charters (2007), this step is necessary to assess the validity and the rigor of the studies. We started of with 1910 from our initial search using the selected databases and then 1182 after search refinement (see Table 1). After applying our inclusion criteria, we were able to up with 43 studies then upon further quality assessment criteria we ended up with 33 studies. However, due to time constraints we used the top 20 out of the 33 studies. These steps are summarized in Figure 1.

Table 1

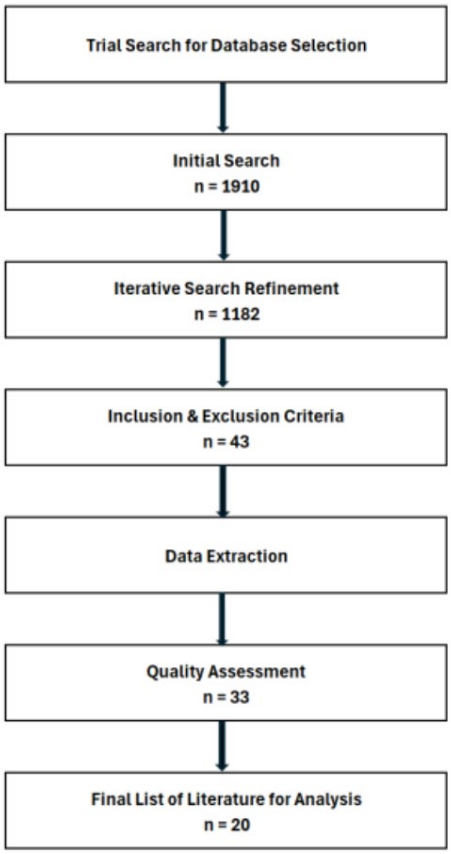
Search String Refinement Results

Iteration	Search String	Date Range	ACM	IEEE	Science Direct	Scopus	Springer Link	Total
1	("Digital Literacy" OR "Digital proficiency" OR "Computer Literacy") AND ("eGovernment" OR "e-Government" OR "Digital Government")	2015- present	288	47	469	134	972	1910
2	("Digital Literacy" OR "Digital proficiency" OR "Computer Literacy") AND ("eGovernment" OR "e-Government" OR "Digital Government") AND ("adoption" OR "usage" OR "use")	2015- present	296	43	419	87	945	1790
3	("Digital Literacy") AND ("eGovernment" OR "e-Government" OR "Digital Government")	2020-present	218	32	366	92	695	1403
4	("Digital Literacy") AND ("eGovernment" OR "e-Government" OR "Digital Government") AND ("adoption" OR "usage" OR "use")	2020-present	217	17	325	61	691	1311
5	("Impact" OR "Effect") AND ("Digital Literacy") AND ("eGovernment" OR "e-Government" OR "Digital Government") AND ("adoption" OR "usage" OR "use")	2020-present	196	5	318	31	632	1182

Note. This table shows a summary of the results of the iterative process of refinement of search strings to improve the relevance and completeness of source literature used for further analysis.

Figure 1

Kitchenham & Charters Protocol & Results Summary



Data Synthesis

This study followed Braun & Clarke's (2006) six-phase thematic analysis to organize and interpret data: familiarizing with the data, generating codes, searching for themes, reviewing themes, defining and naming themes, and writing the final results. Although originally meant for qualitative data, the method has been popularly adapted to include academic and secondary sources. During familiarization, key points from the literature were read and noted. Coding was guided by the research questions and included notes to explain decisions and maintain clarity. Similar codes were grouped into subthemes and then broader themes, which were refined to ensure relevance. This structured approach helped answer the research questions clearly and allowed for transparent documentation. While we considered doing inter-rater reliability, which refers to checking agreement between different reviewers to ensure consistency, we did not apply it here. This is because the coding was done by a single author, making formal inter-rater testing not possible.

Findings

Several major themes and subthemes emerged from the thematic analysis conducted using Braun and Clarke's thematic analysis. Themes related to how the overall impact of digital literacy affects eGovernment adoption in developing countries. Themes were derived from patterns within the codes and notes written down based on the literature. Upon presenting the themes, the study discussed the agreements and disagreements within the scope of the thematic analysis.

Digital Literacy as a Key Enabler of eGovernment Adoption

This theme highlighted the importance of digital skills among users of eGovernment services and their adoption. Citizens with higher digital literacy skills equip users with the confidence and ability to navigate online services, understand the benefits and trust the information on these services. On the other hand, low digital literacy becomes a fundamental barrier that weakens adoption. The difference between digital literacy as an enabler and lack of literacy as an obstacle is further elaborated in these two subthemes.

Digital Skills Enable Citizen Use and Confidence

Citizens were found to be more likely to successfully use eGovernment platforms if they had related digital skills and knowledge. Higher digital literacy was found to promote user confidence, positive attitude and perceived utility of these services. These attributes translate to increased adoption and long-term use. As Nookhao & Kiattisin (2023) noted, "Computer self-efficacy has an influence on behavioral intention because citizens who are confident in their computer self-efficacy will show positive behavior; they are willing to use and will attempt to successfully use e-government" (p. 16). Skilled users can navigate government websites smoothly and are better at identifying high-quality information, which increases the benefits they gain from eGovernment.

Low Digital Literacy as a Barrier to Adoption

On the other side of digital literacy comes the insufficiency was seen as a factor that prevents citizens from fully utilizing eGovernment services. The elderly, less educated and other disadvantaged groups, who have low digital literacy levels, were found to have poor adoption rates – simply avoiding these eGovernment services. Badly designed user interfaces further exacerbate these issues, becoming a frustration for this demographic with already limited digital skills. In effect, a digital divide emerges since those who lack skills, which usually overlap with low education or income, are left behind. In addition to the said impact, it also breeds fears related to cybersecurity, which translates to low confidence. These findings address RQ4, which asks about barriers facing low digital literacy users.

Socio-Economic and Demographic Disparities (Digital Divide)

This theme discussed how socio-economic status and demographic factors create a digital divide in eGovernment adoption, which is linked to RQ3. It was determined that age, education level, income, gender and location affect a person's digital literacy and access, consequently influencing their likelihood of using eGovernment services. The subthemes explained the differences observed: education, gender, marginalized groups, economic and geographic gaps.

Age and Education Gaps in eGovernment Use

The correlation between eGovernment service use and users' age and education level is known to be high (Cordero et al., 2025). As one study explained, "Younger, tech-savvy users reported higher engagement and positive experiences, while older users or those less experienced with digital platforms may face barriers" (Cordero et al., 2025, p. 8), stressing the likely digital divide or digital readiness between the youth and the elderly. Older adults often have lower digital literacy, making them less likely to adopt government services. Education also has a similar effect. Studies noted that higher educational attainment means increased chance of usage since education is a strong predictor of better digital skills and awareness. Nkanata's argument (2024), "e-government potential cannot be fully actualized if part of the population has low education level specially in the developing countries since eGovernment requires digital literacy" (p. 14), supports findings by multiple studies that low-education population struggle to use eGovernment services. The divide observed in these studies means that eGovernment initiatives must make extra effort and provide gap-reducing measures to serve the less-educated and older segments of the population.

Gender and Other Marginalized Groups

There are gender disparities and challenges faced by marginalized groups in the context of eGovernment adoption. Women and men may have contrasting levels of access and digital skills. Gender is one of the many demographic factors, such as age, income, and education, that influence individual use of eGovernment services (Wongmith, 2025). For example, the study found out that social norms and lower education levels for women in some developing countries are considered gender-related constraints that hinder their eGovernment usage. People with disabilities, rural minorities and very low-income groups face layers upon layers of barriers, so services that fail to consider their situation may unfortunately bar them from adoption. Algorithmic biases are also found as risks to embracing these services. Fortunately, subsidized programs aimed directly at women and these marginalized groups can help alleviate these barriers (Djatmiko et al., 2025).

Economic and Geographic Disparities

Technology cost and geographic location were cited frequently as factors influencing eGovernment adoption. Rural residents in developing countries have a meaningful decrease in ease of access to the available digital government services, with Wongmith (2025) noting that "Living outside municipal areas decreased likelihood of eGovernment utilization" (p. 14). The findings reveal that the urban-rural divide is impacted by undeveloped infrastructure and connectivity in remote areas and amplified by lower digital literacy skills. Financial situation matters as well. Since poor citizens are often not able to afford devices or data plans, eServices accessibility suffers as a result. Low-income workers may be excluded due to internet costs and the affordability of devices. It would have served as their access point to the eGovernment benefits. On the other hand, there's an important context in our findings as a couple of studies found in a certain context, basic access had become widespread enough for "income and mobile expense do not exhibit a strong impact on the utilization" (Wongmith, 2025, p. 14).

Barriers to eGovernment Adoption Among the Digitally Disadvantaged

While digital literacy factors have been described as an enabler for adoption, other studies also found that the lack of digital literacy acts as a barrier to hinder eGovernment uptake. This theme directly addresses RQ4, which is the opposite of the enablers previously discussed. These impediments, shown by the literature, are classified as technical, social, or institutional. Understanding these barriers is crucial so project managers and policymakers can work within their sphere of influence and adjust their eGovernment initiatives.

Technical and Infrastructure Barriers

One of the primary barriers to eGovernment adoption is insufficient tech infrastructure and similar issues. Technical barriers like limited internet connectivity, especially in rural areas, unstable connections and citizens' lack of access to devices are deep-seated problems that the majority of developing nations face, as Djatmiko et al. (2025) found:

> Digital inclusion in e-government is heavily influenced by technical constraints, particularly in internet accessibility, device affordability, platform usability, cybersecurity risks, and infrastructure disparities. Studies indicate that rural and marginalized communities often experience a lack of broadband infrastructure, making it difficult for them to access online public services. (p. 10)

Usability problems are also a crux of eGovernment platforms. These badly designed interfaces or navigation complexity contribute to factors that discourage users, especially those with lower technology exposure. In addition to interface design issues, frequent security lapses can also be a technical barrier, as they affect user confidence. As Abdulkareem and Mohd Ramli (2021) found, "Device breakdowns and downtimes weaken the quality of the system and service expectations." (p. 13). These technical problems have a greater impact on those with lower digital literacy and income because of their inadequate skills to overcome this, which widens the digital divide.

Institutional and Policy Barriers and Organizational Resistance

The literature also suggests that existing institutional barriers within governments and policies slow down or even stop eGovernment adoption. Multiple instances where public sector organizations and employees themselves resist change were noted. Bureaucratic resistance, fear of change, and clinging to old processes are major impediments, as shown by several studies. "It identifies administrative resistance to change as the major barrier to e-governance reform implementation, thereby providing organizational and managerial directions" (Inakefe et al., 2023, p. 17). For example, the reluctance of civil servants to use and understand new eGovernment systems, or their fear that their jobs will become obsolete can result in substandard rollout of these services, thus providing poor support for citizens. The internal resistance usually leads to subpar service delivery, insufficient training within agencies, which consequently affects citizens' adoption. An example of this is front-line staff inadequately assisting or encouraging potential users.

Siloed systems across different departments make eGovernment services extremely inconvenient to use and trust. This is a sign of a lack of coordination and collaborative policy frameworks. Developing countries lack a high-level, multi-departmental framework or strategy to guide their digital government initiatives, or else they won't scale well, nor will it properly integrate. Resource issues are also noted, and the lack of ICT initiatives and training hinders long-term success (Inakefe et al., 2023). Corruption was well noted by Inakefe (2023) as well, noting that it sabotages eGovernment reforms by misusing funds or pushing back against transparency. These internal factors create a situation where it becomes a barrier for citizens in using eGovernment. Overcoming them requires strong leadership, appropriate policies, change management, integration training and anti-corruption measures.

Strategies and Interventions to Enhance Adoption and Digital Literacy

This theme focused on strategies, recommendations, and best practices in the studies, so IT Project Managers can improve project outcomes by increasing digital literacy and e-government adoption. With RQ1 in mind, the subthemes provide general insights for stakeholders and policymakers interested in higher eGovernment use. These are basically solutions that address the barriers and take advantage of what was discussed in earlier themes. It is interesting to point out that similar recommendations were given by multiple studies, suggesting agreement on certain interventions.

Digital Literacy Training and Education Programs

The most proposed strategy is to conduct a sweeping digital literacy and skills training for citizens. Studies suggest that governments should invest in public education to raise the digital competency of the population. Chuah et al. (2024) confirmed:

To stimulate higher acceptance and utilization of government digital services for sustainable health risk communication and management, the government must raise the public's level of digital literacy and proficiency. By offering training programs and demonstrations, the government may also need to think about making investments in education about digital and technological skill levels (p. 5).

Initiatives include adding specific subjects to the school curriculum to improve digital literacy and organizing community-based workshops and adult ICT courses that target seniors, rural residents and other marginalized groups (Méndez-Rivera et al., 2023). Continuous learning was emphasized by Inakefe et al. (2023. This is to keep pace with technology changes and slowly build confidence in users. These programs may leverage public-private partnerships, NGOs, or local organizations to reach into communities, especially those outside urban areas. Building digital knowledge for citizens is vital for the overall impact of eGovernment, especially for the marginalized communities.

User-Centric Design and Accessibility Improvements

Another important consideration that IT project managers need to address is the design of eGovernment services with end-users' needs and abilities in mind – improving system accessibility, intuitiveness and ease of use. Projects that adopt a citizen-centric design principle are essential to

align with users' capabilities and expectations. Design improvements may involve the following: simplifying language or avoiding technical jargon, using clear layouts, and ensuring interfaces are easy to navigate even for users who may be digitally literacy challenged (Wongmith, 2025). Peeters et al. (2025) suggested that "the idea of 'data intermediaries' or frontline workers who broker the relationship between the digital state and vulnerable citizens, is an example of the way government organizations can identify and accommodate to these concerns" (p. 8). This is why including multi-channel support, such as assisted kiosks or help centres, is of immense help to less tech-savvy citizens to get guidance. With the same principle, the same author noted that access to human agents helps prevent exclusion of vulnerable users, as it helps complement online government services with human support. Mobile-friendly design is another suggestion. Mobile devices are prevalent and have less upfront cost (Méndez-Rivera et al., 2023). Having lightweight apps and responsive websites designed for mobile widens access.

Multi-Stakeholder Partnerships and Inclusive Governance

As pointed out in a number of studies, collaboration beyond just the government and IT consultants is a requirement for successful eGovernment projects. There is a need to engage multiple stakeholders – the private sector, civil society and different government agencies to support digital literacy that improves adoption. Public-private partnerships can provide resources and complement the literacy training efforts. Given that Abdulkareem and Oladimeji (2024) have stated that "partnerships with civil society organizations leveraging their community reach can aid grassroots digital literacy efforts" (p. 282), partnering with NGOs and community organizations can only help extend the reach of training programs. They may also act as intermediaries that may also serve as mentors and digital access points. Involving these groups provides representation to those communities and provides a voice during the project design phase (Peeters et al., 2025). This is important since it avoids one stakeholder dominating the discussion and IT project managers can listen to a diverse set of voices, which will benefit adoption of eGovernment.

Discussion

Impact of Digital Literacy on Developing Nations' eGovernment Systems

The findings of the present study confirmed that digital literacy is vital and plays a foundational role in shaping citizen engagement with eGovernment platforms, addressing RQ2. Higher digital literacy plays a role in citizens becoming more confident in navigating online services and trusting these online services, which makes them more willing to adopt eGovernment tools. The theoretical link between digital literacy and confidence aligns with the Technology Acceptance Model (TAM), where perceived ease of use and perceived usefulness are big reasons for citizens to adopt (Desmaryani et al., 2024). Our results show that digital literacy cannot be viewed only as a technical skill, but it can also be shaped by social context, access and previous experiences.

Other systematic reviews in the literature have supported the present study's findings. According to Omweri (2024), rural regions of Kenya, Ghana and Indonesia have identified a significant 'digital literacy' barrier due to infrastructure gaps and limited training. Their review highlighted the need for targeted digital literacy programs to help rural areas and disadvantaged groups. Digital literacy as a barrier was also confirmed by Sagala & Őri (2025) to be true. To decrease the gap, they suggested solutions to improve eGovernment inclusion, such as social mobilization and multi-channel access. The present study supports those findings as well but also adds a different perspective from a project success perspective, which is long-term engagement. The findings suggest that digital literacy also contributes to technical trust and when users can use the system confidently, they perceive the eGovernment system as secure and reliable. This is perhaps essential to support continued use rather than just a one-time initiative.

The finding also suggests that digital literacy should be a primary concern for developing nations in their digital government strategy as well as to be included in all the stages of eGovernment system implementations. Failure to do so risks online services becoming underused or potentially ignored.

Impact of Citizen Socio-economic Status in Digital Literacy

Socio-economic factors such as income, age, education and geographic location appear to have a big part to play in moulding the digital literacy of citizens. People from rural locations, or those who have lower income, use digital platforms less than others due to a lack of access, connectivity and training. These findings are consistent with what's available in the literature, showing that digital literacy is not equally distributed despite being in the same country.

The systematic review by Lukáč et al. (2025) examined how digital literacy and cybersecurity awareness are influenced by socio-economic factors such as education, internet access and the Human Development Index (HDI). They concluded that safer online behaviour and digital skills can be attributed to higher education and broader internet access. Omweri (2024) also affirmed this view. He highlighted persistent urban-rural disparities in eGovernment implementations in several developing countries.

Considering the question RQ3 raises, these studies support our conclusion that socio-economic factors can become active barriers to adoption. With targeted outreach and inclusive design as critical activities to bridge these gaps, IT project managers are encouraged to consider this in their planning and rollout strategies. Adapting to local conditions and testing user readiness will go a long way in ensuring that most people can use the eGovernment services as they are made available.

Obstacles to eGovernment Adoption for Digitally Marginalized Users

Our study identified several barriers that prevented digitally marginalized citizens from using the digital platforms. Given the lack of training, poor interface design, low trust and infrastructure limitations, citizens are found to be often overwhelmed by complex forms and confusing instructions with the new technology (Wongmith, 2025). These hurdles can snowball especially considering some eGovernment implementation initiatives have siloed systems, compounded by poor communication and support channels. This provides some insight into what RQ4 was aiming to uncover.

In Sagala and Őri's study (2025), the barriers were categorized into infrastructure, end-user, and organizational, proposing multi-channel strategies to address them. Our study also supports these claims. However, there was a need for a practical perspective to be added to their findings, showing how activities done during project phases affect user experiences. For example, when interfaces are not user-friendly and disjointed, citizens with low digital literacy may likely refuse to use eGovernment systems. These represent missed opportunities to make a more inclusive and supportive online service. IT project managers can influence the design and approach of eGovernment implementations before their 'go-live', making their approach more proactive rather than reactive.

Other Factors that Affect eGovernment Adoption

RQ5 sought to identify other factors that impact eGovernment services adoption. Our study found that, in addition to digital literacy, trust, usability, stakeholder engagement and institutional support were important enablers of digital government platforms (Abdulkareem & Mohd Ramli, 2021; AbdulKareem & Oladimeji, 2024; Djatmiko et al., 2025). If citizens perceive these services as reliable, easy to use, and backed by credible institutions, citizens are found to more likely to use them.

Sihotang et al's (2022) review had similar results. They highlighted poor interface design and stakeholder engagement as detrimental to eGovernment adoption in developing nations. In terms of adoption outcomes, it's also important to consider the role of institutional capacity in planning, coordinating, and sustaining eGovernment (Omweri, 2024). While our study supports these claims about stakeholder engagement and interface design, there remains limited literature that connects this to an IT project manager's perspective. From an IT project management perspective, eGovernment

adoption is a multifaceted challenge. It requires different strategies – social, technical and institutional to work together and no single factor can explain its success or failure.

Practical Implications for IT Project Managers

Surprisingly, there was not much written in academic literature that provides insights for IT Project managers in eGovernment initiatives. Most studies discussed user behaviour, policies and ICT infrastructure. However, there is a limited understanding presented for how project teams and their managers can influence citizens to use the online services. The present study underscores the importance of IT project managers and their pivotal role in improving eGovernment adoption in developing countries. Thus, our study helps fill the gap by identifying useful practices and considerations, such as, citizen training, and stakeholder engagement that project managers can pragmatically incorporate to address digital literacy barriers and improve engagement. Table 2 summarizes what we have found out in our systematic literature review and activities that can be done by Project Managers to help drive eGovernment Adoption.

Table 2

Project Management Activities in eGovernment

Strategic Focus	Project Manager Activities	Effect on eGovernment Adoption
Citizen Training	Include digital literacy training as part of the project rollout Allocate budget for community workshops Work with local organizations	Helps citizens get familiar with tutorials and walkthroughs builds confidence in using the platform, especially among marginalized communities
Usability and Interface Design	Make simple interfaces Use plain language Conduct pilot tests and targeted usability testing in communities with limited digital skills	Addresses poor interfaces that discourage users with low digital literacy Improves accessibility and user experience
Stakeholder Engagement	Coordinate with NGOs, telecom providers, and other government departments Work directly with local leaders, schools, and community groups	Builds trust and relevance by involving actual users Ensures systems reflect community needs and improve rollout success
Youth as Digital Ambassadors	Engage youth to help spread awareness and trust Partner with schools and NGOs to support training and outreach	Leverages peer influence to increase awareness and trust Helps bridge generational gaps in digital literacy
Mobile Accessibility	Create apps for mobile devices Ensure platforms work on low-end devices and slow internet connections	Mobile phones are a cost-effective access point Ensures widest possible reach, especially in underserved areas

Digital Literacy for Marginalized Groups	Focus training on marginalized communities and those in unfavourable situations Prioritize these stakeholders in rollout strategies	Addresses digital exclusion Improves adoption and trust among groups often left out of mainstream digital initiatives

Note. Based on our findings and discussion sections.

IT Project Managers can consider using the insights presented in the findings and discussion section to inform their work on eGovernment initiatives in developing countries. Understanding how digital literacy affects adoption may help plan, design and rollout systems that are more inclusive and effective. We grounded our insights in the PMBOK framework, particularly the stakeholder management processes – identify, plan, manage and monitor (PMI, 2021).

Identify Stakeholders

PMBOK describes this step as recognizing all individuals, groups or organizations that can affect or be impacted by the project, taking note that some stakeholders can be difficult to identify (PMI, 2021).

In current eGovernment projects, vulnerable groups such as those with low digital literacy are often deprioritized or overlooked. This study highlights the need to identify and involve these stakeholders early and consistently. These include rural citizens, elderly users, low-income communities, and marginalized groups. Youth, NGOs, and local leaders should also be recognized as key actors in outreach and training efforts.

Plan Stakeholder Engagement

This involves developing strategies to communicate and interact with stakeholders more effectively. Planning based on stakeholder needs and the potential impact they have on the project (PMI, 2021).

Current strategies are flawed because systems often cater to the general masses, leaving disadvantaged users behind. PMs should plan engagement activities such as usability testing in low-literacy communities, plain-language design and mobile accessibility. After identifying stakeholders, planning how to involve non-governmental organizations (NGOs), community organizations and even youth ambassadors helps the project address concerns for these groups.

Manage Stakeholder Engagement

The process of implementing the planned strategies to communicate and work with stakeholders. The goal is to meet their needs and expectations, address issues, and foster the appropriate level of involvement throughout the project (PMI, 2021).

For example, disadvantaged users might be more open to mobile-first designed systems. Iterative UX/UI testing and subsequent feedback from this group will go a long way towards system adoption. Project managers, during the project design, should ensure eGovernment systems are usable on low-end devices and slow connections to have a wide reach of users. In addition, training programs should be delivered in accessible formats to ensure inclusivity. Managing stakeholder expectations, needs, and current issues is a core PMBOK guideline for IT project managers, and our study's findings reinforce its importance.

Monitor Stakeholder Engagement

PMBOK emphasizes tracking stakeholder relationships and evaluating the effectiveness of project deliverables and engagement strategies, adjusting as needed (PMI, 2021).

Monitoring must include feedback loops with community representatives and usage tracking among marginalized groups. There is a need to identify and address institutional and policy barriers, such as bureaucratic resistance or lack of coordination. Prioritizing at-risk citizens and adaptive and inclusive engagement strategies should be considered by project managers.

Limitations and Directions for Future Work

The present study makes some initial progress for IT Project Management in the digital literacy area. This may be strengthened by including insights, via interviews or field observations, from IT Project Managers involved in eGovernment projects. Also, more research is needed on how AI tools like service chatbots affect users, especially those with low digital skills.

Conclusion

The systematic literature review in the present study explored how digital literacy affects the adoption of eGovernment services in developing countries, with a focus on the role of IT project managers. It found that while access to technology is important, citizens must also have the skills to use and trust digital platforms. IT project managers play a key role by prioritizing digital literacy training, community engagement, and user-friendly system design during rollout. Socio-economic factors like income, education, and location also shape digital literacy levels and influence the successful adoption of eGovernment technologies. Trust and usability were identified as essential for encouraging use of eGovernment services. Overall, the study highlights the need for citizen-centred design and shows how project teams and their managers can help bridge the gap between technology and its more marginalised users.

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Managing Academic Integrity in the AI Era: A Project Management Lens on Academic Integrity

Kavya Ramesh
Master of Information Technology Project Management, Auckland University of Technology, Auckland, New Zealand
Email: kavyaramesh96@gmail.com

Minh Nguyen
Head of Department of Computer and Information Sciences, Auckland University of Technology, Auckland, New Zealand
Email: minh.nguyen@aut.ac.nz

Abstract

This study investigates how AI-integrity initiatives are put into practice in higher education by focusing on IT project management, governance, and the delivery of educational technology. It explores the development of the Egg & Basket Quiz prototype as an example of technology-based learning intervention, while also addressing gaps in institutional policy and integrity. The research uses a mixed methods design to collect both quantitative and qualitative data from 25 students and 3 faculty members. The results reveal that AI is frequently used, with 72% of participants using it weekly. There is also uncertainty about institutional rules, which points to project risks related to governance, ethical compliance, and stakeholder involvement. The study is framed as a project of organizational change and digital transformation, based on PMBOK principles for managing risks and stakeholders, the Technology Acceptance Model (TAM) for user engagement, and insights from academic integrity literature. The findings show that adopting AI-integrity requires careful planning, leadership, stakeholder involvement, risk management, and step-by-step solution development, which are all key elements of IT project management. This research offers a project-management perspective on implementing ethical AI-integrity initiatives in higher education.

Keywords

AI in education, academic integrity, IT project management, governance and risk, educational technology

Introduction

The use of AI in higher education is growing, which raises questions about integrity as well as opportunities for innovation. This research is now contextualized as an IT project management issue where universities must plan, resource, and deliver AI-integrity solutions, despite its initial positioning as an educational technology study. This study adopted a project-management framing, viewing:

- AI-integrity policy implementation as a governance and stakeholder management project.
- Deployment of digital educational tools, Introducing the Egg & Basket Quiz as a technology-enabled learning delivery project.
- Enhancement of AI literacy as a structured change initiative, requiring planning, communication, milestones, and stakeholder buy-in.

The research fills a gap that puts academic integrity at risk because high AI use is not yet accompanied by strategic policy or pedagogical frameworks. This study shows how project managers can drive ethical AI adoption through governance, risk control, and digital solution delivery by utilizing PMBOK practices and TAM principles.(Dafoe, 2018; Ghosh, 2025; Unesco, 2022)

Literature Review

Previous research on AI and academic integrity focuses mainly on educational and ethical elements (Alsharefeen & Al Sayari, 2025)with limited exploration from a project management perspective. Theoretical integration is enhanced using:

- PMBOK Governance & Stakeholder Management – framing AI policy deployment as project leadership (scope, risk, stakeholder engagement)(Sims & Kramer, 2015).
- Technology Acceptance Model – informing design of the Egg & Basket Quiz to improve adoption(Davis, 1989).
- Ethical Decision-Making) – supporting interpretation of student AI behaviour(Panzl & McMahon, 1989).
- Academic Integrity Principles – guiding policy implications(Bretag, 2018)

By demonstrating how AI-integrity systems must be strategically managed like a digital transformation project, including governance, uncertainty management, resource allocation, training delivery, and stakeholder alignment, this study fills the identified gap.

Methodology

To better understand how academic integrity in the AI era can be managed as an IT project within tertiary education environments, the study used a mixed-methods exploratory design. To position these as organizational change, risk governance, and technology-enabled project delivery challenges, the study examined stakeholder perceptions, integrity practices, and preparedness to implement AI-integrity management initiatives. Semi-structured interviews and an online survey were used to collect data.(Institute, 2021)

Three academic staff members and twenty-five postgraduate students enrolled in various University of Technology's doing different master's program as well as the bachelor's program received the online survey. Participation was anonymous and voluntary. The frequency of using AI tools, the perceived clarity of institutional policies, and academic integrity-related decision-making behaviours were all recorded in the survey. For instance, 72% of student respondents said they used AI tools at least once a week, and 58% weren't sure if this use complied with school rules(Creswell & Creswell, 2017). Few examples of a survey quote were:

> I use ChatGPT to come up with ideas, but I'm not sure what is allowed and which all practices count as malpractices.

> When I started using Gen AI for academic purposes, Even I forgets about the simple things which I can do myself. Blindly I am depending on these AI chatbots for solving simple problems.

Semi-structured interviews were conducted with three faculty members to understand institutional perspectives. This explored readiness to adopt tools such as the Egg & Basket Game model, approaches to AI literacy training, and the challenges of policy enforcement. One academic noted "Academic staff members frequently voice concerns about AI in casual settings, but there isn't a formal system in place to convert these concerns into curriculum or policy alignment."

The data was analysed thematically and mapped against key areas from the PMBOK framework(Institute, 2021), including risk management, stakeholder engagement, change management, and governance. This enabled positioning of academic integrity management as a project implementation challenge within educational technology delivery.

Table 1

Survey Participants Summary

Participant Group	Number	Key Characteristics
Postgraduate Students	25	Frequent AI users, varied policy awareness.

(mostly from MITPM)		
Academic Staff	3	Participating in integrity enforcement and supervision.

Table 1 summarises the profile of participants involved in this study, including postgraduate students and faculty members. It provides an overview of the sample size, key characteristics, and relevant engagement with AI tools. This context supports interpretation of survey and interview findings in relation to AI-integrity behaviours and educational technology adoption.

Table 2.

Theoretical Framework alignment

Framework	Applied to study analysis
Academic Integrity Theory(Bretag, 2018)	Used to analyse ethical norms and the risk of doing things wrong.
PMBOK Governance & Risk Management(Institute, 2021)	Mapped integrity initiatives as project processes.
Technology Acceptance Model (TAM)(Silva, 2015)	Justified technology-enabled learning tools Hence introducing, The Egg & Basket Quiz

Table 2 presents the theoretical frameworks applied in this study to guide analysis, design, and interpretation. It aligns each framework with specific aspects of AI-integrity implementation, including policy, technology adoption, and project management processes. This mapping provides a structured lens for understanding the intervention and connecting empirical findings to relevant theory.

Methodological Positioning in the Framework of Project Management

The research conceptualises AI-integrity implementation within tertiary institutions as a project management challenge, involving:

- Stakeholder engagement: Aligning student and faculty expectations.
- Risk management: Mitigating AI misuse.
- Training and resource planning: Building AI literacy capability.
- Policy rollout as controlled project delivery: Aligning institutional governance with digital ethics initiatives.

Technology-Enabled Learning Intervention and Strategic Suggestions (Egg & Basket Quiz Model)

Based on empirical findings and the prototype-stage mixed-methods data collected from student and faculty stakeholders, this study identifies a need for strategic and project-managed interventions to strengthen academic integrity within AI-enabled learning environments. The recommendations reflect project governance principles, aligning with educational technology deployment, stakeholder engagement, and risk mitigation processes typically used in IT project management.(Kerzner, 2025; Prensky, 2003).

Recommendations for a Holistic AI-Integrity Framework

Institutions should take a proactive approach involving pedagogy, technology delivery, and governance to handle this organizational change project successfully. Important project-related suggestions consist of:

- Policy Development (Governance & Scope Management): Establish clear disclosure policies supported by standardised templates as formal deliverables. These should promote transparency, informed consent, and alignment with institutional AI-integrity objectives.
- Assessment Redesign (Quality and Risk Management): Implement resilient, multimodal, and process-driven assessment formats (e.g., oral defences, reflective journals, in-class writing), reducing dependency on output-heavy tasks vulnerable to AI misuse.
- AI Integrity Literacy (Training & Capability Development): Integrate AI-integrity training into academic programmes for both students and staff. This includes understanding *how, when, and why* AI should be used in a manner that maintains academic standards and supports informed decision-making.
- Faculty Development (Stakeholder Engagement & Change Management): Deliver structured professional development to support pedagogical adaptation in response to AI integration. This strengthens stakeholder readiness and reduces resistance to digital transformation.

Technology-Assisted Prototype Approach: The Egg and Basket Quiz

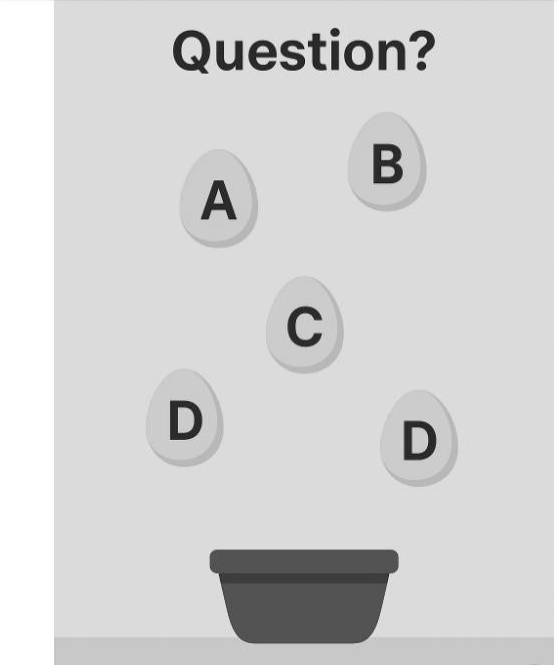
The paper presents the Egg & Basket Quiz as a prototype educational technology intervention to operationalize the recommendations and close the integrity gap. It facilitates scenario-based learning and moral decision-making and was created using iterative design concepts in line with Agile IT project management.

- Mechanism: Participants operate a digital "basket" to catch "eggs" (example: - AI-related ethical questions), simulating risk-based decision-making under time constraints.
- Feedback: Immediate, policy-aligned responses function as a live monitoring and control mechanism, enabling real-time learning and behaviour adaptation.
- Objective: The model promotes critical thinking and ethical cognition through rapid decision-making, reflecting how project managers navigate integrity risks during technology implementation.

In line with the Solution Design and Pilot Phase of an educational IT project, this gamified learning concept functions as a technology-enabled solution prototype.(Venkatesh et al., 2003)

Figure 1

The 'Egg & Basket' game model



Recommended features of the technology enabled tool

Pedagogical Features

- Scenario-based questions simulating real academic decision-making situations.
- Policy-linked explanations to clarify acceptable and non-acceptable AI use in context.
- Reflective prompts encouraging learners to evaluate their choices and ethical implications.
- Designed to reinforce institutional integrity standards while being student-centred.

Gameplay Design

- Adaptive difficulty levels to match learner proficiency and promote progressive learning.
- Multiple feedback modes (immediate, delayed, reflective) to suit different learning preferences.
- Randomisation of question scenarios to reduce predictability and encourage critical thinking.
- Accessibility options ensuring inclusivity (e.g., screen-reader compatibility, timing controls).

Academic Integrity Design Principles

- Transparency features, including optional disclosure input fields for learners to express how they might use AI in solving tasks.
- Positive reinforcement, such as bonus points for demonstrating correct ethical practice.
- Gentle consequences (soft penalisation with recovery options), aligning with educational, not punitive, goals.
- Encourages self-correction and accountability, reflecting constructive approaches favoured in New Zealand higher education.

Assessment and Monitoring

- Instructor dashboard to allow project managers and teaching staff to monitor progress, risk patterns, and engagement.
- Optional pre- and post-quiz integrity micro-assessments to measure changes in awareness.
- Learner summary reports for self-tracking and potential reflection assessment tasks.

Technical Delivery Features

- Privacy-first architecture, complying with IT governance and data minimisation principles.
- Modular and easy content update mechanisms, supporting iterative PM lifecycle updates.
- NZ English default contextualised for local higher education norms.
- Multilingual support, promoting wider accessibility and adaptability for international learners.

Discussion

The findings of this study indicate that students frequently use AI tools in their academic work, yet uncertainty regarding acceptable practices persists, with 72% reporting weekly use and 58% unsure about institutional rules. This represents a governance and risk challenge for institutions, positioning AI-integrity management as a structured project initiative requiring risk identification, stakeholder engagement, and strategic planning. Applying Academic Integrity Theory highlights the importance of transparency, accountability, and fairness, which can be operationalised through structured project deliverables.

The Egg & Basket Quiz is a technologically enabled educational tool that was created using Agile methodology and iterative project management principles. The tool serves as an example of how digital interventions can be implemented as an IT project, where the project lifecycle consists of prototyping, user testing, and iterative refining. User engagement is explained by the Technology Acceptance Model

(TAM), which supports the strategic integration of the gamified tool within the curriculum by increasing adoption rates due to high perceived utility and ease of use. Features like scenario-based inquiries, feedback loops, and reflective prompts are designed using PMBOK domains including risk management, stakeholder involvement, quality management, and scope definition.(Luckin & Holmes, 2016)

The study proposes a set of project-aligned recommended features for the Egg & Basket Quiz, translating pedagogical and ethical requirements into deliverables:

- Pedagogical: Scenario-based questions, policy-linked explanations, and reflection prompts for ethical decision-making.
- Gameplay: Adaptive difficulty, randomized question order, multiple feedback modes, and accessibility options to maximise engagement.
- Academic Integrity Design: Encouraging disclosure, awarding bonus points for ethical behaviour, and soft consequences to foster accountability.
- Assessment and Monitoring: Instructor dashboards, pre/post micro-quizzes, and learner summaries as project control mechanisms.
- Technical: Privacy-first architecture, modular content updates, NZ English defaults, and multilingual support for scalable implementation.

These features reflect PM practices such as deliverable definition, iterative testing, quality control, and stakeholder-focused training, ensuring that AI-integrity interventions are feasible, measurable, and sustainable.

Universities may systematically manage risk, uncertainty, and stakeholder resistance by framing AI-integrity programs as IT projects. Academic integrity can be improved by formal project management techniques while preserving educational flexibility, as demonstrated by the integration of pedagogical interventions with governance and assessment frameworks(Selwyn, 2021)

Conclusion

This study reframes AI-integrity challenges as project management problems within higher education, highlighting the delivery of technology-enabled learning tools, policy interventions, and AI literacy initiatives as organisational change projects. The Egg & Basket Quiz serves as a prototype project deliverable, demonstrating how gamified, scenario-based learning can be integrated into curricula to strengthen integrity. Recommendations and features are mapped to PMBOK domains, ensuring governance, risk mitigation, stakeholder alignment, and iterative development are embedded in delivery.(Turner & Müller, 2003; Zawacki-Richter et al., 2019)

Institutions can proactively handle adoption issues, integrate ethical decision-making, and guarantee congruence between pedagogy, technology, and policy by coordinating integrity interventions with project management principles. The suggested aspects of the tool pedagogical, gameplay, integrity, assessment, and technical offer quantifiable deliverables and KPIs that facilitate assessment and ongoing development. While PMBOK directs systematic planning, scope definition, risk management, and stakeholder involvement, TAM informs user adoption tactics.

The limited sample size (25 students, 3 professors) and the intervention's prototype stage are among its drawbacks. To evaluate scalability, future study should broaden stakeholder involvement, incorporate longitudinal evaluation, and pilot the Egg & Basket Quiz across several courses. Organizational preparedness will also be strengthened by coordinating future deployment with official project lifecycle documentation, milestone tracking, and change management procedures.

This study demonstrates that effective AI-integrity implementation is best approached as a project-managed educational technology initiative, where structured governance, iterative development, and strategic stakeholder engagement enable ethical, sustainable AI adoption in higher education.(Jobin et al., 2019)

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A Mobile DevOps Project Management Framework

Farhan Khan
Sr. Engineering Leader, Postgraduate Researcher, Auckland University of Technology
Jing Ma
Director of Women, Department of Data Science and AI, Auckland University of Technology
Email: sgtroswell@gmail.com; jing.ma@aut.ac.nz

Abstract

Mobile applications have become critical infrastructure in finance, healthcare, and public services, yet their development and operations pipelines remain complex and disconnected. Although DevOps practices have matured in web and cloud systems, mobile environments continue to face fragmented monitoring, weak governance visibility, and inconsistent security assurance. This study addresses the problem of limited managerial control and transparency in mobile DevOps projects, where automation lacks connection to governance and decision making. The objective was to develop a unified model that integrates automation, monitoring, and governance to strengthen project oversight. Drawing from a Multivocal Literature Review of academic and practitioner studies and examined through a demonstration linking an iOS application with Sentry and Azure DevOps, the research produced the Mobile DevOps Project Management Framework. The demonstration illustrates how real time logging, alerting, and dashboards can provide continuous visibility for project managers. It illustrates how organisations can strengthen reliability, assurance, and transparency by embedding governance within continuous delivery cycles.

Keywords

Mobile DevOps, project governance, continuous assurance, monitoring and visibility, organisational maturity

Introduction and Background

Mobile applications have evolved from being digital conveniences to essential services that sustain modern economies. They now support daily operations in banking, education, healthcare, and government. Each year more than two hundred and fifty billion applications are downloaded worldwide (Statista, 2024), showing society's increasing dependence on mobile technology. This widespread use has driven organisations to seek faster and more reliable software delivery methods, resulting in the global rise of DevOps practices that integrate development and operations through automation and collaboration (Bass, 2015; Forsgren et al., 2018).

Although DevOps has transformed how web and cloud systems are delivered, mobile environments remain less mature. Frequent operating system updates, device fragmentation, and the dependency on app store approvals create natural barriers to continuous deployment. In addition, monitoring, telemetry, and logging practices differ between mobile platforms, which prevents consistent visibility of system health or compliance (Zeng et al., 2019). These inconsistencies limit project managers' ability to make informed decisions, even when automation tools are in place.

This situation highlights a broader organisational issue. DevOps has traditionally focused on technical speed and efficiency, while governance and management visibility have developed more slowly (Kerzner, 2017). Mobile delivery pipelines therefore struggle to provide reliable evidence for managerial control and assurance (Harty et al., 2021). The lack of integration between automation and

governance not only affects operational reliability but also weakens accountability, compliance, and organisational learning.

This study addresses that problem by developing a framework that connects automation, monitoring, and governance into one continuous management process. The research investigates how project managers can achieve visibility, assurance, and control in mobile DevOps projects where technical and managerial practices are often disconnected.

To guide this investigation, the following research questions were considered.

First, how can automation and monitoring be integrated to improve visibility and accountability in mobile DevOps environments?

Second, what governance mechanisms enable project managers to assure reliability and compliance during continuous delivery?

Third, how can a unified framework support organisational learning and sustain maturity in mobile DevOps?

By addressing these questions, the research aims to help organisations align project management with modern DevOps practices and to establish a governance model that improves reliability, assurance, and decision making in mobile software delivery.

Literature Review and Current Challenges

Early DevOps literature focused on engineering speed, collaboration, and automated builds (Balalaie et al., 2016; Wettinger et al., 2016). More recent studies emphasise that governance must evolve alongside automation because effective control depends on how operational evidence is interpreted (Kerzner, 2017; Wiedemann et al., 2023). In mobile environments, this alignment is difficult to achieve due to inconsistent telemetry, unstable networks, and privacy limits on data collection (Harty et al., 2021; Kose, 2024).

Research consistently shows that fragmented toolchains weaken managerial visibility. Integration among build, test, and compliance systems is often poor, resulting in duplicated or missing data (Laso et al., 2022). Quality-of-service monitoring delivers value only when embedded within governance structures (Pontillo et al., 2024). Without interpretation and ownership, operational data becomes noise rather than insight.

Automation is frequently mistaken for managerial control. Continuous delivery pipelines can generate excessive alerts, and security scans expose vulnerabilities without assigning responsibility for remediation (Feio et al., 2024; Lombardi & Fanton, 2023). Such conditions create fast but fragile systems where speed undermines reliability.

Cultural maturity remains essential. (Erich et al., 2017) and (Kose, 2024) found that DevOps success relies on leadership commitment and shared understanding of measurement. Without reflective learning, even advanced automation fails to create improvement.

To explore this problem, the study conducted a Multivocal Literature Review combining academic and grey sources following (Garousi et al., 2019). Sixty-nine studies published between 2010 and 2025 were assessed and synthesised to identify recurring challenges in visibility, assurance, and governance. The findings informed the conceptual foundations of the Mobile DevOps Project Management Framework, later examined though a demonstration that integrated Sentry and Azure DevOps to connect automated monitoring with project governance.

The objectives of this study were to identify gaps limiting managerial visibility in mobile DevOps, to design a unified framework integrating automation, monitoring, and governance, and to examine it through a demonstration using Sentry and Azure DevOps. These aims ensured the research connected theoretical insight with practical application.

The review of prior work revealed a clear gap, as existing DevOps and observability models focus on technical integration but overlook the managerial processes that transform operational data into

governance insight. This gap prompted the development of the Mobile DevOps Project Management Framework.

Theoretical Foundations

The research problem addressed in this study concerns the lack of governance visibility and managerial oversight in mobile DevOps environments. This challenge sits within the broader area of project governance and management control theory. Governance in projects is not limited to structural approval gates. It is a system of controls that links operational behaviour to organisational objectives through measurement, feedback, and accountability as described by (Kerzner, 2017) and (PMI, 2021). Recent work on DevOps teams reinforces this understanding by framing DevOps as a control environment that combines process controls, information controls, and cultural controls rather than a practice focused only on technical execution. This study adopts that perspective and treats mobile DevOps pipelines as governance mechanisms in which telemetry, automation, and workflows operate as instruments of control.

Within this control-based lens, the four core constructs in the Mobile DevOps Project Management Framework are interpreted as governance controls rather than engineering capabilities. Integration reliability functions as an information control. It determines whether the data feeding dashboards and audit artefacts can be trusted as a sound basis for managerial decisions. Automation and visibility function as diagnostic and interactive controls. They provide continuous feedback that allows managers to observe performance and intervene when required. Continuous assurance represents boundary and risk controls by embedding security and compliance rules directly into the delivery pipeline so that violations are detected early. Organisational learning and maturity align with cultural and learning controls. They ensure that incidents and telemetry are converted into shared norms, improved practices, and higher capability across teams. Taken together, these constructs position the framework directly within project governance and management control theory. They show how technical automation can be governed through structured information flow, timely feedback, and repeated learning cycles.

Mobile DevOps functions as an interdependent system of tools, workflows, and human decision making. Studies such as (Erich et al., 2017) and (Kose, 2024) show that technical failures often arise from organisational issues such as unclear ownership, limited analytical capability, or gaps in shared understanding. This perspective aligns with contemporary socio-technical thinking, which emphasises that technical automation and organisational practices must evolve together. Interpreting mobile DevOps in this way helps explain why integration reliability, visibility, assurance, and learning must be treated as governance controls rather than purely engineering activities.

This theoretical perspective supports the study in two ways. First, it guides the analysis of evidence in the literature review by interpreting findings about logging, monitoring, and governance as findings about how control is created or weakened in mobile DevOps environments. Second, it provides the foundation for the core contribution of the study. The Mobile DevOps Project Management Framework does not offer another tooling pattern. It offers a governance-oriented control model for mobile DevOps that brings information controls, diagnostic feedback, boundary controls, and learning mechanisms together within a single repeatable cycle.

Methodology

The study used a Multivocal Literature Review to combine academic and practitioner evidence on mobile DevOps governance. This method was selected because mobile engineering practices evolve quickly and rely heavily on community platforms, technical blogs, and industry documentation. The review followed the process outlined by (Garousi et al., 2019) and was adapted to the specific needs of this project. The search covered the period from 2010 to 2025. Academic studies were identified through Google Scholar, Scopus, IEEE Xplore, ACM Digital Library, SpringerLink and ScienceDirect,

while grey literature was sourced from engineering blogs, industry reports, cloud provider documentation, and mobile analytics platforms. Search terms related to mobile DevOps, monitoring, logging, observability, continuous assurance, governance, cultural maturity, security integration, telemetry, and toolchain reliability, and these terms were applied in different combinations to ensure broad coverage.

All records were screened in three stages. The first stage removed duplicates and sources unrelated to mobile delivery. The second stage applied inclusion criteria that required each study to provide evidence about logging practices, monitoring reliability, security validation, cultural maturity, or governance visibility. The third stage excluded sources that did not contain empirical findings or that focused only on general DevOps topics without mobile applicability. This process resulted in sixty-nine studies that were suitable for analysis. Each study was assessed using criteria adapted from standard software engineering review guidelines. The criteria considered clarity of method, relevance to mobile DevOps, depth of evidence, and reliability of the findings. Studies that did not meet a basic threshold of clarity or relevance were removed, and the remaining studies provided a balanced mix of academic and practitioner insights.

Data was extracted into structured tables that captured author information, publication year, context, problem findings, and DevOps practice details. The extracted material was coded through an iterative process. Initial codes described issues such as fragmented telemetry, weak correlation of logs, gaps in security checks, excessive manual intervention, and unclear ownership of monitoring practices. These codes were repeatedly reviewed and refined to identify patterns across the studies. The refined codes were clustered into broader themes that represented recurring challenges in mobile DevOps. These themes included integration reliability, visibility and governance, continuous assurance, and cultural maturity. Each theme was linked to direct evidence from the studies. The themes were then used to define the foundational elements of the Mobile DevOps Project Management Framework. The complete protocol is available in the extended research report.

Mapping Literature Themes to Framework Components

Table 4.1

Mapping of Literature Theme to Framework Components

Framework Component	Supporting MLR Themes	Evidence from Reviewed Studies
Integration Reliability	Fragmented telemetry, inconsistent logs, weak cross tool correlation	(Harty et al., 2021) reported inconsistent logging in mobile analytics. (Zeng et al., 2019) showed weak correlation across SDKs. (Batoun et al., 2024) identified schema reliability issues. (Wettinger et al., 2016) highlighted toolchain misalignment.
Automation and Visibility	Limited visibility, weak monitoring integration, missing contextual data	(Laso et al., 2022) observed gaps in connected monitoring systems. (Pontillo et al., 2024) identified limited insight into performance behaviour. (Feio et al., 2024) noted excessive manual review of alerts.
Continuous Assurance	Late security checks, manual validation, lack of compliance alignment	(Lombardi & Fanton, 2023) described security scanning delays. (Feio et al., 2024) found limited automation in security testing. (Madhushanie et al., 2025) identified manual privacy checks.
Governance Alignment	Poor decision visibility, unclear accountability, inconsistent reporting	(Kerzner, 2017) emphasised the need for measurable governance. (Wiedemann et al., 2023) presented DevOps as a control environment. (Laso et al., 2022) showed weak integration between metrics and governance.

Organisational Learning and Maturity	Cultural gaps, limited capability building, fragmented ownership	(Erich et al., 2017) highlighted cultural maturity challenges. (Kose, 2024) observed leadership and measurement gaps. Studies across the review linked adoption success to reflective learning.

The following examples illustrate how findings from the reviewed studies informed each component of the framework. (Harty et al., 2021) observed that mobile analytics logs often differ in structure, completeness, and reliability, which directly supports the need for integration reliability within the framework. Similarly, (Zeng et al., 2019) reported that log messages generated by different mobile SDK implementations are inconsistent, reinforcing the importance of correlated telemetry across tools. (Lombardi & Fanton, 2023) noted that security validation in many delivery pipelines tends to occur late in the process, which aligns with the framework's emphasis on continuous assurance. (Erich et al., 2017) found that successful DevOps adoption depends strongly on shared ownership, collaboration, and organisational learning, supporting the inclusion of cultural maturity and learning capability as core elements of the model. These examples demonstrate how empirical evidence from the literature shaped each component of the proposed framework.

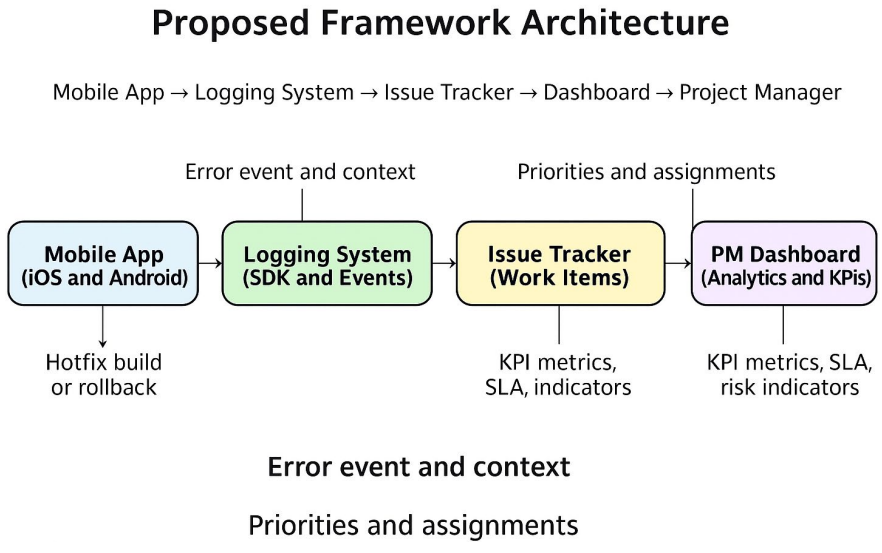
Mobile DevOps Project Management Framework

The framework was developed through a structured design process informed by both academic research and practitioner insights. A Multivocal Literature Review following (Garousi et al., 2019) was conducted to identify recurring challenges in mobile DevOps projects, focusing on visibility, assurance, and governance. Findings from sixty-nine studies were coded and synthesised into thematic dimensions that shaped the five foundational elements of the framework. These conceptual findings were then refined through an iterative design science approach, aligning framework components with established project management standards such as those proposed by the (PMI, 2021) and (Kerzner, 2017).

Figure 5.1 presents the framework's architecture. It is designed to translate operational events into management insight, ensuring that reliability, assurance, and learning are embedded throughout the delivery process. The model is built on five foundational principles. Integration reliability maintains consistency of telemetry across all connected tools. Automation and visibility provide a shared data environment that links technical and managerial decision-making. Continuous assurance embeds security and compliance validation directly within development workflows. Governance alignment connects operational metrics with organisational objectives, enabling measurable accountability. Organisational learning ensures that each iteration generates knowledge and capability growth.

Figure 5.1

Proposed Framework Architecture



The Mobile DevOps Project Management Framework differs from traditional DevOps, DevSecOps, and observability approaches because it treats mobile delivery as a governance system rather than a technical automation pipeline. DevOps practices focus on speed and integration, while DevSecOps extends this with security checks. Observability frameworks concentrate on system insight through telemetry, tracing, and metrics. These models provide technical capability but do not explain how operational evidence becomes part of project governance or how managers interpret that evidence for decision making. The proposed framework addresses this gap by linking information controls, diagnostic feedback, boundary controls, and learning mechanisms within a single management cycle. It also differs from web or server-based DevOps because mobile environments require distributed telemetry, platform specific constraints, and delayed release cycles, which limit visibility and complicate assurance. The framework therefore offers a governance-oriented control model that integrates managerial oversight with mobile specific automation and monitoring constraints. Its originality lies in positioning mobile DevOps as a socio technical control system that supports organisational decision making rather than a sequence of engineering tasks.

Table 5.1

Comparison of Related Approaches and the Proposed Framework

Approach	Primary Focus	Limitation for Mobile	Distinction from Proposed Framework
DevOps	Speed and continuous integration	Relies on uniform environments absent in mobile	Framework introduces governance controls and decision visibility
DevSecOps	Integrated security checks	Emphasises scanning but not managerial assurance	Framework connects security events with governance and accountability
Observability Models	Telemetry and insight	Focus on signals but not ownership or interpretation	Framework embeds telemetry inside governance cycles
Web and Server DevOps Models	Server-side pipelines	Do not address platform diversity and delayed releases	Framework is tailored to mobile complexity and distributed telemetry

The Mobile DevOps Project Management Framework operates through a seven-stage cycle that transforms mobile delivery into a continuous governance process. It begins with event planning, where measurable indicators and risks are defined. Instrumentation and logging follow, ensuring telemetry is auditable and well-structured. Continuous integration and deployment automate builds while retaining traceability. Alerts and tickets are generated automatically, making every issue visible to management. Dashboards then consolidate technical and governance information for real-time monitoring. Controlled release and validation confirm stability before deployment, while review and learning close the loop by capturing insights for future improvement.

Performance indicators summarised in Table 5.2 demonstrate how the framework enhances maturity. Integration reliability improves data correlation and traceability (Batoun et al., 2024; Wettinger et al., 2016). Visibility and governance shorten managerial decision cycles (Feio et al., 2024; Pontillo et al., 2024). Continuous assurance reduces audit preparation time (Lombardi & Fanton, 2023). Cultural maturity grows through structured review and training (Erich et al., 2017; Kose, 2024).

Table 5.2
Framework Performance Indicators

Dimension	Maturity Contribution	Observed Improvement	Supporting Studies
Integration Reliability	Stable feedback pipeline	Demonstrated high consistency in data correlation and error traceability across tools	(Batoun et al., 2024; Wettinger et al., 2016)
Visibility Governance	Actionable dashboards and reviews	Faster managerial decision cycles due to continuous data refresh and shared dashboards	(Feio et al., 2024; Pontillo et al., 2024)
Continuous Assurance	Automated security validation and evidence	Significant reduction in audit preparation time through integrated compliance checks	(Lombardi & Fanton, 2023)
Cultural Maturity	Learning and training programmes	Noticeable increase in DevOps adoption supported by structured learning and leadership involvement	(Erich et al., 2017; Kose, 2024)

The framework establishes a balanced ecosystem in which automation supports management oversight rather than replacing it. To validate its effectiveness in practice, a real-world demonstration was conducted using Sentry and Azure DevOps.

Framework Demonstration

This demonstration explores the practical behaviour of the framework's principles rather than validating the conceptual model. It examines how telemetry moves through the workflow and how automation supports governance visibility. Full validation of the framework requires organisational testing and expert evaluation, which is noted as future research.

To examine the practical behaviour of the framework's principles, a practical demonstration was conducted to test its core principles of integration reliability, visibility, and continuous assurance. A prototype iOS application was instrumented to generate operational telemetry that flowed through Sentry and Azure DevOps pipelines. This environment was designed to simulate a real delivery context where automation directly supports project governance. The demonstration assessed response time, data traceability, and auditability, verifying that each event could be captured, logged, and converted into a governance artefact visible to project managers.

The demonstration aimed to test the framework's principles of integration reliability, governance visibility, and continuous assurance. A prototype iOS application related to Sentry for monitoring and Azure DevOps for issue tracking and dashboards. The setup replicated a realistic delivery pipeline in which user actions, such as login, data entry, and simulated crashes, automatically generated telemetry events that were automatically logged in Sentry and converted into work items in Azure DevOps.

Table 6.1
Timestamp Analysis of Event Flow

Scenario	User Action (iOS App)	Sentry Log Time (UTC)	Azure DevOps Record Time (UTC)	Observed Delay (seconds)
Login: Invalid Credentials	4:00:04 PM	4:00:06 PM	4:01:08 PM	64
IPO: Incorrect Submission	4:20:19 PM	4:20:23 PM	4:22:13 PM	114
IPO: Correct Submission	4:20:55 PM	N/A	N/A	N/A
Simulated Crash	4:24:40 PM	4:24:49 PM	4:25:26 PM	46

Timing analysis confirmed near-real-time synchronisation, with differences between systems of less than 2 minutes. Efficiency improved significantly compared with manual log handling reported in earlier studies (Batoun et al., 2024; Madhushanie et al., 2025). Table 6.2 summarises these gains, showing a marked reduction in manual correlation and validation work. Figures 6.1 also illustrates how the dashboards provided live visibility into incidents and their corresponding tasks, creating an unbroken chain of accountability from event to resolution.

Table 6.2

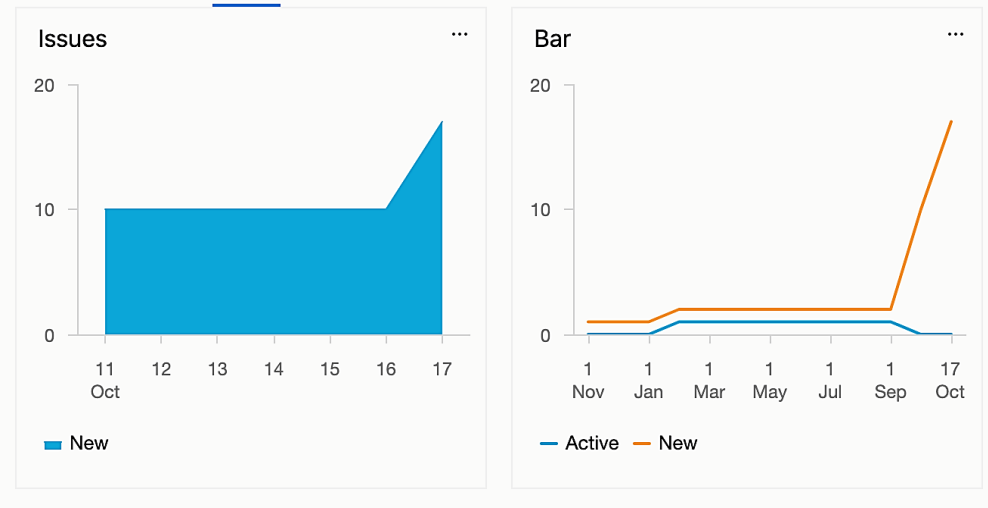
Comparison of Manual Baseline and Automated Demonstration Results

Process Area	Baseline Manual Effort	Key Academic Source	Automated Outcome	Relative Improvement Observed
Alert triage and classification	Manual review and categorisation of large volumes of alerts	(Madhushanie et al., 2025)	Automated ticket creation in Azure DevOps directly from Sentry events	Manual triage replaced by automated correlation
Log correlation across tools	Reconciliation of logs between build, monitoring, and deployment systems	(Wettinger et al., 2016)	Automatic linking of logs and work items across systems	Human correlation eliminated
Data verification and schema validation	Repeated manual checks of configuration and schema consistency	(Batoun et al., 2024)	Validation checkpoints enforced automatically within the pipeline	Human verification replaced by automated validation

The demonstration showed that automation and governance can operate seamlessly together. Logs became auditable records, dashboards delivered real time visibility, and the results confirmed the framework's practical value in turning governance principles into measurable outcomes.

Figure 6.1

Sample Azure DevOps Dashboard for Project Managers



Limitations of the Study

The study has several limitations that must be acknowledged to provide transparency regarding the scope of the findings. The demonstration examined the framework in a controlled setting using a single prototype iOS application connected with Sentry and Azure DevOps. This environment allowed close observation of telemetry flow and governance visibility but did not represent the diversity of tools, organisational structures, or delivery constraints found in real projects. The behaviour of the

framework therefore reflects an illustrative example rather than evidence gathered from field deployment.

The Multivocal Literature Review synthesised a wide range of academic and practitioner sources, yet the evidence relied on published studies and available documentation rather than primary data from organisations. Grey literature can be uneven in methodological depth and may reflect specific tooling contexts that are not generalisable. Although quality criteria were applied, variability in evidence strength remains a constraint.

The framework was conceptualised and examined through design principles and demonstration rather than through organisational case studies, expert evaluations, or longitudinal assessment. As a result, the study does not claim empirical validation of the framework's outcomes. The demonstration confirmed that telemetry can move reliably through connected systems, but it did not test leadership behaviour, organisational maturity, governance processes, or cultural adoption. Future studies are needed to evaluate how the framework performs across different organisations, mobile platforms, compliance environments, and levels of DevOps maturity.

Future Research Directions

Future research should extend the framework beyond controlled demonstrations and examine its effectiveness within real organisational settings. Field based case studies can explore how the model performs when teams operate under varied constraints such as strict compliance rules, diverse toolchains, and complex governance structures. These studies would provide evidence about adoption behaviour, leadership influence, and the quality of managerial decisions produced through the framework. A Delphi study involving experts in mobile DevOps, governance, and software project management would offer systematic evaluation of the framework and help establish consensus around its conceptual validity. Longitudinal studies can also assess how the framework influences organisational maturity, capability progression, and the development of data driven governance habits. Further work may investigate the application of the model across different mobile ecosystems such as Android, Flutter, and cross platform architectures, as well as expanding the concept of continuous assurance with predictive monitoring and artificial intelligence to support proactive project decision making. These directions would establish the empirical grounding required to confirm the value of the framework in practical project management environments.

Project Management Implications

The framework and its demonstration together illustrate that mobile DevOps can be managed as an integrated system of technical automation and organisational governance. This section interprets these findings in the context of project management practice, focusing on how the framework redefines managerial roles, enhances decision visibility, and promotes continuous assurance.

The Mobile DevOps Project Management Framework positions project managers not merely as task coordinators but as custodians of data reliability and governance. When governance principles guide automation, it delivers transparency and predictability. Managers can observe incidents as they occur and make informed decisions before issues escalate. This aligns with (Kerzner, 2017) argument that performance control depends on measurable accountability and with the (PMI, 2021) standard that defines governance as integral to organisational success.

Dashboards play a transformative role in this process. They are no longer technical artefacts but instruments of governance. By allowing engineers and managers to share the same visual data, the framework encourages mutual understanding and trust. Performance discussions shift from a retrospective to a continuous approach, fostering agile leadership and collective ownership.

Continuous assurance emerges as a critical managerial capability. Automated policy validation brings compliance into everyday operations, reducing risk while accelerating delivery. This is particularly

valuable in sectors such as finance and healthcare, where real-time governance is essential for compliance (Lombardi & Fanton, 2023).

Finally, learning completes the governance cycle. Data becomes valuable only when it drives behavioural change. Regular review sessions and capability building ensure that each cycle strengthens analytical maturity and leadership insight. This supports (Kose, 2024) conclusion that cultural evolution, rather than tool adoption, determines the long-term sustainability of DevOps transformation.

Conclusion

This research developed and examined a comprehensive framework that unites automation, monitoring, and governance within mobile DevOps environments. The Mobile DevOps Project Management Framework responds to the long-standing absence of a structured model that connects technical automation with managerial oversight. The framework was informed by a Multivocal Literature Review that synthesised academic and industry sources, and its principles were examined through a live demonstration using Sentry and Azure DevOps.

The findings show that governance and assurance can be embedded directly into automation processes. When automation is properly aligned with project management objectives, it enhances visibility, accountability, and reliability across the delivery pipeline. The results illustrate that automated monitoring not only reduces manual workload but also transforms operational data into governance evidence that managers can use for real time decisions. This demonstrates that automation can serve as both a technical enabler and a managerial control mechanism.

The study contributes to the project management discipline by extending traditional governance concepts into continuous delivery environments. It provides a practical model for integrating performance measurement, compliance, and organisational learning within mobile software projects. The framework also contributes a replicable approach for combining DevOps toolchains with management standards such as those outlined by the (PMI, 2021) and (Kerzner, 2017).

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Beyond Automation: Human-Centered Agility and AI-Enabled Leadership for the Future of IT Project Management

Beni Suranto[1]
Department of Computer and Information Sciences Department, Auckland University of Technology, Auckland, New Zealand
[1]Email: beni.suranto@autuni.ac.nz

Abstract

Artificial Intelligence (AI) is fundamentally reshaping the foundations of IT project management (PM), signalling a shift from conventional tool-assisted coordination toward hybrid cognitive ecosystems in which humans and intelligent systems co-construct project decisions. While contemporary discourse tends to frame AI adoption as a race toward automation, emerging evidence emphasizes a more nuanced transition where augmentation, interpretive judgment, and robust socio-technical integration contribute to sustainable project performance. This profound transformation generates significant organizational friction by introducing conflicting logics across traditional PM, agile methodologies, and new AI workflows, particularly regarding how uncertainty evolves and how value is optimized. Employing a structured interpretive synthesis of interdisciplinary literature spanning scholarly research and industry reports from 2020 to 2025, we articulate the Human-Centered Agility paradigm. Human-Centered Agility positions AI not as a replacement for managerial cognition, but as an essential enabler of deeper human involvement in strategic and relational project activities. Findings demonstrate that AI augments human judgment by automating routine work, generating predictive insight, and enhancing knowledge flows. Successfully leveraging this shift requires leaders to cultivate a new framework of AI-Enabled Leadership Competencies. These required competencies include technical skills such as prompt engineering and AI literacy, combined with crucial human capacities like cognitive complexity (the ability to reconcile contradictory logics) and ethical oversight. Human-Centered Agility thus reframes project management for the AI era as the intentional practice of designing socio-technical systems that amplify human value, strengthen organizational learning, and ensure strategic coherence.

Keywords

AI in Project Management, Human-Centered Agility, AI-Enabled Leadership, Hybrid Intelligence, Socio-Technical Integration.

Introduction

Artificial Intelligence (AI) has emerged as a transformative force across organizational systems, fundamentally altering how work is structured, interpreted, and governed. In project management, the introduction of intelligent automation, predictive analytics, and generative AI systems has shifted the landscape from conventional planning and coordination toward more dynamic, data-driven, and learning-oriented approaches. Recent developments in AI-enabled project tools illustrate this trajectory. Platforms such as Planner Copilot, Asana Intelligence, Wrike Work Intelligence, Rovo, ClickUp Brain, MIRO AI, and Notion AI demonstrate how AI is becoming an integral part of everyday project work. These tools automatically generate tasks, summarize communications, forecast delays, identify risks, and synthesize knowledge from distributed sources. Their emergence signals a shift from using AI as an external analytical resource to integrating it as a cognitive collaborator that participates in real-time project sensemaking.

Scholarly work reinforces this shift by describing how AI affects managerial cognition, decision-making practices, and organizational knowledge structures (Kitsios & Kamariotou, 2021; Raisch &

Fomina, 2025; Raisch & Krakowski, 2021; Taboada et al., 2023). AI capabilities increasingly support not only routine automation but also cognitive augmentation through prediction, pattern recognition, scenario exploration, and interpretive assistance(Taboada et al., 2023; Vial et al., 2023). Firms that integrate AI into project and portfolio management functions demonstrate measurable improvements in planning accuracy, resource utilization, risk detection, and strategic alignment(Singla et al., 2025). Yet the rapid proliferation of AI introduces new tensions. Traditional project management assumes uncertainty decreases over time, while AI workflows may maintain or increase uncertainty through iterative model retraining. Agile methodologies assume predictable increments of deliverable value, while AI systems optimize for statistical performance, not business outcomes(Mohammad & Chirchir, 2024). These conflicting logics generate organizational friction, underscoring the need for new leadership models that can effectively navigate socio-technical complexity. These tensions are further clarified in Table 1, which contrasts the foundational assumptions of traditional project management, agile methodologies, and emerging AI workflow logic to show where misalignments and friction typically arise.

Table 1

Comparison of Project Management Logics: Traditional PM, Agile, and AI Workflow Logic

Dimension	Traditional Project Management	Agile Project Management Logic	AI Workflow Logic
Assumption about Uncertainty	Assumes uncertainty decreases as the project progresses and more information becomes known.	Assumes uncertainty is expected and managed through incremental delivery and short cycles.	Uncertainty may remain constant or increase because models evolve continuously, require ongoing experimentation, and can drift due to the introduction of new data.
Primary Decision Basis	Upfront planning, structured processes, predictive schedules.	Customer value, iterative scope refinement, emergent requirements.	Statistical performance, model accuracy, predictive validity, and data- driven insight.
Nature of Work	Linear, sequential, milestone driven.	Incremental, adaptive, collaborative.	Iterative experimentation, retraining, feature engineering, and continuous data ingestion.
Role of Human Judgment	Dominant and centralized, supported by tools.	Shared and collaborative, embedded in team interactions.	Human judgment must interpret algorithmic output, calibrate trust, and manage uncertainty in black boxes.
Core Risk Source	Scope creep and schedule deviation.	Misalignment between increments and stakeholder priorities.	Data quality problems, model opacity, and ethical concerns.
Knowledge Flow	Document-driven, explicit knowledge.	Interaction-driven, mixed tacit and explicit knowledge.	Dynamic, AI-mediated, reliant on knowledge extraction from data and generative synthesis

Note: (Derived from Anisin, 2024; Carvão, 2025; English, 2025; Kitsios & Kamariotou, 2021; Mohammad & Chirchir, 2024; Nieto-Rodriguez & Vargas, 2025; Raisch & Fomina, 2025; Raisch & Krakowski, 2021; Singla et al., 2025; Taboada et al., 2023; Vial et al., 2023)

Industry sources caution against adopting AI through trend-driven or fear-of-missing-out strategies. AI should empower human capability rather than replace it, a view consistently emphasized across recent industry analyses (Anisin, 2024; Carvão, 2025; English, 2025). Harvard Business Review similarly argues for "working with AI" rather than simply "using AI," advocating hybrid decision cycles in which humans provide contextual framing and ethical oversight while AI contributes computational insight (Nieto-Rodriguez & Vargas, 2025).

Taken together, these developments indicate a pivotal moment for the project management discipline. The question is no longer whether AI should be incorporated but how project methodologies, organizational cultures, and leadership practices must evolve to ensure that AI serves as an enabler of human judgment, ethical responsibility, and creative problem-solving. This paper argues that Human-Centered Agility provides a coherent pathway for reconciling automation with augmentation, enabling organizations to build project environments that remain adaptive, ethical, and strategically aligned in the AI era.

Literature Review

AI has become a central enabler of organizational transformation, and its influence is increasingly visible in the evolution of project management practices. Early studies characterized AI primarily as a source of automation. However, the dominant contemporary perspective emphasizes augmentation, hybrid intelligence, and the emergence of new knowledge ecosystems(Raisch & Fomina, 2025; Raisch & Krakowski, 2021; Yee et al., 2025). Within project management, AI now permeates planning, estimation, coordination, risk analysis, knowledge management, and decision support, requiring new models of leadership and organizational capability.

The state of the art in AI-augmented project management is anchored in three macro-capability domains: process automation, cognitive insight generation, and cognitive engagement. These macro-domains encompass a broader set of six detailed sub-capabilities widely cited in the literature. These sub-capabilities are mapped in Table 2.

Table 2

AI Sub-Capabilities and Their Application to Project Management Activities

Macro Domain	AI Sub-Capability	Description of Capability	Key Project Management Activities Supported
Process Automation	Automated Task Execution (RPA, Workflow Automation)	Automates routine tasks, data entry, document routing, and administrative coordination.	Status reporting, updating schedules, document control, and risk log updates.
	Intelligent Process Orchestration	Uses rules, agents, and ML-enhanced workflows to streamline multi-step processes.	Sprint planning automation, backlog refinement, and resource reallocation.
Cognitive Insight Generation	Predictive Analytics and Forecasting	Uses ML, clustering, and statistical models to forecast timelines, effort, resource needs, and risks.	Schedule estimation, cost prediction, and resource optimization.
	Cognitive Insight (Pattern Recognition, Risk Intelligence	Identifies anomalies, bottlenecks, dependency risks, quality issues, and early warning signals.	Risk identification, defect prediction, dependency mapping, scenario planning.
Cognitive Engagement	Conversational Agents and Copilots	Chatbots and AI copilots provide query answering, project document parsing, and decision support.	Requirement analysis, stakeholder communication, and project onboarding.
	Generative AI for Knowledge Creation	Synthesizes explicit knowledge, summarizes meetings, drafts reports, and creates insights from documents.	Meeting summaries, proposal drafting, knowledge retrieval, and lessons learned documentation.

Note: (Derived from Alavi et al., 2024; Durrani et al., 2024; Engel et al., 2022; Leoni et al., 2024; Mohammad & Chirchir, 2024; Pan & Zhang, 2021; Raisch & Fomina, 2025; Raisch & Krakowski, 2021; Taboada et al., 2023; Yee et al., 2025).

Beyond these capabilities, the literature identifies numerous challenges and barriers that shape the adoption of AI in project management. These challenges span technological, organizational, and environmental dimensions within the TOE framework, and are synthesized in Table 3.

Table 3

TOE-Based Challenges and Barriers in AI-Augmented Project Management

TOE Dimension	Challenge Category	Description
Technology	Data Limitations	Incomplete, biased, inconsistent, or synthetic datasets reduce accuracy and generalizability.
	Model Opacity	Black box behaviour undermines trust, explainability, and accountability.
	Computational Constraints	High infrastructure requirements, model drift, and demand for scalable systems.
Organization	Conflicting Logics	Tensions between traditional PM, agile, and AI workflows.
	Talent Gaps and Cultural Resistance	Lack of AI-skilled staff, fear of automation, and misalignment with the existing work culture.
	Limited Governance	Absence of ethical, privacy, and accountability mechanisms for AI adoption.
Environment	Regulatory Constraints	Data protection, liability, and compliance challenges.
	Market Over Expectation	Unrealistic assumptions create poor investments and adoption failures.

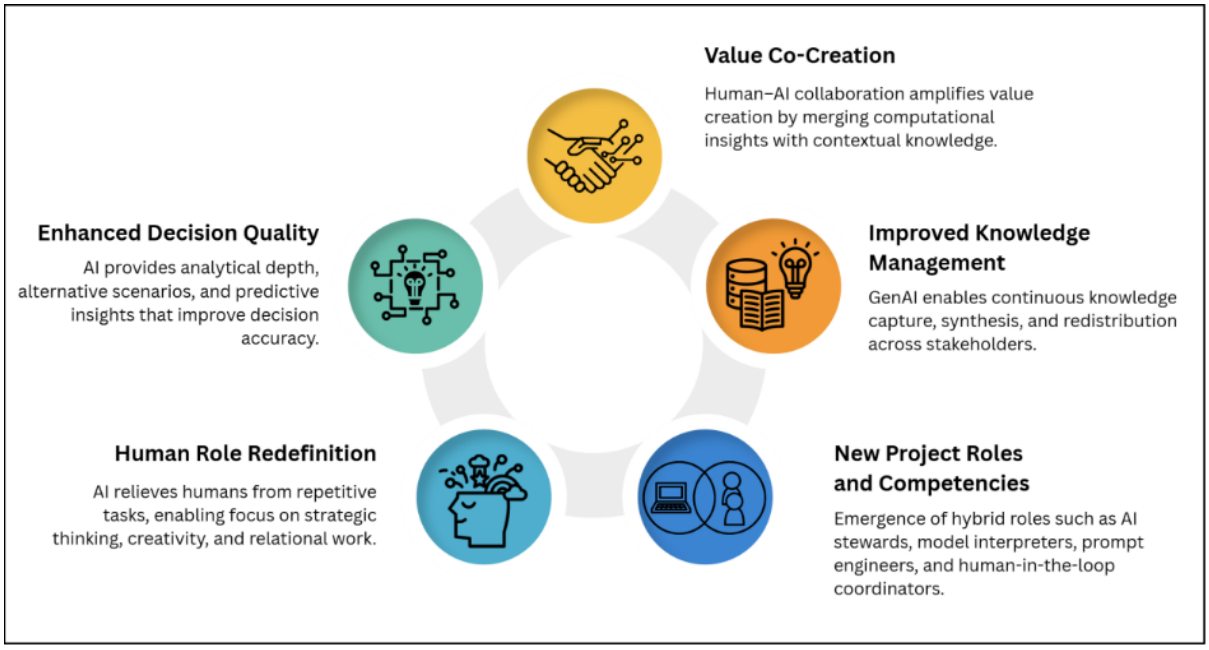
Note: (Derived from Arslan et al., 2022; Dolata & Crowston, 2023; Fügener et al., 2022; Jaiswal et al., 2023; Leyer & Schneider, 2021; Malik et al., 2022; Mohammad & Chirchir, 2024; Sarafanov et al., 2023; Steyvers & Kumar, 2024; Vial et al., 2023; Weber et al., 2023).

Despite these challenges, the literature consistently identifies opportunities when AI is conceptualized as an augmentative rather than a substitutive force. These opportunities are illustrated in Figure 1.

Future-oriented studies articulate a broader shift toward Industry 5.0 principles, emphasizing sustainability, resilience, and human-centricity. Research suggests that organizations must redesign knowledge workflows to incorporate generative AI, capture tacit knowledge through AI interactions, and build regulatory-compliant data ecosystems that enable trustworthy AI adoption (Holmström, 2022; Tubaro et al., n.d.; Yu et al., 2023). The literature also highlights the need for dynamic and self-evolving AI models that can adapt to changing project contexts without requiring constant manual recalibration. Across these streams, a consistent theme emerges: the strategic value of AI lies not in automation alone but in fostering human learning, organizational intelligence, and collaborative sensemaking.

Figure 1

Opportunities and Positive Outcomes of AI-Augmented Project Management



Note: (derived from Anisin, 2024; Carvão, 2025; Jain et al., 2023; Leyer & Schneider, 2021; Ng et al., 2021; Nieto-Rodriguez & Vargas, 2025; Sarafanov et al., 2023; Singla et al., 2025; Sun & Song, 2025; Vial et al., 2023).

Methodology

This study adopts a structured interpretive synthesis to conceptualize how AI is reshaping leadership, organizational capability, and project management practice. This methodology was selected because AI's influence spans technological systems, organizational culture, and human cognition, making a traditional systematic literature review insufficient for capturing the socio-technical, conceptual, and leadership-oriented shifts currently underway.

To ground the synthesis in contemporary developments, a multi-source literature search was conducted across the period of 2020 to 2025 in Scopus, IEEE Xplore, ACM Digital Library, ScienceDirect, and SpringerLink, complemented by practitioner sources such as Harvard Business Review, McKinsey Insights, and the Forbes Technology Council. The search used targeted keywords including "AI-enabled project management," "hybrid intelligence," "cognitive automation," "decision augmentation," "knowledge management transformation," and "AI leadership capabilities."

A two-stage filtering process was applied: the first stage included studies directly relevant to AI adoption within project or program management contexts, while the second stage evaluated theoretical contribution, methodological rigor, and alignment with IT project environments. This process reduced an initial pool of 254 publications to a final dataset of 42 academic and 8 practitioner sources. The literature was then analysed through an integrative mapping process that transitioned from raw textual data to higher-order conceptual constructs.

Coding proceeded by identifying excerpts related to six guiding themes (automation, augmentation, conflicting logics, socio-technical interactions, competency demands, and knowledge workflows), while allowing additional concepts to emerge iteratively. Coded segments were clustered using an approach similar to axial coding, enabling the identification of recurring patterns and conceptual linkages. For example, text fragments concerning model opacity, bias, and accountability were clustered into the construct of Ethical and Governance Competencies within the emerging AI-enabled leadership framework. Clustering continued until no new thematic categories emerged, indicating theoretical saturation suitable for conceptual development.

The final stage, conceptual synthesis, reconciled key contradictions within the literature, particularly the misalignment between traditional project management logic, which assumes uncertainty decreases over time, and AI workflow logic, which often maintains or increases uncertainty through iterative retraining. Additional tensions addressed included the divergence between agile value delivery and AI-based statistical optimization, as well as the competing narratives of automation-first versus augmentation-first strategies. Synthesizing these tensions across disciplines enabled the formation of the Human-Centered Agility paradigm, which reframes project management in the AI era as a deliberate socio-technical design practice where technology amplifies human judgment, ethical responsibility, and organizational learning.

The methodology acknowledges several limitations, including interpretive subjectivity due to single-researcher coding, potential recency bias stemming from the concentration of studies published between 2020 and 2025, and the overrepresentation of AI success cases in the literature due to publication bias. It also lacks empirical validation, as the study synthesizes conceptual and theoretical insights without applying or testing the Human-Centered Agility paradigm in real project environments. Despite these constraints, the interpretive synthesis approach still provides a rigorous and coherent pathway for integrating diverse theoretical and practitioner insights into a unified conceptual model that captures the evolving interplay between AI capabilities, human cognition, and organizational project systems.

Discussion

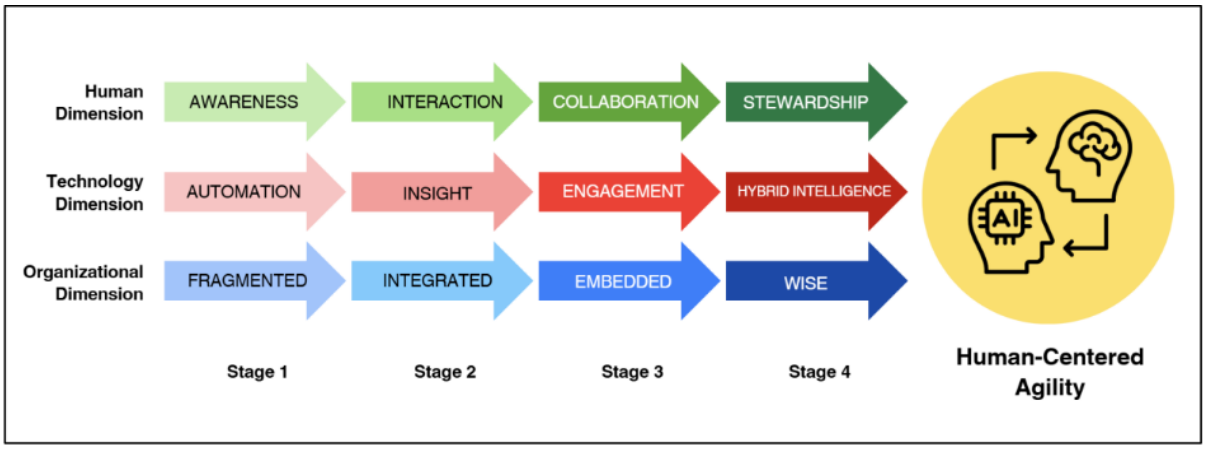
The rise of AI-augmented project management demands a reconceptualization of leadership, capability, and collaboration. The literature is increasingly rejecting binary narratives of human replacement and instead positioning AI as an active partner in the creation of organizational intelligence. This perspective aligns with the concept of Human-Centered Agility, which treats AI adoption not as a technology deployment exercise but as a process of reflective learning, ethical stewardship, and capacity building.

At the core of Human-Centered Agility is the recognition that AI and humans excel in fundamentally different but complementary domains. AI systems provide computational speed, pattern detection, predictive modelling, and continuous monitoring, while humans contribute ethical judgment, contextual sensitivity, creativity, empathy, and responsible agency. This complementarity is best understood through the hybrid intelligence metaphor described in recent literature, which represents the evolution from the solo human expert to the centaur configuration. In this configuration, the machine handles the complex, calculation-heavy tasks, while the human defines the strategy, resolves ambiguities, interprets opaque mechanisms, and ensures alignment with social and ethical expectations. Within project management, this means that AI must not be treated as an external analytic tool but as a collaborator within a socio-technical system that requires deliberate integration.

Within this vision, leadership evolves into a higher-order integrative role. Rather than controlling tasks, leaders curate intelligence flows across human actors, AI systems, and organizational processes. They cultivate environments where automation and augmentation coexist productively, and where conflicts among traditional PM logic, agile logic, and AI workflow logic are navigated through thoughtful negotiation. Leaders require the capacity to interpret AI outputs, contextualize model predictions, and assess the broader implications of automated recommendations. Research shows that human–AI collaboration is most productive when managers possess the cognitive complexity to understand and reconcile contradictory logics, and when they maintain the ability to shift between exploration and exploitation modes as project conditions evolve(Giraud et al., 2023; Steyvers & Kumar, 2024). Figure 2 presents the Socio-Technical Integration Pathways, which map the progressive co-evolution of human leadership capabilities, AI functions, and organizational structures as they move toward the Human-Centered Agility paradigm.

Figure 2

Socio-Technical Integration Pathways illustrating the progressive co-evolution of human leadership, AI capabilities, and organizational systems toward Human-Centered Agility.



Human-Centered Agility also emphasizes the collective, cultural, and organizational dimensions of AI adoption. The success of AI-augmented project management depends not only on the capabilities of individual leaders but on an organizational culture that prioritizes augmentation over full automation. A growing body of research suggests that augmentation is the only sustainable path to long-term competitive advantage, as it preserves human meaning, fosters learning, and enables organizations to respond to uncertainty with flexibility rather than rigidity (Przegalinska et al., 2025; Sun & Song, 2025). Organizations that strategically balance automation and augmentation tend to outperform those that pursue automation-first approaches, in part because they maintain human interpretive control while leveraging computational efficiency.

The emergence of AI-enabled project leadership brings new competencies to the forefront. AI literacy becomes an essential foundation, enabling leaders to understand AI systems' capabilities and limitations. Beyond general literacy, leaders must develop interpretive skills to evaluate AI recommendations, identify biases, and recognize when algorithmic guidance deviates from ethical or contextual expectations. Prompt engineering emerges as a practical leadership capability that enables project managers to shape AI system behaviour and elicit contextually appropriate outputs. This competency reframes AI systems from opaque agents into transparent collaborators whose contributions can be intentionally directed. These emerging capability demands are synthesized in Table 4, which outlines the core human, technical, and ethical competencies required for AI-enabled project leadership.

Table 4

AI-Enabled Leadership Competencies

Competency Cluster	Specific Competency	Description of Capability	Leadership Value in AI-Augmented Project Management
Human Competencies	Cognitive Complexity	Ability to hold multiple, even contradictory, truths simultaneously and reason across automation-augmentation paradoxes.	Enables leaders to integrate AI-driven insight with human judgment, avoiding overreliance on algorithmic certainty.
	Empathy and Relational Awareness	Sensitivity to human concerns, fears, motivations, and team dynamics when AI changes work roles and power Structures.	Preserves trust, psychological safety, and team cohesion in AI-disrupted environments.

	Communication and Sensemaking	Ability to translate complex AI outputs into actionable meaning for diverse stakeholders.	Facilitates alignment between technical insights and strategic decision-making.
	Adaptive Learning Orientation	Commitment to continuous learning, experimentation, and capability development.	Supports ongoing adaptation to fast-evolving AI tools and workflows.
Technical Competencies	AI Literacy and Model Understanding	Foundational understanding of how AI systems function, including limitations, training data requirements, and interpretability issues.	Enables leaders to make informed decisions about AI adoption, delegation, and oversight.
	Prompt Engineering	Skill in crafting structured prompts that guide AI systems toward outputs aligned with project requirements.	Enhances decision support, risk insight generation, and quality of AI-assisted project documentation.
	Data Interpretation and Validation	Ability to assess data quality, identify noise and bias, validate AI-generated predictions, and contextualize outputs.	Strengthens accountability and reduces risks associated with relying solely on algorithms.
	Workflow Orchestration with AI Tools	Skill in integrating AI tools into PM processes, including backlog refinement, schedule prediction, and scenario analysis.	Improves efficiency and supports higher-level strategic reasoning by freeing time for human-centric work.
Ethical and Governance Competencies	Responsible AI Oversight	Ability to detect risks of bias, discrimination, opacity, and inequitable impact.	Ensures ethical integrity of AI-augmented PM decisions and outcomes.
	Transparency and Explainability Stewardship	Commitment to ensuring that AI recommendations are interpretable and accountable.	Builds trust with stakeholders and ensures compliance with governance requirements.
	Human-Centric Decision Authority	Maintaining final human judgment in critical decisions involving ambiguity, ethics, or stakeholder implications.	Prevents decision abdication and reinforces the principle that AI supports but does not replace human agency.
	Governance and Compliance Awareness	Ability to align AI use with organizational policies, industry standards, privacy regulations, and audit requirements.	Reduces legal, regulatory, and reputational risks while ensuring the responsible integration of AI tools.

The literature further emphasizes the importance of social competencies, including empathy, communication, and relationship building. These competencies become increasingly important as AI systems reshape human work and redistribute cognitive labour. Leaders must manage the psychological responses of team members who may fear job loss, status loss, or diminished autonomy. They also must cultivate trust in AI systems without encouraging blind reliance. Research on human–AI trust calibration reveals that productive collaboration emerges when humans strike a balance between skepticism and openness, leveraging AI to alleviate cognitive load while retaining ultimate decision-making authority (Fügener et al., 2022; Leyer & Schneider, 2021).

Human-Centered Agility also reframes stakeholder relationships. As AI systems become more embedded in project communication channels, they influence how information is produced,

interpreted, and circulated. This requires leaders to establish governance structures that define when and how AI participates in decision processes, how the integrity and privacy of data are protected, and how algorithmic decisions are explained to stakeholders. Emerging research on AI ethics within project and production systems suggests that leaders must adopt proactive governance mechanisms that account for liability, fairness, data rights, and transparency (Merhi & Harfouche, 2024; Yu et al., 2023). These mechanisms must be embedded into the everyday fabric of project workflows rather than treated as post-hoc compliance activities.

To complement the leadership competencies described above, Table 5 summarizes the organizational enablers that underpin AI readiness and Human-Centered Agility that must be in place for hybrid human–AI project ecosystems to function effectively.

Table 5

Organizational Enablers for AI Readiness and Human-Centered Agility

Enabler Category	Specific Enabler	Description of Organisational Capability	Relevance to Human-Centered Agility
Technological Foundations	High-Quality Data Infrastructure	Availability of integrated, clean, governed, and interoperable data across the organization.	Ensures reliable insight generation and reduces model drift, bias, and opacity.
	Scalable AI/ML Infrastructure	Cloud platforms, GPUs, model management pipelines, monitoring tools, and APIs.	Supports adaptive, evolving AI systems that align with changing project conditions.
	Complementary Digital Technologies	Digital twins, BIM, RPA, knowledge management systems, and IoT ecosystems.	Facilitates automation–augmentation synergy and enhances situational awareness.
Human and Skill-Based Enablers	AI Literacy Across Roles	Foundational understanding of AI limitations, risks, and value creation mechanisms.	Enables responsible delegation and shared interpretation of AI outputs.
	Cross-Functional Collaboration Skills	Ability for business, PM, and data roles to co-create solutions ('AI power couple').	Fosters integrative intelligence and reduces misalignment between business value and technical work.
	Continuous Upskilling and Learning Structures	Training, KM workflows, AI-supported learning, and prompt engineering capability	Encourages adaptive learning and reinforces cultural readiness.
Cultural and Strategic Enablers	Augmentation-First Mindset	Prioritizing human–AI collaboration over automation-only strategies.	Creates psychological safety and preserves human meaning in PM workflows.
	Risk-Oriented and Experimentation Culture	Acceptance of uncertainty, rapid iteration, and exploratory experimentation.	Aligns with AI workflow logic and supports adaptive decision-making.
	Ethical and Responsible AI Norms	Data governance, transparency practices, explainability protocols, privacy, and compliance measures.	Safeguards trust and aligns AI systems with organizational values
Governance and Structural Enablers	Adaptive Governance Models	Structures for monitoring model drift, bias, accountability, and evolving risks.	Ensures long-term sustainability and responsible use of AI.

	Clear Decision Authority and Accountability Chains	Defined rules about where AI participates in decisions and where humans retain final authority.	Prevents decision abdication and reinforces human-centric governance.
	Integration of AI into Organizational Memory	Mechanisms to store, curate, and leverage AI-generated knowledge and interaction traces.	Strengthens collective intelligence and long-term learning trajectories.

A central implication of Human-Centered Agility is that organizations must redesign knowledge workflows to harness generative AI effectively. Generative models demonstrate new capabilities in knowledge creation, synthesis, summarization, and transformation, which can streamline learning and accelerate decision cycles. Yet the meaningful use of generative AI requires intentional alignment with human-derived tacit knowledge. Studies show that tacit knowledge often remains undocumented within project teams, but interactions with AI tools can leave digital traces that serve as valuable inputs to organizational memory if captured through well-designed knowledge management processes(Alavi et al., 2024; Leoni et al., 2024). Knowledge workflows, therefore, need to evolve toward systems that treat AI interactions as knowledge assets while maintaining rigorous privacy, governance, and oversight.

Human-Centered Agility highlights an unresolved research and practice gap concerning dynamic AI models. Most AI systems used in project management today remain static, requiring periodic manual recalibration to adapt to changing project conditions. Yet project environments are fluid, particularly in exploratory software development and digital transformation contexts. The literature calls for the development of dynamic, self-evolving models that can adapt to emerging conditions while maintaining transparency and control. These developments require new research on adaptive governance structures, evolving risk management practices, and mechanisms for monitoring model drift, bias amplification, and changes in data distributions (Tsaih et al., 2023; Weber et al., 2023).

Operationalising Human-Centered Agility requires translating its conceptual elements into concrete project routines. For instance, organizations may introduce structured AI-interpretation checkpoints within sprint reviews or stage-gate assessments to ensure that algorithmic predictions are contextualized rather than accepted at face value. Hybrid governance mechanisms can pair project managers and data specialists in shared decision forums where statistical optimization is reconciled with strategic intent, ethical boundaries, and tacit knowledge. Organizations must also institutionalize processes that document, challenge, and integrate AI outputs into organizational memory while safeguarding transparency and accountability.

The value of Human-Centered Agility becomes clearer when applied to practical scenarios. In a software delivery project, an AI forecasting model predicts significant schedule slippage. Instead of reacting by mechanically replanning, an AI-enabled project lead convenes engineers, product owners, and a data analyst to interpret the output, confirming that the delay stems from a hidden inter-team dependency. The resulting decision blends computation with practical judgment. In a construction domain, a digital twin flags safety risks based on sensor anomalies; rather than simply enforcing automated restrictions, managers involve site supervisors and safety officers to redesign workflows in ways that preserve worker agency. In a public-sector transformation program, a chatbot analysing citizen service logs reveals recurring pain points; human–AI review sessions allow project teams to refine policy interventions while safeguarding equity and regulatory compliance. In an enterprise IT modernization effort, generative AI proposes architectural refactoring options; architects critically evaluate these options against legacy constraints and organizational strategy, selecting a solution that balances innovation with operational continuity. These scenarios illustrate how Human-Centered Agility transforms project decision-making from a linear managerial process into a distributed, adaptive, hybrid-intelligence practice.

Conclusion

AI is altering the foundations of project management, not by replacing human expertise but by reframing how cognition, coordination, and organizational learning unfold across project life cycles. This paper argues that the sustainable and responsible adoption of AI requires a paradigm shift toward Human-Centered Agility, which is a model that integrates automation with augmentation, values human interpretive agency, and positions AI as an enabler of higher-order leadership capabilities.

The literature demonstrates that AI augments managerial judgment through predictive insight, scenario generation, and continuous monitoring, while relieving humans of routine tasks that burden cognitive capacity. AI-enabled project environments provide leaders with opportunities to focus on complex problem-solving, stakeholder engagement, ethical deliberation, and the creative recombination of knowledge. However, realizing these opportunities depends on developing organizational cultures that prioritize augmentation over blind automation, embrace risk-oriented learning, and invest in AI literacy and hybrid competencies such as prompt engineering, interpretive reasoning, and socio-technical orchestration.

Future research should explore dynamic and self-evolving AI models that can adapt to emergent project conditions, as current static models often require manual recalibration and fail in volatile environments. There is also a need to examine how tacit human knowledge can be captured through human–AI interactions without compromising privacy or ethical norms. Further inquiry into regulatory, environmental, and liability concerns is essential, particularly as AI agents become increasingly autonomous and integrated into decision-making processes.

Additionally, empirical studies should investigate how Human-Centered Agility can be operationalized in different project domains, team structures, and cultural contexts. Longitudinal research could examine how hybrid intelligence evolves and how leadership capabilities transform as AI becomes increasingly integrated into organizational workflows.

Ultimately, the future of AI in project management hinges not on how intelligent machines can become but on how wise organizations can remain. By embracing AI as an enabler of human flourishing, project management can evolve into a discipline that advances performance while safeguarding the human values at the core of meaningful work.

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Addressing the Challenges of Remote Work in Scaled Agile Frameworks: Organisational and Change Management Solutions

Twinkle Joy[1]

Project Management Research Office, AUT Computer and Information Sciences Research Centre, Auckland University of Technology

Stephen J. Thorpe[1]
Project Management Research Office, AUT Computer and Information Sciences Research Centre, Auckland University of Technology

[1]Email: twinklejoy0180@gmail.com

Abstract

Agile methodologies have become central to contemporary software development, promoting iterative delivery, continuous feedback, and cross-functional collaboration. As organisations scale Agile adoption, the *Scaled Agile Framework* (SAFe) provides structured guidance for aligning multiple teams, coordinating program-level work, and maintaining portfolio oversight. Concurrently, the shift to hybrid and remote work environments introduces complexities in communication, collaboration, leadership visibility, and technological integration. This research report presents a systematic review of 32 peer-reviewed studies published between 2017 and 2024, aiming to investigate the challenges of implementing SAFe in distributed contexts and explore the application of Kotter's *8-Step Change Model* to support organizational transformation. Using Braun and Clarke's thematic analysis, five key themes emerged: communication and collaboration, scaling framework challenges, change management and resistance, technological dependencies, and leadership and governance. Findings indicate that remote SAFe adoption requires balancing structured change management with Agile's iterative principles, integrating digital tools effectively, and fostering leadership presence and psychological safety across distributed teams. By mapping Kotter's model onto remote Agile practices, the presented research report provides both conceptual insights and practical guidance for practitioners navigating large-scale distributed Agile transformations. The research highlighted the relevance of combining structured change frameworks with adaptive Agile practices while suggesting avenues for future empirical validation to strengthen understanding of remote SAFe implementation.

Keywords

Remote work, Scaled Agile Framework (SAFe), Agile transformation, Kotter's 8-Step Change Model, organisational change

Introduction

Agile methodologies have become central to modern software development, emphasising iterative delivery, continuous feedback, and cross-functional collaboration (Beck et al., 2001; Highsmith, 2009). As organisations expand Agile adoption beyond small teams, the *Scaled Agile Framework* (SAFe) has emerged as a dominant model for scaling Agile practices, offering structured guidance on roles, planning cycles, portfolio alignment, and program-level coordination. Concurrently, the rapid growth of hybrid and remote work has fundamentally reshaped how Agile teams communicate, align, and deliver value across geographical boundaries and time zones. This transition presents critical challenges for organisations implementing SAFe to support digital transformation at scale.

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Remote work introduces complexities in communication, knowledge sharing, leadership engagement, and cultural alignment across distributed Agile Release Trains (ARTs) (Dingsøyr et al., 2018; Reunamäki & Fey, 2023). While SAFe and other scaling frameworks like DAD are widely adopted, there is limited guidance on adapting these frameworks to remote contexts, where face-to-face collaboration and spontaneous problem-solving are replaced with virtual interactions. Existing literature discusses the challenges of remote Agile broadly, but a focused synthesis that maps these challenges to structured change management frameworks, such as Kotter's 8-Step Model, remains scarce.

To address this gap, the present study conducted a Systematic Literature Review of 32 peer-reviewed journal articles and conference papers published between 2017 and 2024. Using Braun and Clarke's (2021) *Thematic Analysis*, the study identifies recurring challenges, evaluates change management responses, and develops practical and conceptual insights for guiding remote SAFe adoption. By integrating Kotter's structured change framework with distributed Agile practices, this research advances existing knowledge by offering a conceptual lens for understanding and managing change in remote SAFe implementations, while providing actionable guidance for practitioners navigating large-scale, distributed Agile transformations.

Literature Review

Agile methodologies have evolved substantially since the Agile Manifesto, emphasising iterative development, continuous stakeholder feedback, and collaborative, cross-functional teamwork (Beck et al., 2001; Highsmith, 2009). The Scaled Agile Framework (SAFe) extends these principles into organisational-level coordination by providing structured roles, planning cadences, and governance practices designed for complex and distributed environments (Leffingwell, 2016). SAFe aims to align teams through shared vision, synchronised cadences, and integrated delivery pipelines. However, translating SAFe from co-located contexts into remote settings introduces new tensions, particularly where communication, visibility, and feedback loops become fragmented.

Remote and distributed work amplifies coordination complexity. Reduced informal interactions, communication delays, and uneven access to information hinder shared understanding across Agile Release Trains (ARTs) (Dingsøyr et al., 2018; Ford et al., 2021). Furthermore, videoconferencing fatigue limits attention and participation in key ceremonies such as retrospectives and PI planning (Nesher Shoshan & Wehrt, 2022; Döring et al., 2022). These difficulties (summarised in Figure 1) indicate that traditional SAFe implementation must be adapted to retain agility, sustain engagement, and maintain alignment across distributed teams.

Figure 1

Challenges in adopting SAFe in remote work Environments

Communication, Team Dynamics, and Collaboration in Remote Agile Teams

Communication is foundational to Agile effectiveness, yet remote work reduces opportunities for spontaneous clarification and weakens team cohesion (Olson & Olson, 2000; Buła et al., 2024). Distributed interaction patterns often produce delays in decision-making and create fragmented understanding of project goals. To address these challenges, research highlights the importance of structured communication protocols, intentional check-ins, and integrated collaboration tools (Reunamäki & Fey, 2023).

A deeper theoretical consideration concerns psychological safety, which enables individuals to share concerns, admit uncertainty, and challenge assumptions behaviours that are especially at risk in remote communication environments (Edmondson, 2019). Applying Kotter's early steps, 'creating a sense of urgency' and 'communicating the vision', in distributed settings risks becoming overly top-down if psychological safety is weak. Agile, in contrast, is built on iterative dialogue and collective sense-making. This creates a fundamental conflict: Kotter assumes a linear progression, while Agile requires continuous renegotiation, adaptation, and feedback. Successful integration therefore depends on reinforcing team dynamics, promoting open communication, and cultivating virtual environments where individuals feel safe to participate actively.

2.2 Scaling Agile with SAFe in Distributed Environments

SAFe's synchronisation mechanisms ARTs, PI planning, Scrum of Scrums, and cadence-based ceremonies are designed to align multiple teams. Yet in remote contexts, time-zone differences, reduced visibility of work, and inconsistent participation create coordination bottlenecks (Ciancarini et al., 2022; Turetken et al., 2017). Misalignment in backlog priorities and technical dependencies becomes more likely when distributed teams lack shared situational awareness.

Role ambiguity represents another significant limitation. Unclear differentiation between Product Owners, Scrum Masters, Release Train Engineers, and System Architects can hinder governance and decision-making (Fagerholm et al., 2021). These ambiguities intensify in remote environments where communication is mediated by tools and where implicit coordination cues are lost.

Critically, the structured nature of PI planning can clash with Agile values of adaptability. While PI events provide cadence and alignment, they risk becoming rigid, highly scripted sessions when held virtually particularly when attention spans are reduced by digital fatigue. Therefore, scaling Agile remotely requires balancing SAFe's need for synchronisation with Agile's iterative flexibility.

Change Management, Resistance, and Theoretical Tensions

Resistance to change remains common in distributed Agile environments. Manifestations include passive disengagement, inconsistent ceremony attendance, selective tool use, or reluctance to adopt new processes (Lehtinen et al., 2017; Marsya & Raharjo, 2024). Kotter's 8-Step Change Model offers a structured approach, emphasising vision, coalitions, short-term wins, and institutionalisation of change (Carreño, 2024; Trawick & Carraher, 2023).

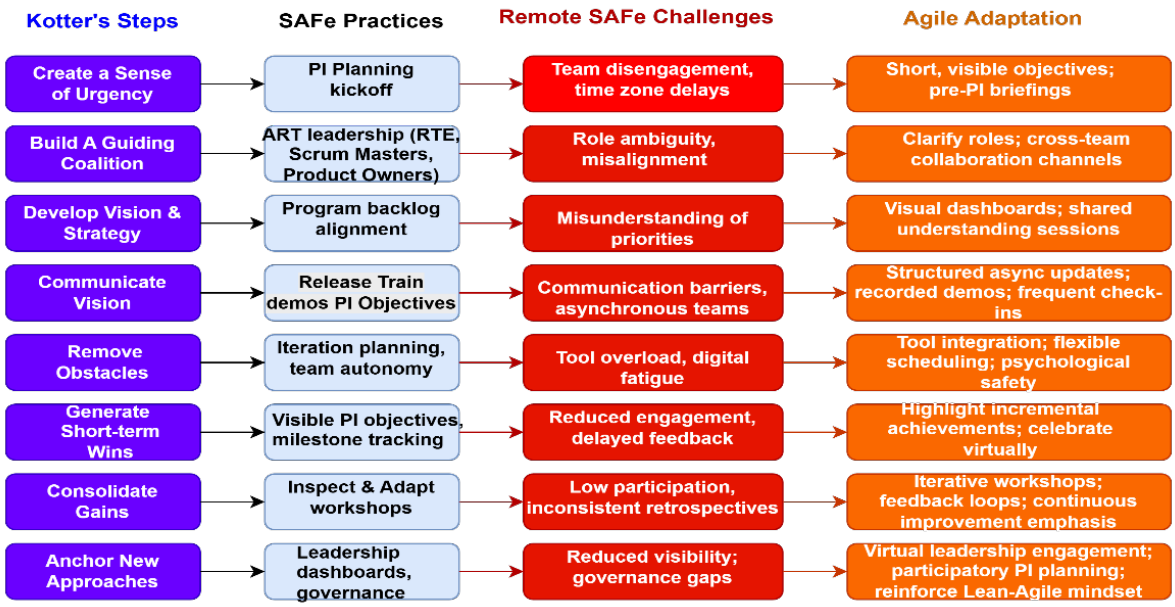
However, a deeper conflict exists: Kotter's model is fundamentally linear, whereas Agile and SAFe operate cyclically through inspect-and-adapt loops. Kotter's steps suggest stability after each stage, while Agile assumes continuous change. Integrating the two requires augmenting Kotter with iterative feedback mechanisms so that each step supports - not constrains - ongoing adaptation.

The literature on team dynamics and psychological safety strengthens this argument: resistance often arises not merely from process difficulty but from emotional and relational factors, especially in remote teams where isolation and reduced trust heighten uncertainty. Embedding Agile ceremonies within Kotter's steps and using short feedback loops to reinforce buy-in, helps address these challenges.

Figure 2 visualises how Kotter's eight steps map onto SAFe practices, highlighting remote-specific obstacles and practical Agile adaptations for distributed environments.

Figure 2

Integrating SAFe, Kotter, and Remote Agile Adaptations



Technological Dependencies and Digital Workflows

Distributed Agile teams depend heavily on collaboration platforms for backlog management, communication, and documentation. When multiple, non-integrated tools are used simultaneously (e.g., Jira, Confluence, Slack, Teams), teams often encounter duplication, inconsistent workflows, and fragmented visibility (Putta et al., 2018; Wu, 2022). Such friction undermines Agile's emphasis on transparency and rapid feedback.

Kotter's steps specifically generating short-term wins and empowering broad-based action provide opportunities to reinforce tool adoption through visible performance improvements and streamlined processes. Iterative check-ins and continuous improvement sessions strengthen alignment between tool practices and Agile values.

Leadership, Visibility, and Distributed Organisational Alignment

Leadership visibility is critical for motivation, clarity, and trust in Agile environments (Edmondson, 2019). In distributed settings, reduced executive presence can lead to uncertainty, slow decision-making, and disengagement. Virtual dashboards, online planning boards, and structured escalation pathways (Ciancarini et al., 2022) help restore transparency and maintain alignment.

More importantly, leaders must support team autonomy and psychological safety not just enforce process compliance. When leaders actively participate in PI planning, retrospectives, and vision-setting sessions, they help co-create objectives rather than impose them. This leadership behaviour aligns Kotter's emphasis on guiding coalitions with Agile's emphasis on shared ownership.

Figure 3 illustrates the conceptual tension between Kotter's sequential steps and Agile's cyclical nature, highlighting conflict points such as delayed feedback loops, reduced engagement, and limited leadership visibility in remote environments. This highlights the need for an integrated, adaptive approach rather than strict adherence to either model.

Figure 3

Conceptual representation of the tension between Kotter's linear change steps and Agile's iterative cycles in distributed SAFe teams

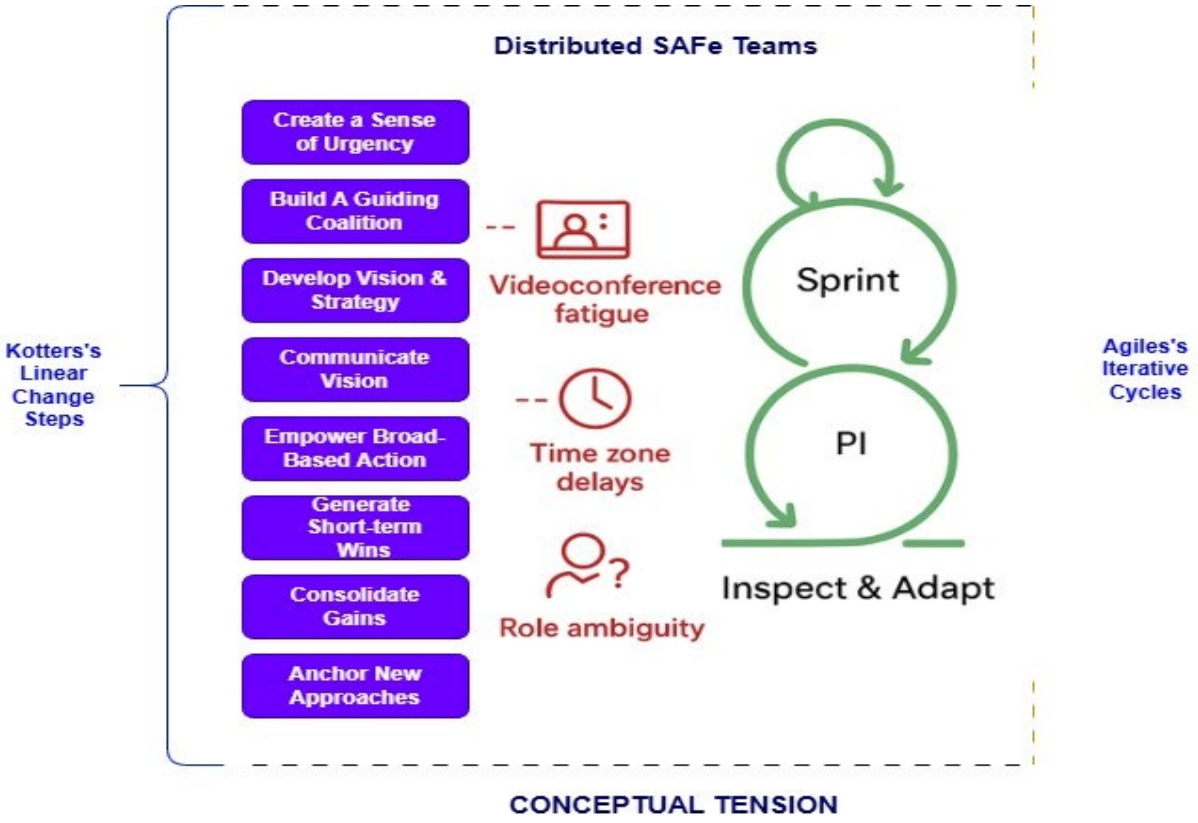


Table 1

Summary of Literature Review

Theme/ Section	Key Findings	Gaps/Limitations	Contribution
Communication and Collaboration	Remote teams face misalignment and reduced trust; structured check-ins and collaboration tools help (Olson & Olson, 2000; Dingsøyr et al., 2018)	Limited strategies for distributed SAFe teams	Investigates communication approaches for remote Agile teams

Scaling Agile with SAFe	Coordination across ARTs is complex; role ambiguity affects decisions (Ciancarini et al., 2022; Magistretti & Trabucchi, 2025)	Little guidance for multi-time-zone ART coordination	Explores dependency management and role clarity in distributed SAFe
Change Management and Resistance	Low engagement and tool reluctance common; structured change models help (Lehtinen et al., 2017; Carreño, 2024)	Limited research on managing change in distributed environments	Applies Kotter's model to increase engagement in distributed Agile
Technological Dependencies	Non-integrated tools create silos and inefficiencies (Putta et al., 2018; Wu, 2022)	Limited guidance for tool integration in remote SAFe	Evaluates tool integration and process standardisation
Leadership and Organisational Visibility	Visibility is critical for alignment and trust; dashboards and escalation paths help (Edmondson, 2019)	Insufficient insights on managing remote Agile teams	Assesses leadership visibility and governance in distributed SAFe

Methodology

Overview

This study employed a Systematic Literature Review (SLR**)** (Kitchenham et al., 2009) to examine the application of change management frameworks primarily Kotter's 8-Step Model within remote Agile work environments. The review focused on peer-reviewed literature to ensure scholarly validity and transparency (Pereira & Serrano, 2020).

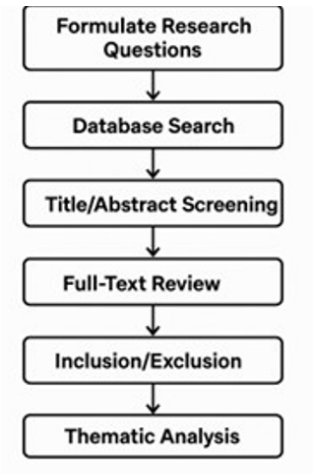
To interpret the literature, Braun and Clarke's (2021) six-phase Thematic Analysis was used to identify recurring patterns such as communication barriers, coordination challenges, leadership evolution, and resistance management in distributed Agile teams. The study also assessed Kotter's model for its relevance in guiding change and fostering alignment during virtual transformations.

Research Method

Following Kitchenham et al. (2009), a structured SLR approach was adopted. Searches were conducted in Scopus, IEEE Xplore, and Google Scholar using keywords including *"Agile methodology," "remote work," "change management," "SAFe framework,"* and *"distributed teams."*

Articles were screened via title, abstract, and full-text review, yielding 32 high-quality studies. This approach enabled a rigorous synthesis of challenges, tools, leadership practices, and change management strategies in remote Agile settings.

Figure 4:
The SLR workflow applied in this research



Research Questions:

Three focused research questions guided the Systematic Literature Review (SLR) and subsequent thematic analysis:

RQ1: Identify key challenges encountered by remote teams in the Scaled Agile Framework (SAFe) in distributed environments.

RQ2: How can Kotter's *8-Step Change Model* (1996) address specific challenges in remote SAFe Agile implementation.

RQ3: What organizational tactics reduce resistance to change and facilitate the adoption of Agile practices in remote teams?

Search Strategy:

Structured searches were conducted using targeted keywords, summarized in *Table 2*

Table 2:
Search terms

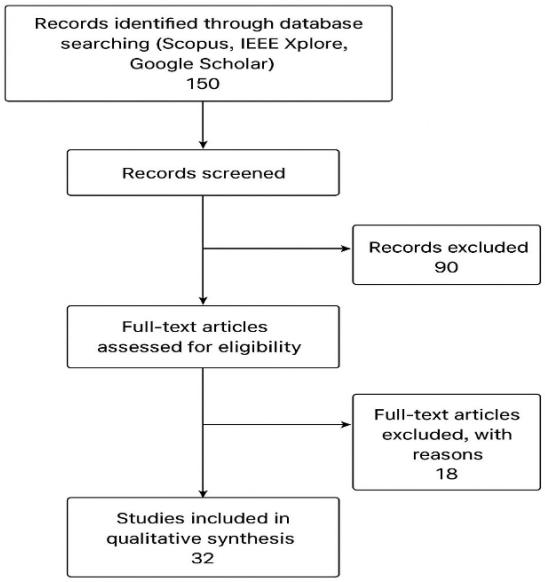
Theme	Search Terms
Agile in Remote Work	"Agile methodology" AND "remote work" OR "distributed teams"
Agile Scaling	"Scaling Agile" OR "Agile at scale" AND "remote teams"
Change Management	"Change management" AND "Agile" AND "remote work"
Agile Challenges	Agile challenges" AND "remote" OR "communication barriers"
Frameworks	"SAFe" OR "Scrum@Scale" OR "LeSS" AND "remote Agile implementation"
Change Models	"Kotter's model" OR "ADKAR" OR "change framework" AND "Agile transformation"

Screening Process

A workflow was applied (see Figure 5). A total of 150 records were initially identified. After title and abstract screening, 90 records were excluded. Full-text review of the remaining 60 articles led to 18 exclusions due to lack of peer-review, domain mismatch, or insufficient methodological detail. The final 32 studies were included in the qualitative synthesis to support thematic analysis.

Figure 5

Workflow illustrating database search, screening, eligibility, and inclusion steps



Inclusion and Exclusion Criteria

Table 3

Predefined inclusion and exclusion criteria

Criteria	Inclusion	Exclusion
Publication Type	Peer-reviewed journals and conferences	Blogs, white papers, newsletters, editorials
Time Period	2014–2024	Before 2014
Language	English	Non-English
Domain Relevance	Agile, change management, remote work	Unrelated sectors (e.g., education, retail)

Quality Appraisal

Each study was evaluated for methodological rigor using a simple scoring rubric:

Table 4

Braun & Clarke's Six Phases of Thematic Analysis

Quality Indicator	Scoring
Clarity of Objectives	0-2
Methodological Transparency	0-2
Relevance to Research Questions	0-2
Data Validity and Reliability	0-2
Total Score	0-2

Note: Studies scoring ≥5 were included, ensuring reliable and relevant data.

Thematic Analysis

Braun & Clarke's (2021) six-phase approach guided coding and theme development:

Table 4

Braun & Clarke's Six Phases of Thematic Analysis

Step	Description
1. Familiarization	Intensive reading and annotation of selected articles to immerse in the data
2. Generating Codes	Systematic coding of relevant features (e.g., "Zoom fatigue", "tool overload")
3. Searching for Themes	Grouping codes into potential themes such as "Collaboration Barriers"
4. Reviewing Themes	Refinement and validation of themes for internal coherence and external relevance
5. Defining and Naming Themes	Assigning meaningful, concise labels and definitions to each theme
6. Producing the Report	Synthesizing findings and mapping themes to research questions for analysis

Table 5

Sample coding Extract

Code	Article	Excerpt
Zoom fatigue	Nesher Shoshan & Wehrt (2022)	"Participants reported increased mental strain during frequent video calls, impacting team collaboration."
Tool overload	Döring et al. (2022)	"Multiple overlapping digital platforms led to decreased productivity and workflow confusion."

Iterative coding led to five overarching themes (as seen in Table 6). Thematic saturation was monitored by checking for recurring patterns until no new codes emerged.

Table 6

Iterative coding in thematic analysis

Theme	Description
Communication and Collaboration	Addresses challenges such as time-zone differences, videoconferencing fatigue, communication lags, and weakened interpersonal team dynamics in distributed environments.
Agile Scaling Framework Challenges	Evaluates frameworks like SAFe in remote contexts—highlighting adaptation issues, coordination complexities, and inconsistent outcomes.
Change Management Practices	Discusses the implementation of structured models such as Kotter's 8-Step Model focusing on resistance, cultural shifts, and leadership buy-in in Agile transitions.
Technological Platform Dependence	Explores the reliance on digital tools (e.g., Zoom, MS Teams, Jira), including issues like redundancy, tool fatigue, and integration challenges.
Leadership and Governance	Covers distributed leadership practices, decision-making authority, accountability in remote teams, and aligning stakeholders in decentralized setups.

Summary of Research Design

The following table summarizes each key action taken during the research process, providing a step-by-step snapshot of how the study was conceptualized, executed, and analysed.

Table 7:

Summary of Research Activities

Stage	Action Taken
Define Research Questions	Developed three guiding qualitative research questions focused on Agile, remote work, and change management
Search Strategy	Used structured keyword searches across Three scholarly databases
Screening Process	Applied inclusion and exclusion criteria through title, abstract, and full-text reviews
Data Selection	Narrowed down from 250 initial results to 33 articles after full-text review
Analysis Method	Employed Braun and Clarke's six-step Thematic Analysis approach
Theme Identification	Identified five key themes relevant to research questions
Ethical Compliance	Maintained integrity through proper citation, source verification, and ethical research practices

Discussion

The study presented in this research report explored explored the challenges and dynamics of adopting the Scaled Agile Framework (SAFe) within remote work environments, synthesizing findings from 32 peer-reviewed studies. The thematic findings communication and collaboration, Agile scaling framework challenges, change management practices, technological platform dependence, and leadership and governance highlight the complexities faced by distributed Agile teams. The following discussion integrates critical analysis, practical examples, and theoretical implications.

Communication and Collaboration

Communication difficulties in remote Agile teams align with prior research emphasizing informal interactions and non-verbal cues in building trust and cohesion (Herbsleb & Mockus, 2003; Olson & Olson, 2000; Hinds & Bailey, 2003). Videoconferencing fatigue, time-zone differences, and tool overload reduce engagement during Agile ceremonies such as stand-ups and retrospectives (Nesher-Shoshan & Wehrt, 2022; Döring et al., 2022). These challenges highlight a fundamental tension between Agile's reliance on spontaneous interaction and the constraints of virtual work. For example, ARTs spanning multiple continents may struggle to synchronize backlog discussions, leading to delays and misalignment. Kotter's Step 4 (Communicate the Vision) and Step 6 (Generate Short-Term Wins) provide guidance to clarify iteration goals and recognize small achievements, sustaining motivation and cohesion. Integrating flexible video use, balancing synchronous/asynchronous communication, and adjusting meeting durations helps mitigate videoconferencing fatigue while preserving psychological safety.

Agile Scaling Framework Challenges

Delays in backlog alignment and role ambiguities within ARTs reflect well-documented complications of distributed work (Ciancarini et al., 2022; Turetken et al., 2017). Overlapping responsibilities between Product Owners and Release Train Engineers, coupled with unclear decision-making authority, exacerbate governance complexities unique to remote SAFe implementations (Fagerholm et al., 2021; Magistretti & Trabucchi, 2025). While SAFe provides structured coordination mechanisms, remote implementations expose gaps in alignment and timely decision-making. For instance, during PI Planning, teams may need to adjust objectives based on real-time feedback, highlighting the iterative tension with Kotter's linear steps. Applying Step 3 (Develop a Vision) and Step 5 (Empower Broad-Based Action) iteratively allows teams to reconcile structured change management with Agile adaptation. Alternative models such as ADKAR, emphasizing individual change readiness, can complement Kotter by providing a more flexible, iterative approach suitable for remote contexts.

Change Management and Resistance

Resistance to Agile adoption manifests as low participation, reluctance to embrace new processes, and reduced psychological safety (Lehtinen et al., 2017; Marsya & Raharjo, 2024; Putta et al., 2018). Kotter's 8-Step Change Model offers a structured framework for leadership visibility, communication, and behavioural change (Magistretti & Trabucchi, 2025). However, its linear approach may conflict with Agile's iterative cycles, requiring repeated revisiting of steps such as Step 3 (Develop a Vision) or Step 2 (Form a Guiding Coalition). For example, a Release Train Engineer may need to reassess the vision after a sprint review to align with updated priorities. Hybrid approaches that integrate Kotter's steps with iterative feedback loops or ADKAR enhance practical applicability in distributed Agile environments. Such integration ensures leadership maintains momentum while adapting to real-time challenges, supporting psychological safety and overall adoption success.

Technological Tool and Platform Dependence

Dependence on multiple, often non-integrated digital tools can cause duplication, fragmentation, and delays in task tracking (Putta et al., 2018; Magistretti & Trabucchi, 2025; Zhang & Boyle, 2023).

Fragmented tool usage increases cognitive load, disrupts workflow, and impairs team morale. For example, integrating Jira with Confluence enables real-time progress tracking across distributed ARTs, while Kotter's Step 6 (Generate Short-Term Wins) highlights small deliverables, reinforcing consistent practice adoption. Prioritizing tool integration, establishing usage guidelines, and aligning digital platforms with governance practices are essential for maintaining operational coherence in distributed Agile teams.

Leadership and Governance

Reduced leadership visibility contributes to uncertainty and misalignment in distributed SAFe environments (Magistretti & Trabucchi, 2025; Ciancarini et al., 2022). Intentional leadership behaviours trust-building, empathy, clear communication, and outcome focus are crucial to bridge physical distance and sustain Agile momentum. Kotter's Steps 1 (Create Urgency), 4 (Communicate Vision), and 8 (Anchor New Approaches) guide distributed teams in reinforcing change and embedding it in organizational culture. For instance, weekly virtual check-ins by Release Train Engineers ensure alignment, gather feedback, and reinforce governance structures. This demonstrates how structured change management can be integrated with Agile practices to enhance coordination and team performance.

Implications and Future Research

The findings in the present study illustrate how remote work reshapes Agile adoption at scale, emphasizing communication, governance, change management, and tool challenges. Integrating structured change management with Agile practices, aligning technological tools, and sustaining leadership visibility are essential for remote SAFe success. Kotter's model provides a valuable foundation, but iterative adaptation is necessary. Future research could involve longitudinal studies of distributed ARTs, semi-structured interviews with Agile coaches, field observations of remote ceremonies, and surveys exploring psychological safety and resistance dynamics. Such empirical work would bridge theory and practice, validate conceptual findings, and assess alternative or hybrid change models in distributed Agile contexts.

Limitations

The study presented in this paper relied exclusively on secondary peer-reviewed literature, which may not capture real-time dynamics. Variations in context, methodology, and geographic focus may limit generalizability. Kotter's 8-Step Change Model was applied conceptually; its practical effectiveness in diverse remote SAFe environments requires empirical validation. Future empirical studies using longitudinal observation, practitioner surveys, or cooperative inquiry could provide deeper insights into distributed Agile adoption and change management effectiveness.

Conclusion

Summary of Research and Key Findings

The research presented in this research report investigated the challenges associated with adopting the Scaled Agile Framework (SAFe) in remote work environments, synthesizing evidence from 32 peer-reviewed studies. The key findings highlight persistent issues in communication and collaboration, ambiguities in Agile scaling and role definitions, resistance to change, technological dependencies, and reduced leadership visibility. These findings align with existing research while also identifying unique barriers specific to distributed Agile contexts, such as the intensified impact of tool overload and time-zone differences on coordination and psychological safety.

Interpretation and Implications for Theory and Practice

From a theoretical perspective, the research report demonstrates that traditional change management models, such as Kotter's 8-Step Change Model, remain relevant and can provide structured guidance for managing organizational change in distributed Agile environments. However, the insights should be interpreted with caution, as they are derived solely from secondary literature and have not been empirically validated through interviews or real-world case studies.

From a practical perspective, the study underscores the importance for organizations to:

- Integrate structured change management alongside Agile practices to guide transitions and address resistance.
- Address technological fragmentation, ensuring that digital tools are integrated and workflows are streamlined to reduce cognitive load and miscommunication.
- Enhance leadership presence and governance visibility in distributed teams to maintain alignment, trust, and accountability.

The synthesis of these findings highlights unique insights generated by this review, including a mapping of common remote Agile challenges to Kotter's model, identification of critical intervention points for leadership and communication, and practical guidance for balancing structured change with iterative Agile practices.

In conclusion, successful Agile transformation in remote teams requires a dual focus: balancing structured change management approaches with Agile organizational practices that prioritize human and cultural dimensions. This approach supports resilience, sustained momentum, and long-term success in distributed Agile environments. While the conceptual relevance of Kotter's model is reinforced, future research incorporating empirical validation such as longitudinal studies, field observations, or practitioner interviews would strengthen understanding of its practical applicability and further refine strategies for effective remote Agile adoption.

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Mapping Core Practices in Disciplined Agile Delivery (DAD) to ISO 9001:2015 Requirements

Arie Kurniawan
Auckland University of Technology

Ramesh Lal
Department of Computer and Information Sciences, AUT Computer and Information Sciences Research Centre, Auckland University of Technology

Abstract

Organizations adopting agile frameworks often struggle to maintain compliance with ISO 9001:2015 Quality Management Systems – Requirements, particularly during certification audits where evidence of conformance is mandatory. From an ISO 9001 auditor's perspective, this tension reflects a fundamental challenge: agile practices prioritize flexibility, minimal documentation, and rapid iteration, while ISO 9001 enforces structured processes, documented information, and traceability. This study addresses that challenge by investigating how Disciplined Agile Delivery (DAD), a governance-oriented agile framework, can be aligned with ISO 9001 requirements without compromising agility. The research employs a Multivocal Literature Review (MLR), incorporating both academic and practitioner sources, and applies Reflexive Thematic Analysis (RTA) to synthesize insights. Guided by Process Compliance Theory, the study conceptualizes the mapping of DAD practices to ISO 9001 clauses as a hybrid governance approach, embedding compliance checkpoints and documentation enhancements within DAD's adaptive structure. This theoretical framework explains how organizations can operationalize compliance through adaptive mechanisms rather than rigid controls. The findings identify six DAD practice pillars, namely Full Delivery Lifecycle, Focus on Process Goals, Defined Roles and Responsibilities, Agile Governance, Context-Sensitive Practice, and DevOps and Enterprise Awareness. This study also demonstrates their varying degrees of alignment with ISO 9001 clauses. Practical adaptations, such as lightweight documentation strategies and integrated compliance reviews, are proposed to bridge gaps. By combining auditor-informed insights with theoretical framing, this study contributes a structured mapping framework and actionable recommendations for organizations seeking to maintain agility while achieving ISO 9001 certification.

Keywords

ISO 9001, Disciplined Agile Delivery, DAD, Compliance, Practice Adaptation

Introduction

Organizations adopting agile frameworks often face significant challenges when reconciling flexibility with the structured compliance requirements of ISO 9001:2015. From an ISO 9001 auditor's perspective, these challenges are not merely procedural but reflect a deeper tension between adaptive delivery models and prescriptive quality standards. Agile methods emphasize rapid iteration, minimal documentation, and team autonomy, whereas ISO 9001 demands documented evidence, defined roles, and traceable processes to ensure auditability and certification credibility. This tension frequently surfaces during audits, where agile teams struggle to demonstrate compliance without reverting to heavyweight practices that undermine agility.

To interpret this problem, the study applies Process Compliance Theory (PCT), which explains how organizations balance formal compliance obligations with adaptive practices. ISO 9001 represents a prescriptive compliance model, while Disciplined Agile Delivery (DAD) offers a governance-oriented yet flexible approach. By framing the research through this theory, the study positions its mapping as a hybrid governance strategy that embeds compliance checkpoints and documentation enhancements

within DAD's iterative structure. This perspective highlights that compliance, instead of being rigid, can be operationalized through adaptive mechanisms that preserve agility while satisfying certification requirements. The research thus addresses a critical gap for practitioners and auditors seeking to maintain agility in quality-critical environments.

Background

This section examines the foundational literature surrounding DAD and ISO 9001 and how applying the PCT helps interpreting the problem surrounding the effort to reconcile them in the context of certification audit.

Disciplined Agile Delivery (DAD)

Disciplined Agile Delivery (DAD), introduced by Scott Ambler and Mark Lines in 2012, addresses gaps in early agile methods like Scrum and XP, which focused mainly on development and lacked guidance on architecture, governance, and DevOps (Ambler & Lines, 2018). Originating from insights at IBM Rational in 2008, DAD was designed as a hybrid, goal-driven, people-first, and learning-oriented framework that supports the full delivery lifecycle from inception to deployment. It integrates practices from Scrum, Kanban, Lean, Agile Modelling, Agile Data, and the Unified Process, making it suitable for scaling agile while maintaining flexibility (Ambler & Lines, 2018).

DAD evolved into the broader Disciplined Agile (DA) framework in 2015, adding layers such as Disciplined DevOps, DA IT, and DA Enterprise to support continuous delivery and business agility (PMI, n.d.). By 2018, it matured into the Disciplined Agile Toolkit, emphasizing Guided Continuous Improvement through goal diagrams and decision points. PMI's acquisition of DA in 2019 expanded its reach and integration with project management standards, reinforcing its role in enabling context-sensitive agility at scale (PMI, n.d.). DAD supports full delivery lifecycles, typically comprising Inception (planning and alignment), Construction (incremental development), and Transition (testing and deployment) (PMI, n.d.). It offers five lifecycle variants to suit different contexts, ensuring adaptability for diverse teams and domains. Central to DAD are 24 process goals that span across all phases, guiding teams through key activities like scope exploration, technical strategy, quality improvement, and production readiness. Each goal includes decision points and practice options, allowing teams to tailor their Way of Working (WoW) based on context (Ambler & Lines, 2018). This flexibility is critical for aligning agile practices with compliance standards such as ISO 9001, which demand traceability and governance. By combining structured guidance with adaptability, DAD enables organizations to scale agile without sacrificing control or quality.

ISO 9001:2015 Quality Management Systems

ISO 9001:2015 Quality Management Systems - Requirements is the latest revision of the globally recognized standard for Quality Management Systems (QMS), designed to help organizations meet customer and regulatory requirements while driving continual improvement and customer satisfaction (International Organizations for Standardization, n.d.). ISO 9001 is part of the ISO 9000 family, originating from post-World War II efforts to standardize quality practices (Sharma, 2025). Its roots lie in the British Standard BS 5750 (1970s), which influenced the first ISO 9001 release in 1987. Early versions were highly prescriptive, emphasizing documented procedures and compliance. The 1994 update reinforced preventive action but remained bureaucracy heavy (Sharma, 2025).

The 2000 revision marked a major shift to a process-based approach, focusing on customer satisfaction, leadership, and continuous improvement. ISO 9001:2008 refined language for clarity, while ISO 9001:2015 introduced risk-based thinking, flexibility in documentation, and alignment with organizational context and strategy (International Organizations for Standardization, n.d.). It adopted the Annex SL structure for integration with other standards like ISO 14001 and ISO 45001 (International Organizations for Standardization, 2025). Today, ISO 9001 continues to evolve, addressing globalization, digital transformation, and sustainability.

According to the ISO organization, ISO 9001:2015 is built on seven principles:

- Customer Focus: Meeting and exceeding expectations
- Leadership: Establishing unity of purpose
- Engagement of People: Empowering employees
- Process Approach: Managing activities as processes
- Improvement: Driving continual enhancement
- Evidence-Based Decision Making: Using data for decisions
- Relationship Management: Strengthening stakeholder ties

Process Compliance Theory: Concept and Foundations

Process Compliance Theory (PCT) addresses how organizations reconcile formal compliance obligations with adaptive operational practices. It emphasizes that compliance is not merely a static checklist but a dynamic process requiring continuous alignment between regulatory standards and organizational workflows. In regulated environments, compliance ensures adherence to laws, standards, and internal policies, mitigating risks and maintaining operational integrity. Scholars argue that compliance frameworks must evolve beyond rigid enforcement to incorporate flexibility, enabling organizations to adapt without compromising accountability or auditability (Davis, 2025).

The theory posits three core principles:

- Normative Alignment: Processes must conform to external standards (e.g., ISO 9001) while supporting organizational objectives.
- Adaptive Mechanisms: Compliance should be embedded within iterative workflows rather than imposed as post-process checks.
- Traceability and Accountability: Evidence of conformance must be demonstrable through documented information and governance checkpoints, even in agile contexts (Castellanos Ardila et al., 2022).

Process Compliance Theory in Agile – ISO 9001 Integration

In quality-critical domains, compliance frameworks such as ISO 9001 demand structured documentation, defined roles, and risk-based thinking. Studies highlight that organizations often struggle to integrate these requirements into agile environments, where minimal documentation and rapid iteration dominate. PCT provides a framework for designing hybrid governance models that embed compliance within adaptive practices, reducing friction during audits and certification processes (Knisley, 2025).

Recent literature explores how agile frameworks can coexist with ISO 9001 by adopting compliance-oriented adaptations. Adam (2023) and related works propose embedding compliance checkpoints into agile ceremonies and using lightweight documentation strategies to satisfy ISO requirements without undermining agility. These approaches align with PCT's emphasis on balancing flexibility and formal conformance, conceptualizing compliance as an integrated, iterative activity rather than a rigid constraint (Adam, 2023).

Process Compliance Theory provides a tool to interpret the tension between DAD and ISO 9001:2015 in this research. It posits that compliance is not a static requirement but a dynamic process that must balance normative obligations with operational adaptability. From this perspective, ISO 9001 represents a prescriptive compliance model, whereas DAD signifies adaptive governance. The challenge lies in reconciling these paradigms without compromising either agility or auditability. Applying PCT, the integration of DAD and ISO 9001 can be conceptualized as a hybrid governance approach, embedding compliance checkpoints and lightweight documentation within iterative workflows.

Methodology

Objectives and Research Questions

The objectives of this research are as follows: (1) Identify DAD core practices; (2) Map them to ISO 9001 clauses; (3) Propose adaptations for compliance. The research questions formulated for the research are as follows:

RQ1 - What are the themes of core practices prescribed or commonly used in DAD?
RQ2 - How do the practice themes align with ISO 9001:2015 requirements?

RQ3 - What adaptations or extensions to scale agile (e.g. DAD and/or SAFe) practices have been proposed to meet ISO standards?

3.2. Method

The study presented in this paper employed an MLR to investigate the alignment between DAD practices and ISO 9001:2015 Quality Management Systems - Requirements. The MLR approach was chosen because it integrates both academic sources (white literature) and practitioner-oriented materials (grey literature), offering a comprehensive perspective that bridges theory and practice. Unlike traditional Systematic Literature Reviews (SLRs), the MLR includes industry reports, professional blogs, and case studies alongside peer-reviewed research, ensuring that insights reflect both scholarly rigor and real-world applicability (Kitchenham & Charters, 2007; Garousi et al., 2019).

The review followed a structured protocol aligned with PRISMA guidelines to ensure transparency and reproducibility (Page et al., 2021). A detailed search strategy was developed using Boolean operators to construct search strings for three research questions: identifying DAD core practices, mapping these practices to ISO 9001 clauses, and exploring proposed adaptations for compliance. Searches were conducted across major academic databases such as IEEE Xplore, ACM Digital Library, Scopus, and ScienceDirect, complemented by manual searches of grey literature from reputable sources including PMI and ISO websites.

Figure 1

Search strings used in the Selection of Literature

("Disciplined Agile Delivery" OR "Disciplined Agile" OR "DAD") AND ("ISO 9001:2015" OR "ISO 9001" OR "Quality Management Systems" OR "Quality Management" OR "QMS") AND ("mapping" OR "alignment" OR "compliance")

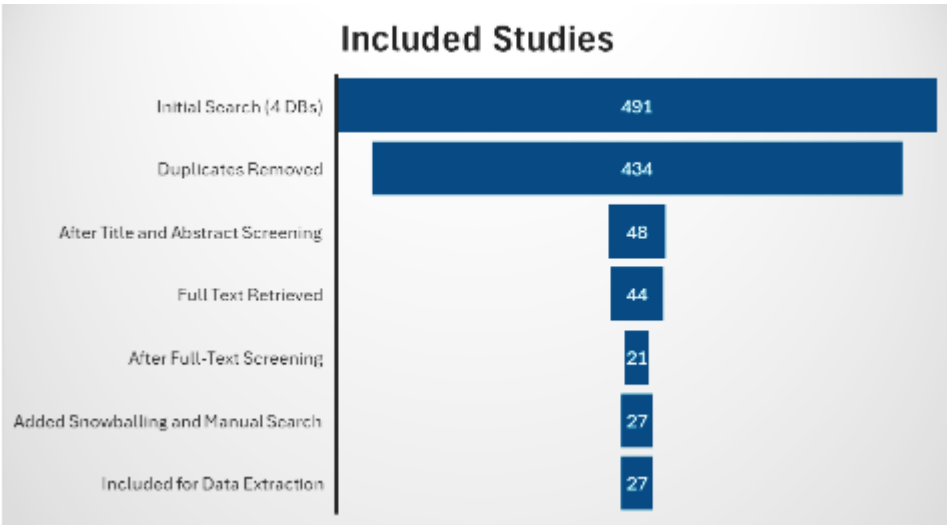
("Disciplined Agile Delivery" OR "Disciplined Agile" OR "DAD") AND ("ISO 9001:2015" OR "ISO 9001" OR "Quality Management Systems" OR "Quality Management" OR "QMS") AND ("integration" OR "alignment" OR "comparison")

Note: The search key strings designed to retrieve the literature.

Clear inclusion and exclusion criteria guided study selection. Literature was included if it discussed Scaled Agile (SAFe or DAD) practices, ISO 9001 requirements, or agile–ISO integration and was published between 2005 and 2025 in English. Studies irrelevant to ISO compliance, opinion pieces, or incomplete texts were excluded. After duplicate removal and initial screening of titles and abstracts, full-text reviews were conducted. Quality assessment applied a scoring framework based on producer credibility, methodological clarity, objectivity, novelty, and impact.

Figure 2

Selection of Literature



Note: Converging numbers of the literature selection process.

Data Extraction and Theme Development

Data extraction was performed using a structured form designed to capture publication details, agile practices, ISO clauses, and quality scores. Coding followed the Annex SL structure of ISO 9001 to ensure systematic mapping. Attributes were iteratively refined to identify emerging themes.

The extracted data was then synthesized using Reflexive Thematic Analysis (RTA), which involved coding, theme development, and iterative refinement (Braun & Clarke, 2020). Themes were aligned with the research questions, and mappings were categorized as direct, partial, or non-aligned.

Process Compliance Theory to Guide the Mapping

The mapping of DAD practice pillars to ISO 9001 requirements was guided by PCT, which frames compliance as a dynamic process rather than a rigid constraint. This theoretical framework influenced the interpretation of alignment by emphasizing the need for hybrid governance that embeds compliance mechanisms within adaptive workflows.

By applying PCT, the mapping was closer to interpretive insight where ISO 9001 requirements were not treated as external constraints but as normative obligations that can coexist with agile adaptability. This perspective informed recommendations such as lightweight documentation strategies and embedded compliance reviews which ensures audit readiness without sacrificing agility. PCT thus provides both a conceptual foundation and practical rationale for categorizing alignment types (direct, partial, potential conflict) and proposing targeted adaptations.

Findings

RQ1: DAD Core Practices

The data analysis process consolidated raw codes extracted from the literature into higher-level themes through iterative refinement. Following the RTA (Braun & Clarke, 2020), initially, individual codes representing agile practices, ISO compliance elements, and adaptation strategies were captured during data extraction. These codes were then grouped into conceptual clusters based on functional similarity, such as risk management, governance, documentation, and lifecycle practices. Through successive iterations, these clusters were mapped to themes aligned with the research questions. This structured approach ensured traceability from granular data points to synthesized themes, enabling

systematic identification of alignment types (direct, partial, or conflict) and supporting the development of adaptation strategies.

Table 1

Data Analysis Sample

Data Code (Iteration 1)	Data Code (Iteration 2)	Themes
SCUM/XP: Daily Standups', 'Lean: Perfect Quality', 'System Process Framework: Continuous improvements via audit findings', 'Lean: Quality Tools (for example: Root Cause Analysis)', 'SCRUM/XP: Customer-driven requirements', 'SCRUM/XP: Product Owner Review', 'Process Control (Requirements', 'Lean: FMEA (Process & Design)', 'Kaizen, Scorecard', 'Lean: PDCA Cycle', 'Lean: Obeya Room', 'Iterative Improvement Cycle', 'SCRUM/XP: Annual reviews and audits', 'Output-Based Performance Evaluation', 'Visual Scorecard', 'Quality Commitment', 'Lean: Bechmarking', 'Lean: Formal Meetings and Brainstorming', 'System Process Framework: Effort tracking with JIRA', 'Backlog updates for comformity', 'SCRUM Documentation: Risk Analysis Report', 'Lean: Significant figures and Data analysis', 'SCRUM/XP: SPRINT Goals, Retrospectives and Team Metrics', 'SCRUM: Sprint Review and Retrospective', 'SCRUM: Face-to-face communication', 'Retrospectives as Management Review', 'Resources, Rules, Coordination, Reviews) ', 'SCRUM/XP: Process improvement through agile retrospectives', 'SCRUM/XP: Continues Improvement', 'SCRUM Documentation: Sprint Review/Retrospective', 'Lean: FMEA', 'Feedback Loop', 'SCUM/XP: Sprint Review Meetings', 'XP: Customer Acceptance Test', 'SCRUM:Risk Management (implicit in Scrum)', 'System Process Framework: Incident and change management', 'Model-Driven Approach: Release plan extension and ceremony registry', 'XP: On-Site Customer Prototyping', 'System Process Framework: Sprints', 'Lean: MSA, SPC, Capability Studies', 'Model-Driven Approach: Daily and retrospective meetings', 'align with PDCA cycle', 'Model-Driven Approach: Backlog specification and refinement', 'Lean: A3 Problem Solving', 'Risk Analysis and Mitigation', 'Six Sigma, Root Cause Analysis', 'Lean: Pareto Charting', 'Lean: Visual Management', 'System Process Framework: Quality Metrics', 'Lean: Continuous Improvement', 'SCRUM:Sprint Review & Retrospective', 'SCRUM: Continuous improvement', 'SCRUM: Risk Management', 'Lean: 8D, 3C, Kobetsu Kaizen (KK)', 'Lean: Gemba Walks', 'SCUM/XP: Reflection Workshops'	Risk Management (FMEA, Risk Analysis Reports) Metrics and Scorecards Retrospectives and Reviews Audit and Compliance Tools Evidence-Based Improvements	Agile Governance (Milestone Review, Risk-Based Thinking, Evidence-Based Improvements)

Note: A table illustrating a sample of data analysis and theme development.

Through the process, six foundational pillars gradually emerged that answer the research questions formulated in RQ1, as summarized in the following table: (1) Full Delivery Lifecycle, (2) Focus on Process Goals, (3) Defined Roles and Responsibilities, (4) Agile Governance, (5) Context-Sensitive Practice, and (6) DevOps & Enterprise Awareness.

Table 2

DAD Core Practice Pillars

No	DAD Core Practice Pillar	Brief Description
1	Full Delivery Lifecycle	Covers inception to deployment and support
2	Focus on Process Goals	Goal-driven guidance for agile teams
3	Defined Roles and Responsibilities	Clear role definitions for accountability
4	Agile Governance	Lightweight governance integrated into agile
5	Context-Sensitive Practice (WoW)	Tailored practices based on organizational needs
6	DevOps and Enterprise Awareness	Integration with enterprise systems and DevOps

Note: DAD Core Practice Pillars emerged from the literature synthesis.

RQ2: Mapping to the ISO 9001:2015 Requirements

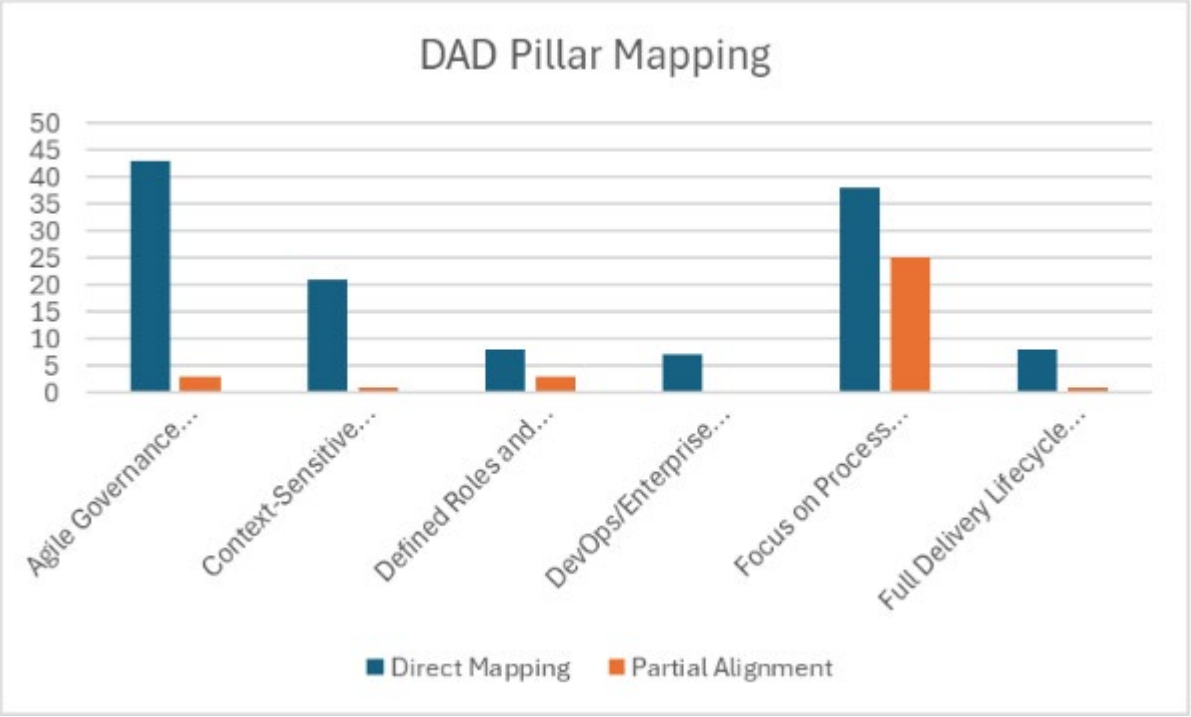
The mapping analysis follows the PCT principles to provide both a conceptual foundation and practical rationale for categorizing alignment types (direct, partial, potential conflict) and proposing targeted

adaptations. For example, the pillar 'Agile Governance' was mapped to clauses on leadership and continual improvement (Clauses 5.1 and 10.3) because PCT supports integrating compliance checkpoints into iterative ceremonies rather than imposing separate audit processes. Similarly, 'Focus on Process Goals' aligns with planning and operational control clauses (Clauses 6.2 and 8.1). This reflects PCT's principle that compliance should be operationalized through goal-driven practices rather than static documentation.

'Agile Governance' and 'Focus on Process Goals' show strong alignment with ISO clauses on monitoring and continual improvement (Clause 9 and 10). 'Context-Sensitive Practice' aligns with organizational context requirements (Clause 4). Limited alignment exists for 'Full Delivery Lifecycle' and 'DevOps & Enterprise Awareness', requiring targeted adaptations.

Figure 3

DAD Core Practice Pillar Mapping



Note. Mapping instances of DAD core pillars to the ISO 9001 requirements.

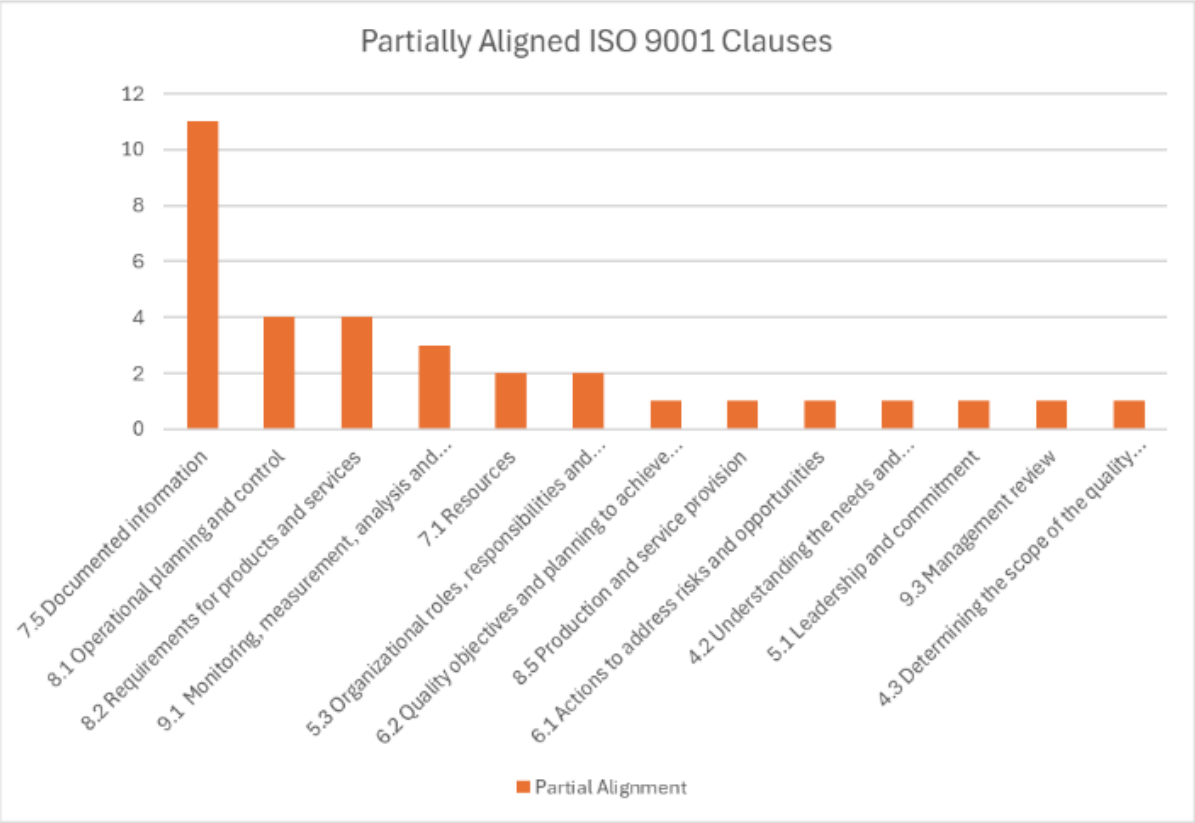
Figure 3 above summarizes these mappings and alignment strengths. For example, 'Agile Governance' maps strongly to ISO clauses on leadership (Clause 5) and continual improvement (Clause 10), while 'DevOps & Enterprise Awareness' requires competency matrices and audit trails.

RQ3-1: Adaptations for Compliance

Most practices exhibit direct mapping to clauses related to Operational Planning (Clause 8), Resource Management (Clause 7), and Continual Improvement (Clause 10), indicating strong compatibility between agile delivery principles and ISO 9001:2015 quality management requirements. However, partial alignments were observed in areas such as Documentation (Clause 7.5) and role formalization (Clause 5.3), suggesting that while agile practices support ISO objectives, they often lack the prescriptive rigor demanded by certification standards.

Figure 4

ISO 9001 Partial Alignment



Note: Instances of partial alignment of DAD core pillars to the ISO 9001 requirements.

These findings underline that DAD's flexibility and goal-driven approach can complement ISO compliance, but adaptations are necessary to bridge gaps in governance, documentation, and audit readiness. Recommended adaptations include: (1) Lightweight documentation templates for Clause 7.5; (2) Compliance checkpoints in agile ceremonies; (3) Role charters translating agile roles to ISO accountability; (4) Extended lifecycle coverage for post-release quality assurance; (5) Competency matrices for DevOps practices.

RQ3-2: Adaptation in Literature

The literature reveals several practical strategies for aligning scaled agile practices with ISO 9001:2015 requirements without compromising agility. Patricia A. Adam's book Agile in ISO 9001 (2023) provides one of the most comprehensive frameworks, offering pragmatic approaches to embed agile principles within ISO-certified environments. Her work emphasizes reconciling Agile's iterative nature with ISO's structured compliance requirements and improving communication with auditors.

A case study from Indonesia (Hermawati et al., 2024) illustrates challenges in public sector projects, where Scrum's minimal documentation conflicted with ISO's traceability demands. The study proposes Standard Operating Procedures (SOPs) to bridge this gap, enabling agile workflows while maintaining compliance.

Industry contributions, such as Milestone Technologies' mapping of ISO clauses to Scrum practices (Burbano-Delgado et al., 2021), demonstrate how agile ceremonies like sprint planning and retrospectives can fulfil ISO requirements for customer focus, risk-based thinking, and design planning. Similarly, academic research in *The TQM Journal* (Mathrani et al., 2022) encourages adaptive documentation strategies with "just enough" documentation to balance agility with ISO's accountability standards.

Finally, Adam's DGQ report *Practically Best Friends?!* (2021) challenges the perceived incompatibility between agility and ISO compliance. It offers guidelines for integrating agile processes into QMS frameworks, emphasizing shared values such as continuous improvement and transparency.

Collectively, these studies confirm that agile and ISO 9001 can coexist through targeted adaptations, including lightweight documentation, compliance checkpoints, formalized roles, and tailored governance practices. These approaches enable organizations to maintain agility while meeting regulatory expectations.

Discussion

Theoretical Framing and Research Contribution

The application of PCT provided a conceptual foundation for interpreting the alignment between DAD practices and ISO 9001:2015 requirements. Rather than treating compliance as a rigid constraint, PCT frames it as a dynamic process that must balance normative obligations with operational adaptability. This perspective guided the mapping by emphasizing hybrid governance that embeds compliance mechanisms within iterative workflows instead of imposing separate, heavyweight processes.

The findings demonstrate that while DAD's governance-oriented structure offers strong compatibility with ISO 9001 principles, gaps remain in areas such as documentation, lifecycle coverage, and competency management. PCT helps explain why these gaps occur, that is because ISO 9001 enforces prescriptive evidence requirements, whereas DAD prioritizes flexibility and context-sensitive tailoring. By applying PCT, the study reframes these gaps as opportunities for adaptive compliance rather than incompatibility. This approach enables organizations to maintain agility while embedding audit-ready practices, creating a hybrid compliance model that balances flexibility with regulatory compliance.

This study offers a unique contribution by addressing a critical gap in the integration of agile practices, specifically DAD, with ISO 9001 compliance and practical audit experience. While previous research has explored mappings between Scrum and ISO 9001 or proposed generic agile–ISO harmonization strategies, these approaches often focus on conceptual alignments. This study leverages auditor experience to propose operationally viable adaptations for certification audits. It focuses on DAD as a governance-oriented, hybrid agile framework that extends beyond development to cover the full delivery lifecycle, making it particularly relevant for organizations operating under stringent quality management requirements. Drawing on practical experience as an ISO 9001 auditor, the research addresses real-world challenges encountered during certification audits, such as gaps in traceability, role formalization, and documented information. This perspective ensures that the proposed mapping and adaptations are not only theoretically sound but also operationally viable for audit readiness.

Insights for Full Compliance

To achieve full compliance in the context of ISO 9001:2015 certification audit, several adaptations to the core practices in DAD are necessary:

Documentation Practices: Enhance lightweight documentation using structured templates, digital repositories, and traceability matrices to meet Clause 7.5 without sacrificing agility.

Governance and Compliance: Integrate compliance checkpoints into agile ceremonies and maintain evidence logs to support audit readiness and continual improvement (Clauses 9.1, 9.3, 10.3).

Role Definition: Formalize agile roles with ISO-compliant accountability statements through role charters (Clause 5.3).

Lifecycle Coverage: Extend DAD lifecycles to include post-release validation and service continuity plans for full process coverage.

Context Sensitivity: Document rationale for tailoring practices and maintain a WoW repository to satisfy standardization requirements (Clauses 4.4, 8.1).

DevOps and Enterprise Awareness: Implement structured competency evaluations, training records, and CI/CD audit trails to align with resource and competence clauses (Clauses 7.1, 7.2).

These adaptations enable organizations to maintain agility while meeting ISO 9001 compliance, creating a hybrid model that balances flexibility with regulatory demands. Rather than abandoning agile principles, organizations can adopt targeted adaptations that embed ISO-compliant structures into agile workflows. For instance, (1) documentation practices can be enhanced through lightweight templates, digital repositories, and traceability matrices, ensuring compliance with ISO 9001 requirements while minimizing overhead. (2) Governance can be strengthened by incorporating compliance checkpoints into agile ceremonies, such as using retrospectives for management reviews and risk assessments. Similarly, (3) role definitions should be formalized through ISO-compliant accountability statements to meet Clause 5.3 requirements. (4) Lifecycle coverage can be extended to include transition and support phases for post-release quality assurance.

The study opens several paths for future research. (1) Empirical studies are needed to evaluate how adaptive documentation strategies influence team velocity and audit outcomes, providing evidence-based guidance for balancing compliance and agility. (2) Comparative research across industries could explore contextual factors such as regulatory environments and organizational maturity, that affect the success of integrating DAD with ISO 9001. Additionally, (3) there is significant potential for developing practical frameworks and toolkits that operationalize this alignment, offering practitioners actionable resources for implementation.

Limitations

Despite its contributions, the study has limitations. (1) While the inclusion of grey literature enriched practical insights, it introduces variability in credibility and methodological rigor, as some sources lack peer review or empirical validation. Quality assessment criteria were applied, but residual bias cannot be fully eliminated. (2) The mapping of DAD practices to ISO 9001 clauses involves interpretive judgment. Although supported by RTA and guided by PCT, the process remains inherently subjective and may reflect researcher bias. Furthermore, (3) Both ISO 9001 and DAD are evolving frameworks. The findings are based on ISO 9001:2015 and the current state of DAD, with limited consideration of the Draft International Standard (DIS) for ISO 9001:2026. Future revisions may affect the relevance of the proposed mapping.

Conclusion

This study set out to examine how DAD practices can align with ISO 9001:2015 requirements and what adaptations may be necessary to support compliance for certification purpose. Through a Multivocal Literature Review and Reflexive Thematic Analysis, six core DAD practice pillars were identified and mapped to ISO clauses, revealing areas of strong alignment as well as gaps requiring targeted adjustments. While the findings suggest that DAD's governance-oriented approach offers a viable pathway for integrating agility with formal quality standards, adaptations in documentation, role formalization, and lifecycle coverage remain essential for audit readiness.

The proposed mapping and recommendations provide practical guidance for organizations seeking to maintain agility while meeting ISO 9001 certification requirements. However, the study's reliance on literature-based synthesis and absence of empirical validation limits generalizability. Future research should focus on case studies, expert reviews, and tool-supported frameworks to operationalize these findings in diverse industry contexts. By addressing these gaps, organizations can move toward more adaptive yet certifiable delivery models that balance flexibility with compliance.

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Adopting Data-Analytics Methods for Decision-making Processes in IT Project Portfolio Management

Thafnitha Faisal
Engineering, Computer and Mathematical Sciences, Auckland University of Technology

Daniel Vaipulu
Project Management Research Office, AUT Computer and Information Sciences Research Centre, Auckland University of Technology

Abstract

This paper investigates how data analytics can be operationalised to improve decision making in IT Project Portfolio Management (ITPPM) for large, scaled agile organisations, using the Disciplined Agile Delivery (DAD) portfolio process blade as the organising lens. Through a multivocal literature review that integrates peer-reviewed and credible grey literature, the research addresses three linked questions: 1) What challenges inhibit data-driven decision-making in ITPPM; 2) Which data analytics methods are reported for ITPPM; and 3) What are the benefits and success factors when analytics methods are integrated into portfolio practices. Findings show recurring barriers across DAD practices, led by poor data quality and integration, immature governance and PMO alignment, tooling and capability gaps, unreliable intake scoring, limited portfolio risk telemetry, and weaknesses in financial and operational measurement. To operationalise these insights, the study proposes a three-layer conceptual framework (DAD practices → analytics methods → benefits & success factors) that serves as a guide for leaders to sequence interventions: establish data and governance foundations, pilot targeted analytics, then institutionalise successful patterns. The paper concludes with practical roadmaps and research directions to validate the framework empirically.

Keywords

IT project portfolio management, Disciplined Agile Delivery (DAD), data analytics methods, ITPPM challenges, governance, MCDM and portfolio optimisation, operational monitoring.

Introduction and Background

Information Technology (IT) evolves rapidly, and large organisations require structured project portfolio management to maintain strategic alignment and value delivery (Dairo et al., 2021). In scaled-agile IT organisations, Project Portfolio Management (ITPPM) is a well-organised approach that enables organisations to assess, select, prioritise, and manage projects by ensuring alignment with strategic business objectives. It emphasises not only project execution but also "doing the right initiatives" and "doing it in the right way" (Rajegopal et al., 2007a). Without a formal IT project portfolio management capability, organisations suffer predictable harms. They incur financial inefficiency through budget overruns and funding of low-value or duplicate initiatives, while strategic alignment drifts as projects are approved that do not support corporate goals or meet customer needs (Levine, 2005). Visibility and decision-making degrade because reporting is fragmented, and there is no single view of status, priorities, or risks, which forces leaders into reactive choices of decisions (Rad & Levin, 2006). IT project portfolio management has progressed from basic lists for selecting projects to comprehensive frameworks that align business strategy, financial oversight, and delivery methods. Early frameworks emphasised financial metrics and discrete stage-gates; approaches incorporate agile delivery, product thinking, and continuous funding models to reflect in dynamically fluctuating digital markets and services.

Collecting precise and reliable project data enhances transparency in decision-making, enabling informed, data-driven decisions, and that will lead to identifying potential challenges, such as unrealistic objectives or financially unsustainable business strategies (Bonham, 2005; Levine, 2005). Throughout this lifecycle, data-driven decision-making has significantly emerged as a cornerstone of modern PPM practices and is significant (Rad & Levin, 2006) by the usage of historical and real-time data collection, consolidation, and optimisation for both Product and Project Portfolio Management. Although data-analytics methods and their adoption for data-driven decision making have been studied, their application to IT projects and portfolio management within DAD practices remains an important gap, warranting further investigation. Disciplined Agile Delivery organises portfolio management around context-sensitive decision points (identify potential value; plan capability; prioritise; manage budget; initiate, finance, or end work; address risk; govern). Integrating analytics into these Process Blade activities promises greater transparency, decision legitimacy, bias reduction, and clearer links between portfolio choices and outcomes. Yet robust empirical evidence is missing on how to operationalise analytics methods within the DAD processes, and which approaches yield demonstrable portfolio improvements in large, scaled-agile organisations. Critical gaps identified in the multivocal literature review serve as the basis from which the research questions are derived. By addressing these questions, the study generates findings that can be directly leveraged to strengthen project portfolio management (PPM) practices through data-driven approaches in real-world organisational environments.

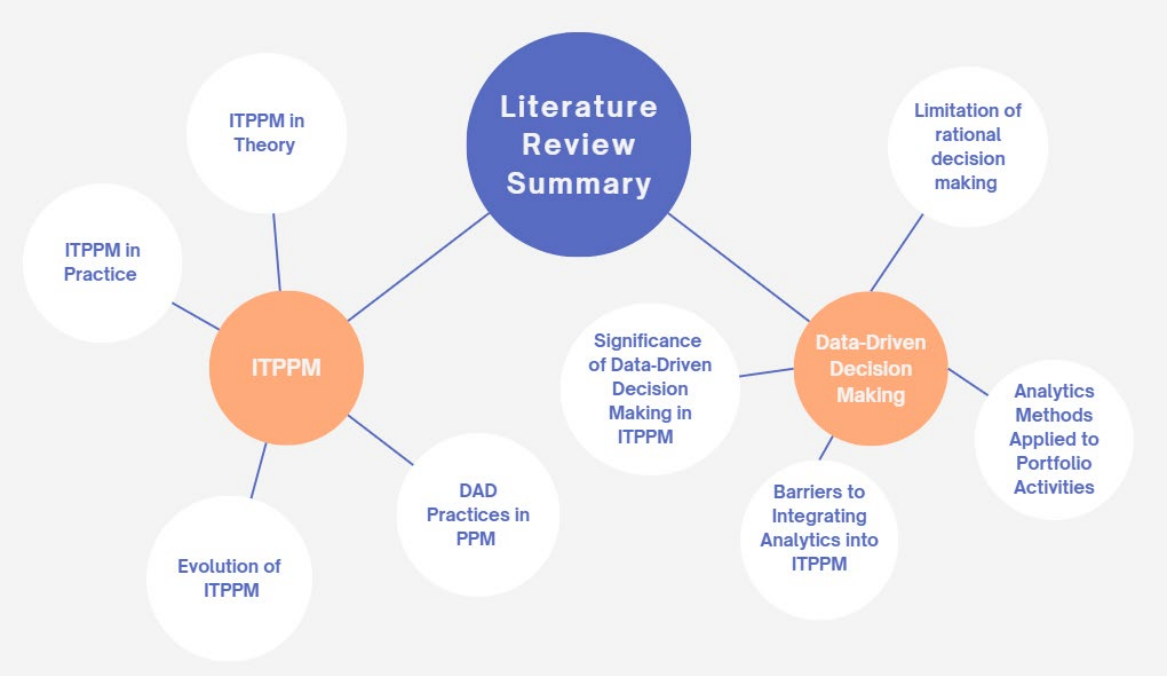
This the study presented in this paper aimed to systematically examine the role of data-driven decision-making in IT Project Portfolio Management within large-scale organisations to identify challenges in IT PPM caused by the lack of data-driven decision-making, and to promote the integration of data analytics techniques to enable a transition to fact-based decision-making while using Disciplined Agile Delivery (DAD) as the foundational IT PPM framework. Finally, the study will evaluate the benefits and success criteria associated with adopting a data-driven approach to portfolio management and introduce a conceptual framework for Data Analytics-Driven Decision Making (DDDM) process. Hence, this study undertakes a multivocal literature review that integrates peer-reviewed research and credible grey literature to establish a robust evidence base. Through thematic analysis, the study systematically maps the use of data-driven techniques across the PPM lifecycle. The outcomes are refined into practical, evidence-based guidelines and a conceptual framework that assesses the benefits and success factors of data-driven PPM, while also highlighting remaining knowledge gaps and priorities for future research.

In the New Zealand context, the urgency of this problem is acute, and Audit New Zealand and national data strategy reviews highlight that fragmented reporting, weak benefits tracking and inconsistent data governance constrain public-sector digital portfolios. while industry reports from TUANZ and Stats NZ and practitioner surveys signal that New Zealand's digital transformation ambitions are constrained by poor data quality, siloed systems, and insufficient analytics capability, with 89% of NZ data leaders acknowledging their data strategies require a complete overhaul before advanced analytics or AI can succeed (AuditNewZealand, 2025; data.govt.nz, 2018).

Literature Review

This literature review synthesises academic and practitioner writing on IT project portfolio management (ITPPM) (Rajegopal et al., 2007a), the rise of data-driven decision making (DDDM) (Eisenhardt & Zbaracki, 1992), and the integration of analytics within Disciplined Agile Delivery (DAD) contexts. It maps major themes, established findings, methodological framework, and persistent gaps relevant to large organisations undergoing agile transformation. Figure 1 shows that the summary of the literature review that structures the review around two primary dimensions and their key subtopics: the practice and evolution of ITPPM and the role of data-driven decision-making in that domain.

Figure 1
Summary of Literature Review



Evolution of Project Portfolio Management in IT

Research on PPM has shifted from financial, stage-gate paradigms toward practices emphasising strategic alignment, outcomes, and continuous funding models (Gutiérrez & Magnusson, 2014). Early work framed PPM as investment control and risk mitigation using financial metrics and rigid gates; more recent literature highlights a move to product-centric models and outcome-based KPIs to support continual value delivery and faster feedback loops in digital markets (Dawidson, 2006). As organisations adopt continuous delivery, product teams, and dynamic reprioritisation, boundaries between project and product portfolios have thinned, requiring more responsive, less schedule-oriented portfolios (Ha & Madanian, 2020). Operationally, weak governance, poor planning and the lack of structured project termination processes create challenges; accurate data is essential for cost estimation and stakeholder management(Project Management, 2021). Companies that fail to innovate risk losing market relevance(Anthony, 2008), indicating a disconnect between strategy and changing customer expectations (Rad & Levin, 2006). ITPPM uses systematic, data-driven methods to evaluate, prioritise and select projects, helping avoid subjective or politically driven decisions, enabling risk assessment, decommissioning of obsolete projects, and prioritisation of new ones, and supporting a shift to an agile mindset through capability and capacity assessments for portfolio balancing (Rajegopal et al., 2007b; Wu & Chatzipanos, 2018).

IT PPM in Theory and Practice

PPM is defined as follows: "*Project Portfolio Management is a dynamic decision process wherein a list of active development projects is constantly revised. In this process, new projects are evaluated, selected and prioritised; existing projects may be accelerated, killed or reprioritised, and resources are allocated and reallocated among the projects in the portfolio.*" (Cooper et al., 1999; Dawidson, 2006). PPM is a decision-making process with three main objectives: aligning the initiatives with strategic objectives such as target markets, product lines, and technological innovations, optimising ROI from software development, reducing risk by diversifying various initiatives in the portfolio (by success factors, as probability of success, technology, investment and so on) and assuring business continuity (Cooper et al., 1999; Gutiérrez & Magnusson, 2014).

Although many firms adopt a rational PPM approach, empirical studies show actual practice often diverges from the prescriptive model (Gutiérrez & Magnusson, 2014). Studies report that strategic, high-impact choices tend to be handled informally, while lower-impact operational decisions follow more formalised procedures; they link this informality to managing uncertainty and a fast-changing business context (Christiansen & Varnes, 2008). They argue that effective management of complex, uncertain projects requires both formal mechanisms for alignment with strategic goals and traceable records.(Choi et al., 2009)conclude that formal, sequential decision models, mainly dependent on precise information that are ill-suited to ambiguous, radical innovation processes and dynamic environments.

Disciplined Agile Delivery and Portfolio Practices

Disciplined Agile Delivery (DAD) frames portfolio management as a value-stream activity that emphasises identifying and realising potential value, continuous funding, and governance aligned with enterprise strategy (Ambler & Lines, 2020). The DAD process blade for Portfolio Management defines a set of decision points, such as identifying potential value, planning capability, exploring and prioritising initiatives, managing budgets, initiating and financing, ending work, addressing portfolio risk, and governing the portfolio, that guide pragmatic, context-sensitive choices for scaled agile organisations(PMI, 2025).

Limitations of Rational Decision-making

(Gutiérrez & Magnusson, 2014) examines how legitimacy shapes decision-making approaches and affects project selection and portfolio governance in product development, finding that organisational acceptance varies and that an idea advances to a project depending on how decision rules are negotiated and legitimised. It finds that approaches vary in organisational acceptance and that an idea's progression to a project depends on how decision rules are negotiated and legitimised. People have cognitive barriers and rarely have complete information about current and past, so they make decisions in the absence of data or in uncertainty that meets an acceptable threshold instead of searching for the absolute best alternative decision. (Eisenhardt & Zbaracki, 1992)notes that strategic decision makers blend deliberate planning with rapid, intuition-driven action: they generate many options but usually analyse only a few or act before all information is available. Evidence indicates that heuristic and inductive approaches can still produce effective decisions (Sarasvathy, 2001). Rational choice models struggle with ambiguity, insufficient or poor information whose impact depends on interpretation (Weick & Weick, 1995), and studies highlight that grounding decisions in reliable data helps reduce bias and strengthen organisational support (Weick & Weick, 1995).

Significance of Data-Driven Decision Making in ITPPM using Data Analytics

The literature further underscores the necessity of a data-driven, fact-based approach to project portfolio management (Baptestone & Rabechini, 2018), advocating adoption of analytics across PPM activities such as strategic fit, portfolio balancing and governance. This study concentrates on challenges in applying data-analytics to improve decision-making for IT projects and product portfolios, covering IT development and digital transformation initiatives, as well as software product offerings (Hannila et al., 2020). These contexts are marked by rapidly evolving technology, complex interdependencies and large volumes of tool-generated data (Bucero, 2018). The research examines how data-driven methods can support key PPM tasks such as selecting and prioritising projects, allocating resources, forecasting outcomes and monitoring portfolio performance (Hannila et al., 2020; Rajegopal et al., 2007b). When effectively used, analytics can significantly increase decision accuracy and objectivity, reduce selection bias, improve resource allocation and enable proactive risk mitigation, delivering efficiency gains and cost savings in execution (Jank et al., 2019). The literature describes a spectrum of methods from basic aggregation to advanced machine learning and simulation (Wach, 2021): predictive analytics that produce granular scores per portfolio element (Bucero, 2018), prescriptive approaches built on time-series forecasting and techniques such as neural networks or

Bayesian networks for investment decisions (Wach, 2021) and a Monte Carlo simulation for time and budget threshold analysis (Platon & Constantinescu, 2014). Following the DAD Portfolio Management process blade, this study will assess method applicability across portfolio phases, including ideation, prioritisation and governance (PMI, 2025). Emerging research and practitioner work report Business Intelligence techniques (e.g., portfolio dashboards and KPI tracking) as visibility enablers, predictive and ML models (e.g., balanced scoring and decision matrices) for delay and overrun prediction (Otten et al., 2015), data mining to reveal product interdependencies (Bucero, 2018) and growing interest in AI-driven optimisation and scenario analysis for selection and balancing (Ha & Madanian, 2020). Despite these advances, data-driven PPM remains nascent in practice: adoption is limited and fragmented, and integration of analytics across the full PPM lifecycle, particularly as framed by Disciplined Agile, is underdeveloped. This study, therefore, synthesises adoption challenges and provides a comprehensive overview of analytics models mapped to PPM phases, together with key success factors for embedding a data-driven approach into portfolio management.

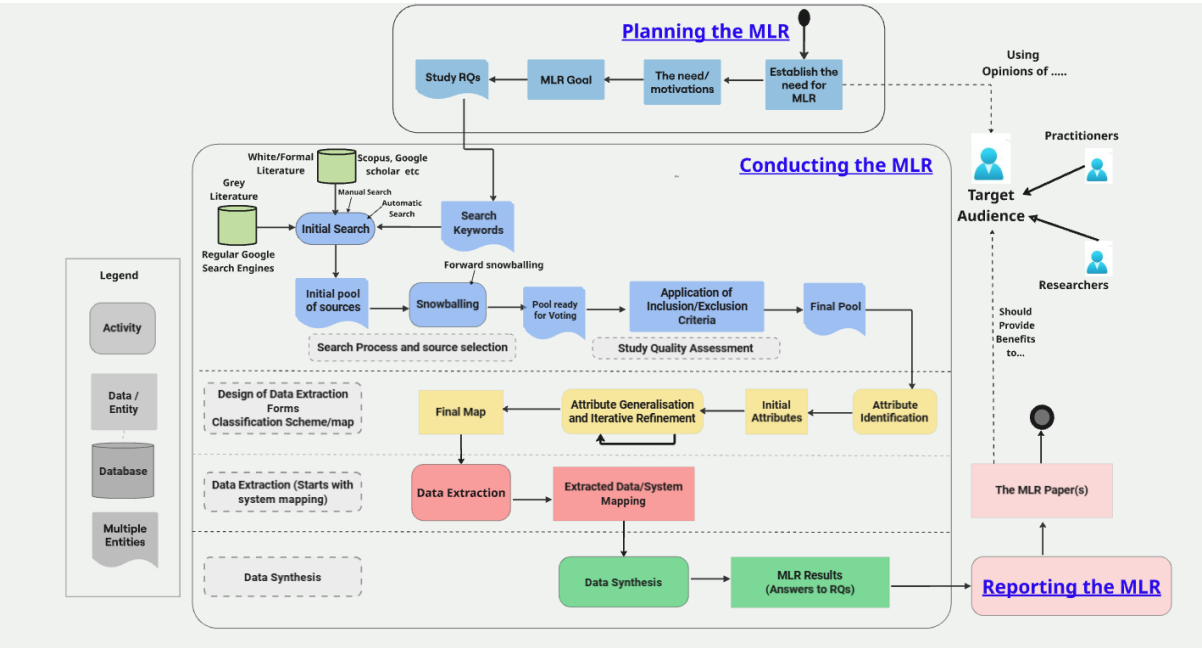
Research Design

The Multivocal Literature Review Protocol

The MLR review protocol was structured in accordance with the three phases outlined by (Kitchenham et al., 2010) (see Figure 1). The multivocal literature review (MLR) protocol guided the study process by defining the search strategy, inclusion and exclusion criteria, quality assessment and study selection process. Employing such a protocol helps to minimise the risk of researcher bias (Kitchenham, 2012).

Figure 2

MLR Overview Diagram



The decision to use a Multivocal Literature Review (MLR) was driven by the limits of traditional Systematic Literature Reviews and the practical needs of a rapidly evolving field (Brereton et al., 2007). The research design for this MLR consists of the following three phases: 1) Planning the MLR, 2) Conducting the MLR and 3) Reporting the MLR. The diagram below illustrates the step-by-step process of the MLR process based on (Garousi et al., 2019).

Aim and Research Question

This research examines how data-driven decision-making can be operationalised within IT Project Portfolio Management (ITPPM) in large, scaled-agile organisations. Distinct from prior work that treats PPM governance and analytics capability as separate maturity tracks, the study explicitly maps analytics methods to the decision points defined in the Disciplined Agile Delivery (DAD) Portfolio process blade and identifies the governance and data preconditions that make those methods persuasive and actionable (Bucero, 2018; Gutiérrez & Magnusson, 2014). Existing literature describes analytics techniques for portfolios and governance maturity models but rarely links specific analytic constructs to context-sensitive DAD decision forums. This study therefore asks one main question with two sub questions. **RQ1**: What are the benefits and success factors of a data-driven process after the integration of data analytics methods in IT PPM? **RQ1.1**: What are the current challenges that exist in IT Project Portfolio management to implement data-driven decision making? **RQ1.2**: What are the key data analytics methods and approaches that have been reported in the context of IT project portfolio management? Answering to each sub-questions, the paper contributes an evidence-weighted mapping of challenges, a method taxonomy aligned to DAD practices, and a practice-centred conceptual framework prescribing (DAD practices → analytics methods → benefits & success factors).

Search Strategy and Terms

The search strings were built for two RQs: RQ1.1 (challenges to data-driven decision making in PPM) and RQ1.2 (data-analytics methods in PPM). Primary white-literature databases searched were Scopus, IEEE Xplore, ACM Digital Library, Springer and ScienceDirect/Taylor & Francis. Grey literature searches used Google and targeted sites (PMI DAD browser, Gartner, SAFe, vendor blogs, Atlassian, Medium, LinkedIn). Forward snowballing (single-layer) was applied, focusing on titles and abstracts for selection (Kitchenham et al., 2010). The study used the search criteria that consist of three substrings S1, S2, S3, S4, and S5, described as follows: S1 - Data-Driven Decision-Making Challenges in PPM

("IT Project Portfolio Management" OR "IT Product Portfolio Management" OR "IT portfolio management" OR "project portfolio management" OR "product portfolio management") AND ("data-driven" OR "data driven" OR "data driven decision" OR "data-driven decision") AND ("challenge" OR "barrier" OR "issue" OR "risk" OR "limitation" OR "problem")

S2 - Data analytics methods in PPM

("IT project portfolio management") AND ("data analytics" OR "data-driven" OR "predictive analytics" OR "predictive analysis" OR "machine learning" OR "decision support" OR "business intelligence" OR "AI"))

S3 - ("IT project portfolio management") AND ("data analytics" OR "data-driven" OR "prescriptive analytics" OR "prescriptive analysis" OR "Diagnostic analytics" OR "Diagnostic analysis" OR "machine learning" OR "decision support" OR "business intelligence" OR "AI" OR "artificial Intelligence"))

S4 - ("IT project portfolio management") AND ("benefits" OR "Advantages" OR "success factors" OR "data-driven" OR "prescriptive analytics" OR "prescriptive analysis" OR "Diagnostic analytics" OR "Diagnostic analysis" OR "machine learning" OR "decision support" OR "business intelligence" OR "AI" OR "artificial Intelligence"))

The figure 3 and figure4 visualise the RQ1.1 and RQ1.2 literature search by showing the number of candidate records returned at each search stage (Initial, Secondary, Tertiary, Reviewed Papers, Snowballing) across key databases and grey-literature sources.

Figure 3

Search Strategy Summary of RQ1.1

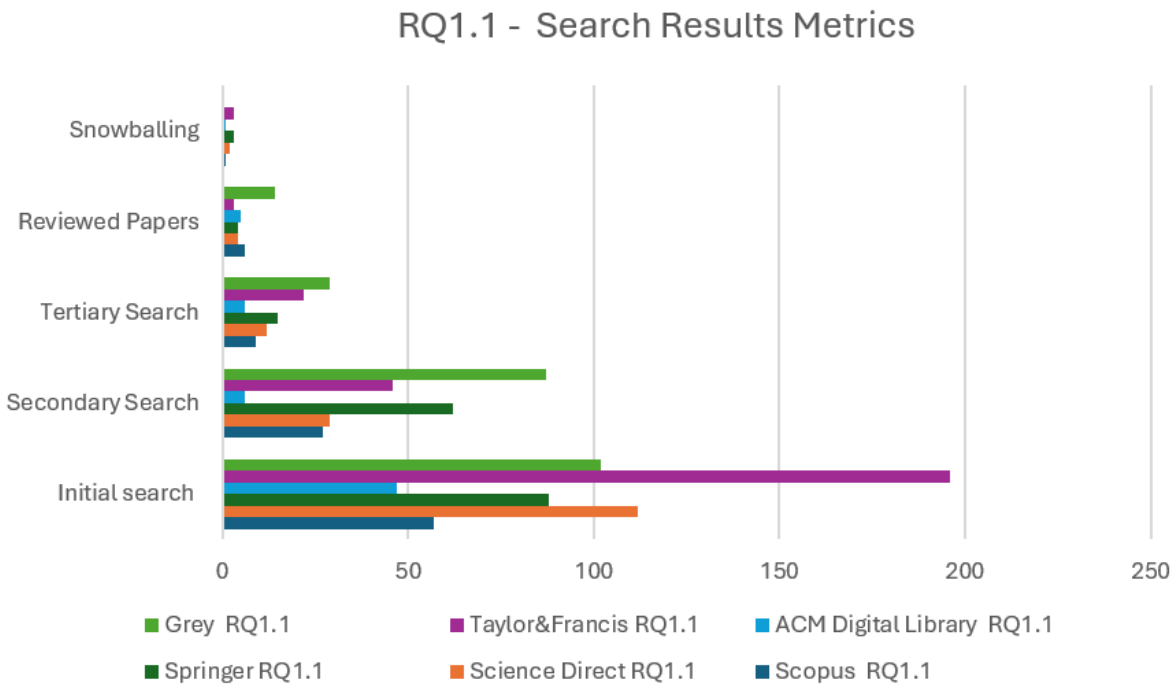
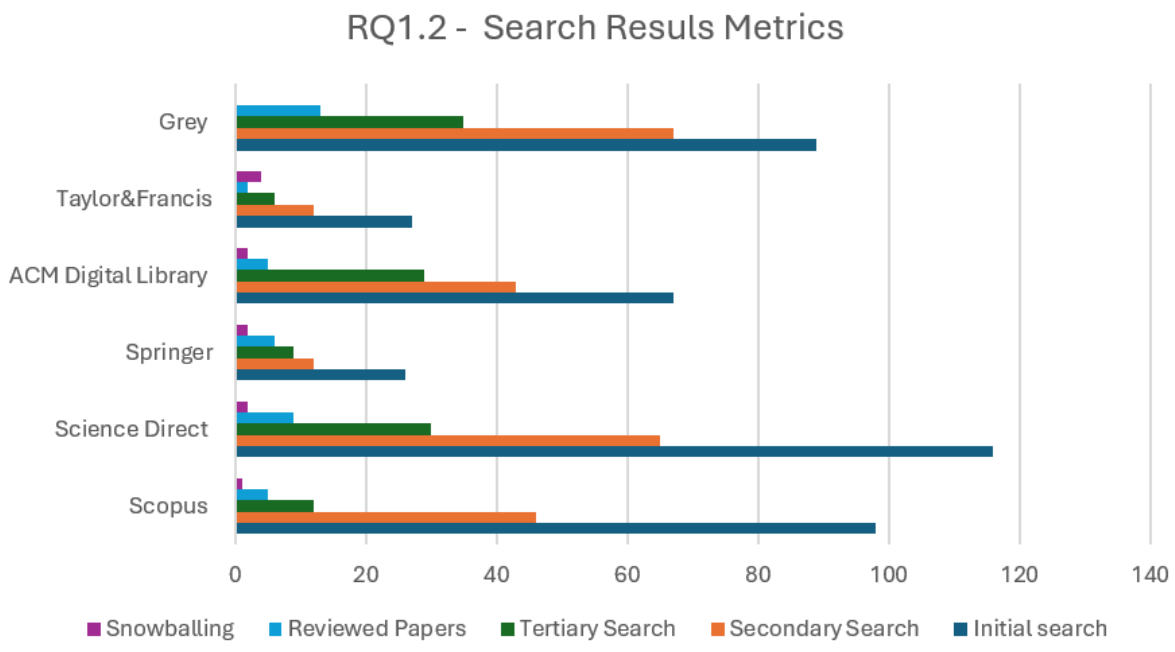


Figure 4

Search Strategy Summary of RQ1.2



Study Inclusion and Exclusion Criteria

Inclusion criteria required explicit relevance to IT project/product portfolio management and data/analytics across DAD lifecycle phases, English language, and publication roughly from 2000 onwards; both peer-reviewed and credible grey sources were accepted. Exclusion criteria removed non-PPM topics, non-data-driven discussions, inaccessible full texts, duplicates and secondary reviews.

Conducting the Systematic Literature Review

Study Selection

In the first round of a protocol-based search across designated electronic databases produced 1069 studies as per the search strategy explained in section 3.1.2. Applying (Garousi et al., 2019) guidelines, titles, abstracts, and keywords were screened, yielding 97 potential papers, including white literature and grey literature. After applying the inclusion and exclusion criteria, 59 papers were retained and reviewed for thematic analysis. Detailed exclusion criteria and reasons are explained in Table 1.

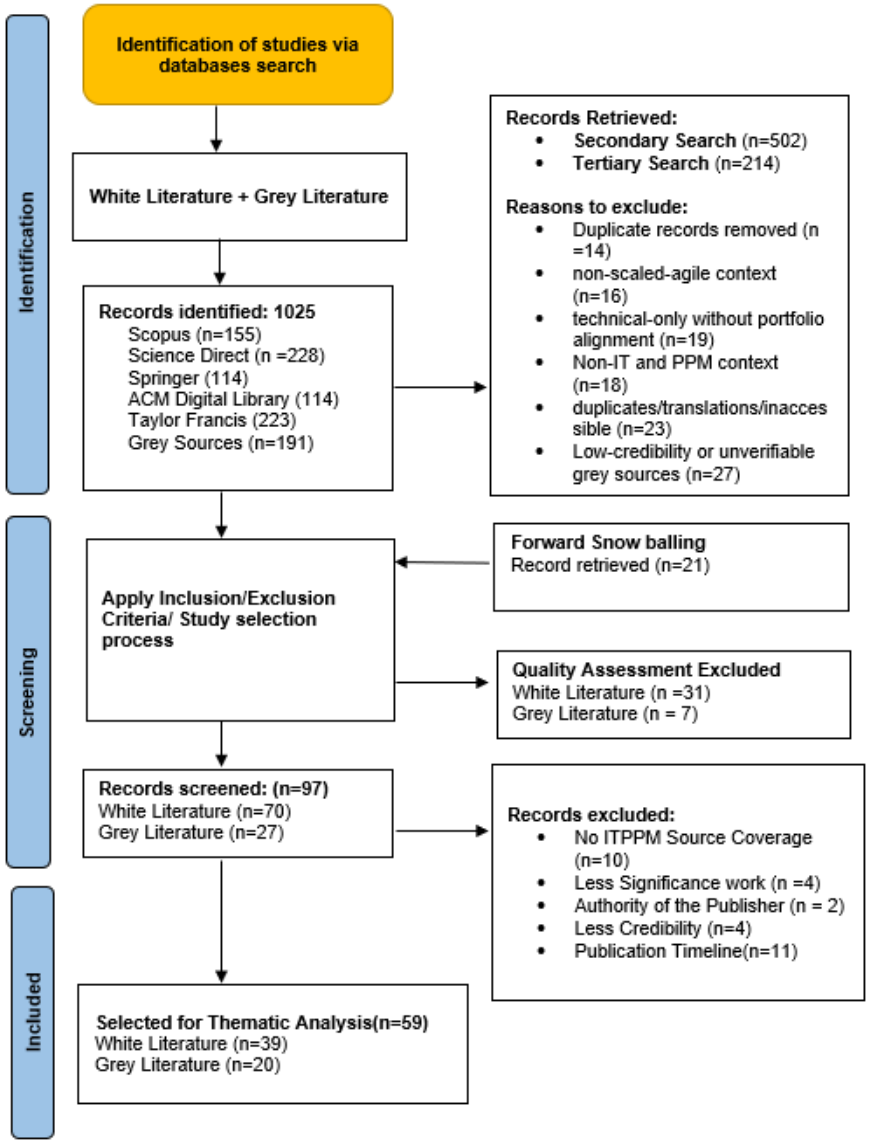
Table 1

Literature (WL & GL) Filtering Summary for Thematic Analysis

Literature Type	Literature Reviewed	Literature Selected (Thematic Analysis)
White Literature	70	39
Grey Literature	27	20
Total	97	59

Figure 5

Flow diagram detailing the screening and exclusion process



Quality Assessment Process

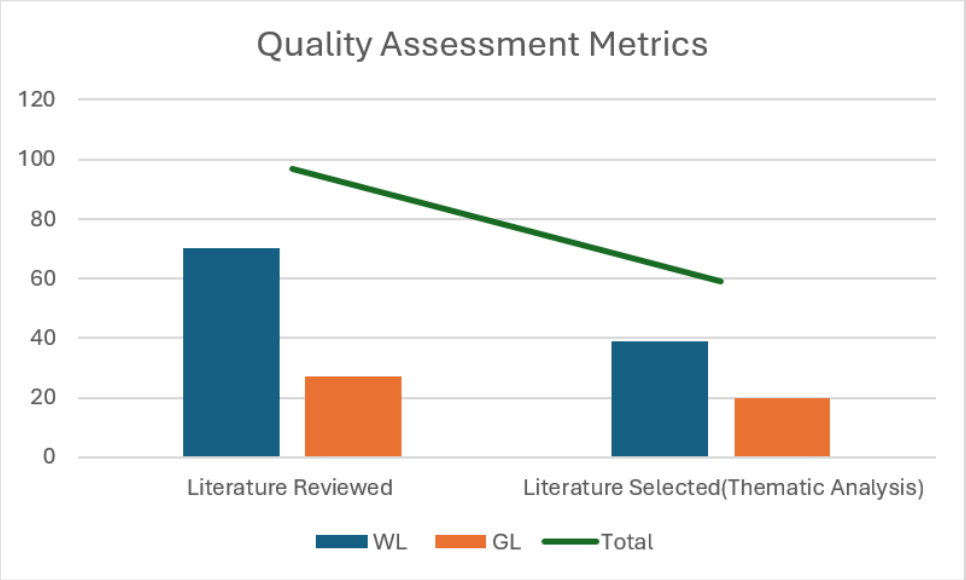
The quality criteria that will be used for assessing the quality of primary studies are adopted from (Garousi et al., 2019). Quality assessment of sources involves evaluating their validity and identifying potential biases, unlike formal literature, which typically undergoes a structured review and publication process, grey literature (GL) follows more varied and less regulated procedures (Garousi et al., 2019). The quality assessment was conducted to evaluate the methodological robustness of the selected studies. It was structured around five key dimensions, each comprising targeted questions designed to determine the credibility of the research and its alignment with the scope of our study (see Table1). The assessment shows how individual records from the database were ranked for methodological relevance and credibility, allowing the reviewer to transparently accept high-quality studies and exclude weaker items. This process ensured that the thematic synthesis used academically rigorous, context-relevant evidence and documented the rationale for inclusion or exclusion. Table 1 offers a detailed breakdown of quality criteria and associated questions. A measurement score from 1 to 4 was used to evaluate each criterion.

Table 2

Quality Assessment Criteria and Score applied to WL and GL

Criteria and Score	Anchoring Questions and Parameters
(A1) Authority of the publisher (Score: Yes=1, Partially=0.5, No=0)	Is the publishing organization reputable/ Author associated with a reputable organization? Is the organization/ author cited often by others? Has the author published other work in the field?
(A2) Source coverage (Score: Yes=1, Partially=0.5, No=0)	Does the source have a clearly stated aim/objective? Is the focus of study on data driven decision making process in PPM? Are the challenges identified in data driven decision making process in IT PPM activities? Are the data collection and analysis methods analysed, described? Are the data collection and analysis methods applied to IT Product portfolio and the Project portfolio activities? Are those success factors documented after integrating the data-driven decision-making process in IT PPM. Are any limits clearly stated? Is the source supported by documented references? Are the conclusions justified by the result?
(A3) Publication Date (Score: Yes=1, Partially=0.5, No=0)	Does the source have a clearly stated date? Does the source enrich the current research, and/or particularly add something unique?
(A4) Significance of work (Score: Yes=1, Partially=0.5, No=0)	Does the source enrich the current research, and/or particularly add something unique?
(A5) Publication/literature type (Score = 0 to 4)	Academic peer reviewed: Extremely high credibility (Score =4) PhD. /Master thesis: Very high credibility (Score = 3) Peer-reviewed experience reports: High credibility (Score =2) Established vendor/leader (method creator) – case studies, blogs: Moderate credibility (Score =1) Commentary/opinion, blog posts from non-established vendor: Low credibility (Score =0)

Figure 6
Literature (WL & GL) Filtering Summary for Thematic Analysis



Data Extraction and Synthesis

The data extraction form provides a structured framework for systematically collecting and organising insights from selected studies to ensure consistency, minimise bias, and maintain traceability between the extracted data and sources (Kitchenham et al., 2010). A standardised Excel extraction form captured bibliographic metadata, context (organisational level, DAD phase), analytics methods, RQ1.1 challenges, RQ1.2 methods, reported benefits and evidence strength. Thematic synthesis (inductive coding → theme generation → mapping) was applied to WL and GL findings. Codes were grouped into mid-level themes and then high-level categories for RQ1.1 and RQ1.2; evidence strength counts were recorded to prioritise themes. Coding and theme generation followed a transparent, multi stage inductive protocol. Stage 1 (open coding): I read each extracted evidence text and applied descriptive open codes that captured the challenges, analytics method, metric, or outcome described (for example: "Inconsistent product master data; missing corporate data model; poor product taxonomy"). Stage 2 (grouping): related open codes were clustered into mid level themes (for example, codes "Fragmented Data", Data quality and governance") were grouped under "Data Quality and Integration". Stage 3 (selective consolidation): mid level themes were consolidated into the high level categories reported in this paper (challenges; method families; benefits; success factors) and mapped explicitly to the DAD practice areas. To improve methodological rigour and reduce individual bias, codes and themes were iteratively reviewed with supervisor across three full passes. Saturation for a given theme was judged reached when additional sources no longer produced substantive changes to the scope of that theme (i.e., new records reiterated the theme without adding new properties). To support prioritisation, each theme carries an evidence weight count (the number of distinct papers reporting the theme)

Findings

The coding and thematic derivation process began by developing the initial findings, which were subsequently reviewed and refined in collaboration with co-authors. Tables 3, 4, and 5 present analyses of challenges, different data analytics methods used and Benefits, success factors, highlighting across the DAD practices. By systematically structuring and organising these findings, the research provides a clearer understanding of the challenges and success factors of adopting data analytics methods in ITPPM. It leads to the development of a conceptualised framework that serve as practical guidance for

portfolio managers and project managers aiming to enhance project outcomes. This section presents findings from a multi-vocal literature review. It provides a consolidated table for RQ1 that directly maps identified challenges (RQ1.1) and data analytics methods (RQ1.2) to each DAD practice and uses these mappings to derive benefits and success factors.

Challenges in IT Project Portfolio Management

This section presents findings of RQ1.1, which provides a table for identified challenges in DAD practices. Each subsection summarises the themed evidence on challenges and pain points identified across the literature. It explains that granular codes from primary studies were aggregated into mid-level and high-level themes and annotated with evidence counts to indicate prevalence. Results highlight which challenge areas are most frequently reported, which are emerging, and where empirical support is weak or mixed. The final figure displays the percentage distribution of challenges across the DAD lifecycle, helping to prioritise those challenges and identify which DAD phases show the highest prevalence of data analytics adoption.

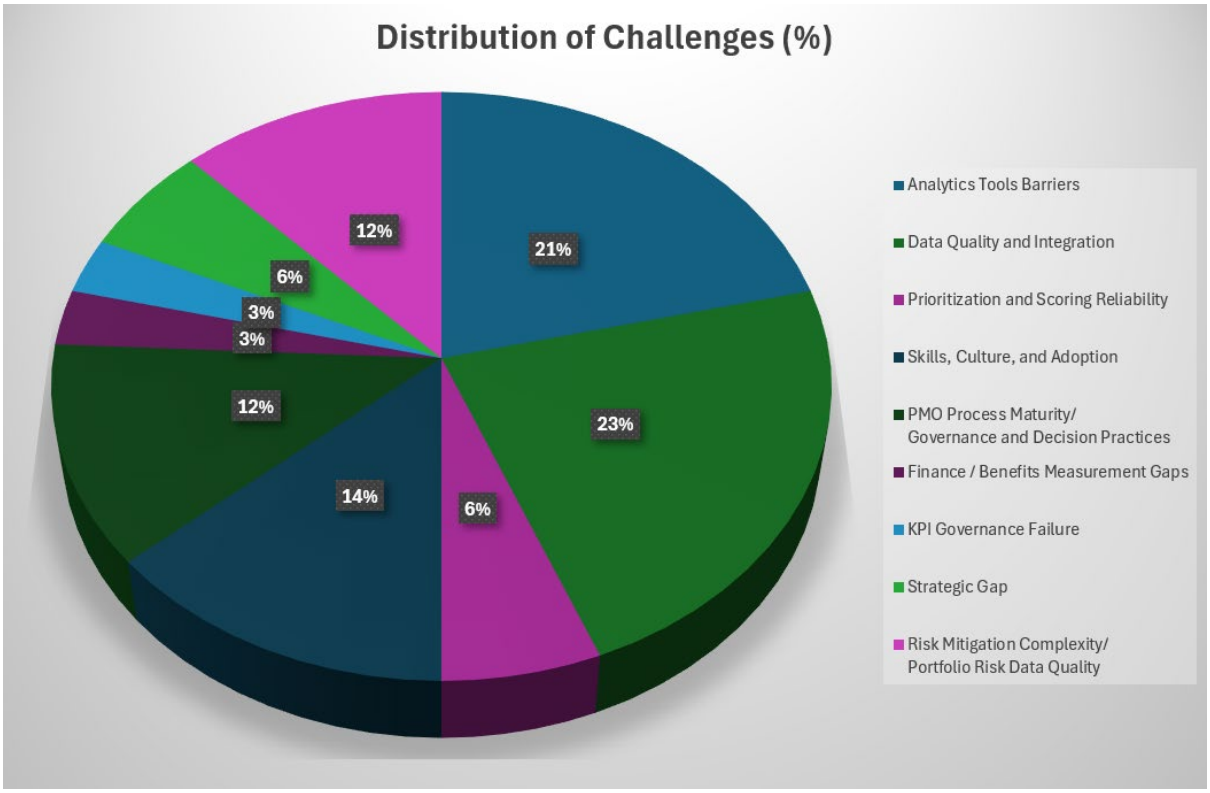
Table 3

Challenges identified in ITPPM for each DAD Practices (RQ1.1)

DAD Practices	RQ1.1 (Challenges)
Identify Potential Values	1) Data quality and Integration 2) Fragmented Strategic alignment & portfolio design gap 3) Organisational Culture and Capability
Plan Capability	1) Data quality and Integration 2) Analytics tools barriers 3) Business Case Quality 4) Analytics-to-Decision Value Gap
Intake work	1) Data quality and Integration 2) Prioritization and Scoring Reliability 3) Immature Data Analytics tools and Training 4) Analytics-to-Decision Value Gap
Explore and Prioritise Potential Initiatives	1) Data quality and Integration 2) Analytics tools barriers
Manage Portfolio Budget/Finance Initiatives	1) Data Quality and Integration 2) Financial Measurement and Benefits Realization 3) Financial Data Latency
Launch / End Initiatives	1) Governance and PMO Maturity 2) Analytics Enablement and Decision Readiness
Portfolio Risk	1) Analytics Tool barriers 2) Risk Mitigation Complexity 3) Portfolio Risk Data Quality and visibility Gap
Governance Portfolio	Governance maturity and data integration analytics

The chart in Figure 7 below shows the distribution of challenge themes by how many DAD practices reported each issue, highlighting the dominance of data quality and integration problems, and Analytics tool barriers.

Figure 7
Distribution of ITPPM challenges across DAD Practices



Data Analytics Methods used in IT Project Portfolio Management

This subsection outlines a categorisation of analytics approaches developed from the coded literature. Method-level codes (for example, dashboards and reporting, predictive modelling, optimisation/prescriptive analytics) were clustered into mid-level themes and then grouped into high-level categories (such as Predictive modelling and Data-Integration analytics, MCDM Optimisation). Each theme is accompanied by an evidence count that indicates how many sources describe or validate the method, enabling comparisons of method prevalence and maturity. Each method theme below is prioritised from most to least broadly applicable to IT PPM and supported by paper IDs captured during data extraction.

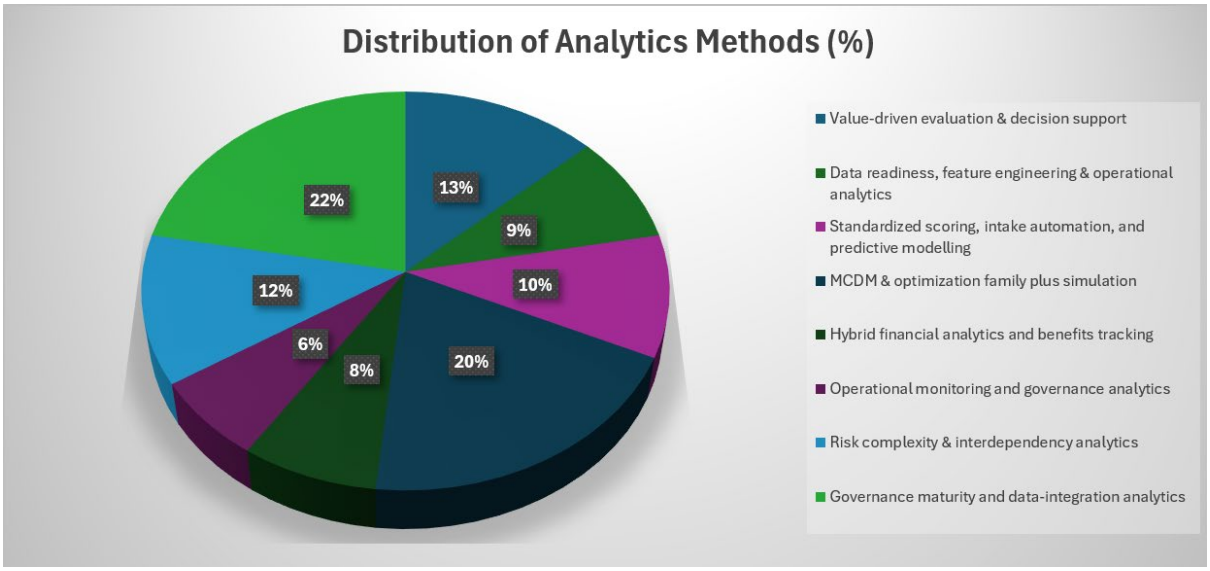
Table 4
Data Analytics Methods used in each DAD Practice (RQ1.2)

DAD Practices	RQ1.2 (Data Analytics Methods)
Identify Potential Values	Value-driven evaluation & decision support
Plan Capability	Data readiness, feature engineering & operational analytics
Intake work	Standardised scoring, intake automation, and predictive modelling, Descriptive methods
Explore and Prioritise Potential Initiatives	MCDM & optimisation family plus simulation
Manage Portfolio Budget/Finance Initiatives	Hybrid financial analytics and benefits tracking
Launch / End Initiatives	Operational monitoring and governance analytics
Portfolio Risk	Risk complexity & interdependency analytics
Governance Portfolio	Governance maturity and data integration analytics

Figure 8 shows the relative representation of analytics methods reported in the literature. It highlights which approaches receive the most empirical attention. Use this chart to identify which analytics approaches are well-established and which areas may need more research, tooling, or capability development.

Figure 8

Distribution of Data Analytics methods in ITPPM



Benefits and Success Factors in Adopting Driven Decision-Making

RQ1 results are being derived by mapping the most frequent RQ1.2 Data analytics methods onto the prioritised RQ1.1 challenges and articulating the concrete improvements those methods produce (benefits), and enablers required to achieve the benefits in terms of organisation, people, data, and technology (success factors). In short, RQ1 is an integrative, evidence-led mapping from challenge => analytic method => (benefit + required success factors). The chain is supported by the literature captured (Paper IDs per practice) and validated by cross-blade recurrence (which shows high evidence strength for several themes).

Table 5

Benefits and Success factors in adopting Analytics Methods for data-driven decision making (RQ1)

DAD Practices	Benefits (RQ1)	Success Factors (RQ1)
Identify Potential Values	More objective, transparent valuation of initiatives Better alignment of selected initiatives with strategy Faster identification of high-value opportunities and clearer investment cases	Agreed strategic criteria and taxonomy; master-data governance; Analytics literacy executive sponsorship; decision-support integrated into PPM tools
Plan Capability	Improved capacity and resource planning accuracy; Reduction in delivery bottlenecks and better sequencing of work; More realistic forecasts for resourcing & timing, enabling proactive action	Integrated systems of record, ETL/feature pipelines, standard metric definitions, PMO engineering collaboration, and training
Intake work	Faster, consistent intake triage; reduced subjective bias; higher throughput and better upstream data quality for analytics	Standardised intake taxonomy; embedded scoring in PPM tool; training for scorers; reliable input data and data provenance

Explore and Prioritise Potential Initiatives	Transparent, reproducible prioritisation; ability to model interdependencies and trade-offs; improved portfolio mixes under constraints	Well-defined attribute set; simulation capability + sensitivity analysis; governance rules to act on model outputs; capacity to interpret results
Manage Portfolio Budget/Finance Initiatives	Clearer ROI and benefits traceability; scenario-aware budgeting; improved allocation and contingency planning	Clearer ROI and benefits traceability; scenario-aware budgeting; improved allocation and contingency planning
Launch / End Initiatives	Early detection of delivery issues; evidence-based go/stop decisions; improved benefit realisation tracking	Reliable event/time/cost recording; KPI owners and data lineage; dashboards with provenance; PMO practices for closing/benefit validation
Portfolio Risk	Earlier, prioritised risk detection, quantified cascading impacts, optimised mitigation plans respecting resource constraints	Centralised risk register with consistent attributes; labelled historical risk data; model explainability and validation; governance to execute mitigations
Governance Portfolio	Consistent reporting and portfolio oversight; higher trust in analytics; reduced tool sprawl; clearer PMO performance measurement	Clear governance charter and roles; metadata/master-data management; PMO capability building; standardised dashboards and tool rationalisation

The literature synthesis shows a clear pattern: pervasive data quality and integration issues, weak governance/PMO alignment, and analytics tool & skills gaps consistently undermine IT portfolio decision-making. Mapped analytics methods concentrate on decision support (MCDM/optimisation, value-driven evaluation) and operational readiness (data-integration, forecasting, monitoring), but method coverage is uneven. When methods are applied against the recurring challenges, they yield concrete benefits (better prioritisation, more reliable forecasts, earlier risk detection) only if foundational enablers such as a single source of data, data literacy of executive leadership, KPI ontologies, governance dashboards, and stakeholder sponsorship are present.

Discussion

This discussion interprets the findings from the multi-vocal literature review through the lens of the conceptual framework "DAD ITPPM Analytics-Compass" developed for DAD PPM Process blade. The DAD ITPPM Analytics Compass presented in this paper is a conceptual framework derived from a multivocal literature synthesis rather than from primary empirical validation. The framework has three concentric layers: the inner layer names the DAD practice, the middle layer lists the analytics methods mapped to that practice, and the outer layer shows the anticipated benefits and the success factors required to realise them. Framing the results this way makes the literature synthesis actionable for IT PPM leaders: it turns abstract themes into a compact, practice-centred pocket guide that links what to do, how to do it, and what must be in place for it to work.

Figure 9
DAD ITPPM Analytics-Compass - Conceptualised

The framework works like a pocket guide to help with three decision tasks: selecting analytics approaches aligned to specific portfolio activities, sequencing capability builds by dependency and maturity and designing success criteria and implementation controls. Presenting the literature this way makes it easier to use, links evidence to practical steps, and provides a clear pathway from analytic technique to measurable portfolio outcomes. In the next section, I interpret the MLR findings from my perspective, emphasising challenges, focusing on practical implications, trade offs. I begin by outlining each DAD practice, linking the prominent challenges identified in the literature to the analytics methods that best address them. I then show how those practice level mappings feed into the DAD ITPPM Analytics Compass and discuss what they reveal about organisational readiness, sequencing of capabilities, and common pitfalls. The framework structures disciplined agile IT portfolio and program management into concentric layers across eight practice areas, where the middle layer prescribes analytic and decision support methods and the outer layer specifies governance, data inputs, and success factors that make those methods actionable. For example, value identification pairs value driver trees and real options with master data governance and executive analytics sponsorship to produce auditable, comparable valuations; planning translates historical flow and engineered features

into probabilistic capacity forecasts only when integrated systems and shared metrics exist; intake standardises scoring and automates pre-scoring to turn idea capture into analytics-ready inputs. Portfolio selection couples MCDM, optimisation and simulation with governance rules and scenario interpretation to yield transparent, reproducible prioritisation; financial controls blend NPV and probabilistic scenarios with live benefits tracking for traceable budgeting and allocation; launch/closure and risk practices rely on provenance-aware telemetry and explainable models to enable evidence-based stage gating and quantified systemic risk mitigation. Overall, the framework's core message is that analytics methods alone do not suffice—reliable data, clear taxonomy, governance maturity, and leadership commitment are required to convert analysis into timely, defensible portfolio decisions.

Conclusion and Future Work

This study synthesised multi-vocal literature to show how IT project portfolio management can become data-driven: it identified recurring barriers across DAD practices (poor data quality and integration, immature governance and PMO capability, gaps in tooling and analytics skills, weak intake scoring, limited risk visibility, and inadequate financial and operational telemetry), mapped common analytics methods to practice needs (governance/data-integration analytics, MCDM/optimisation and simulation, value-driven valuation, data-readiness and probabilistic forecasting, interdependency risk analytics, and operational monitoring), and demonstrated that anticipated benefits (better prioritisation, clearer ROI and traceability, improved forecasting, earlier risk detection, faster intake throughput, and trusted reporting) depend on repeatable enablers clustered into three areas: trusted data and metadata, governance and capability, and targeted analytics tooling. The proposed three-layer framework (practice → methods → benefits/success factors) makes sequencing explicit foundations first (data and governance), pilots second (targeted methods), scale last (institutionalisation)and offers ITPPM leaders a practical roadmap: prioritise master data, KPI ontology, a single reporting layer, executive analytics literacy, and tightly scoped pilots that pair use cases with minimum governance and data hygiene. Empirical gaps remain, notably systematic mappings of analytics types to DAD decision points, multi-case evidence of which analytic constructs improve portfolio KPIs, studies on how data quality and governance affect stakeholder acceptance, and maturity-pathway research showing how organisations move from ad hoc to repeatable, governance-embedded analytics practices.

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Agile Adoption: A New Zealand Case Study

Tauqeer Bilal
School of Engineering, Computer and Mathematical Sciences, Auckland University of Technology
Email: tauqeerbilal@gmail.com

Abstract

The evolving business environment and increasing market pressures have significantly transformed the nature of project management. Organisations are under constant pressure to deliver faster and more effective solutions, driving the adoption of Agile software development. To remain competitive in the global market, software companies must integrate efficiency, flexibility, and quality into their development practices. Agile methodologies offer potential benefits such as reduced development time, improved quality, increased productivity, and cost-effectiveness. Despite its advantages, successful Agile adoption remains challenging, and many organisations struggle to achieve their intended outcomes. Misconceptions, such as adopting Agile merely as a trend or assuming its success in other contexts guarantees similar results, can hinder implementation. A clear understanding of Agile principles and alignment with organisational context is critical for effective adoption. This study presents a case analysis of a New Zealand–based company that successfully implemented Agile practices. Data was collected through four semi-structured interviews. The research highlights key success factors, challenges faced during the adoption process, and the outcomes achieved. Findings demonstrate that Agile adoption can enhance productivity, accelerate delivery, and improve customer satisfaction when aligned with organisational objectives and context.

Keywords

Agile adoption, Agile mindset, Agile benefits, project management, organisational change,

Introduction

In software development projects, a primary challenge is accurately understanding and fulfilling customer needs, as misunderstandings or incorrect assumptions regarding requirements can significantly impact time, quality, or budget (Senay & Rasul, 2018). The fast-paced business environment and increasing complexity of software projects have transformed project management, and organisations relying on traditional approaches often face challenges such as scope creep, inflexibility, and stakeholder dissatisfaction (Matt, 2011).

Research Background

The traditional Waterfall model exhibits several limitations in modern software development, particularly when stakeholder satisfaction is critical (Stoica et al., 2013). Its sequential, phase-by-phase structure restricts feedback incorporation, delays delivery of functional software, and complicates changes once development reaches later stages. The assumption that all requirements can be defined upfront is often unrealistic in dynamic projects with evolving customer expectations (Senay & Rasul, 2018; Schuh et al., 2018). Consequently, Waterfall projects may experience higher costs, inefficiencies, and client dissatisfaction.

In contrast, Agile promotes continuous client involvement, iterative development cycles, and responsiveness to change (Hwai & Yves, 2018). Agile practices encourage early delivery of working software, incremental feedback, collaboration within teams, and transparency throughout the project. Adopting Agile is complex, however, and organisations face challenges such as defining appropriate practices, creating roles, fostering an Agile mindset, and aligning principles with organisational context (Matt, 2011). Agile adoption requires more than process changes; it necessitates cultural and structural adaptation to achieve desired benefits.

Focus and Scope

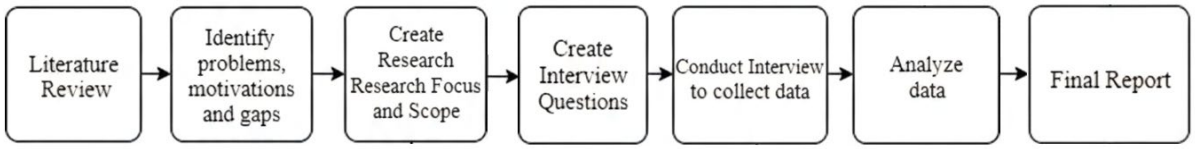
The demand for faster, higher-quality, and cost-effective software drives organisations toward Agile development (Hassan & Shaima, 2011), yet many struggle with adoption due to limited understanding of Agile practices and success factors. Successful adoption requires not only implementing practices but also cultivating the right mindset and aligning Agile principles with the organisational context. This study examines key success factors for Agile adoption in non-Agile organisations, explores challenges encountered during implementation, highlights best practices, and demonstrates the benefits of Agile practices across different project phases.

Research Framework

The research framework is illustrated in Figure 1. The study began with a comprehensive literature review to establish foundational knowledge and identify research gaps, problems, and motivations. Following this, the research methodology was selected, data was collected via interviews, and findings were analysed and presented.

Figure 1

Research Framework



Research Questions

The study presented in this paper sought to answer the following questions:

RQ1: What are the success factors for Agile adoption?

RQ2: What challenges might an organisation face during Agile adoption?

RQ3: What benefits can an organisation obtain following Agile adoption?

Literature Review

Agile adoption within the information technology sector has emerged as a major research focus over the past decade. This chapter establishes a foundation of existing literature and provides background to investigate the key research questions. It reviews concepts related to traditional software development approaches, Agile evolution, Agile practices, team dynamics, adoption challenges, and limitations of Agile methods.

Problems with the Waterfall Approach and the Need for Agile

Although the Waterfall model has historically been used in many large-scale software projects, several studies argue that its traditional management practices are unsuitable for the dynamic and complex nature of modern software development (Kashari, 2017). Its rigidity creates critical problems, including inflexibility to accommodate late changes due to the strict sequential structure (Stoica et al., 2013), delayed customer feedback since working software is often unavailable until later stages, and high rework costs when revisiting earlier phases. Waterfall also assumes that all requirements can be defined upfront, which is unrealistic in rapidly evolving environments (Senay & Rasul, 2018), and it is poorly suited for uncertain or complex projects where frequent change and unpredictable customer expectations are common (Schuh et al., 2018).

Agile Evolution

The Agile Manifesto, published in 2001, defines four core values emphasizing individuals, working software, customer collaboration, and responsiveness to change (Beck et al., 2001). Twelve supporting principles reinforce early delivery, welcome changing requirements, frequent delivery, collaboration, technical excellence, simplicity, self-organization, and continuous improvement (Kashari, 2017)

Reasons for Adopting Agile

Pilar et al. (2012) identified several key motivations for adopting Agile, with the top three being increased productivity (66.9%), improved product and service quality (61.4%), and reduced development cycle time (58.1%). A later global survey by VersioOne (2019) supports these findings, highlighting that organisations adopt Agile primarily to accelerate software delivery (74%), manage changing priorities (62%), and boost productivity (51%).

Agile Practices and Their Benefits

Although Agile is widely believed to enhance software quality and improve development processes, the effectiveness of specific Agile practices often depends on the organisational context (Fernando et al., 2017). Pilar et al. (2012) identified several commonly adopted practices, including daily stand-ups (78%), iteration planning (74%), unit testing (70%), and continuous feedback (77%), using a five-point scale to measure adoption levels. Across the literature, researchers highlight that these practices contribute to numerous benefits, such as better project monitoring and tracking, increased team collaboration, improved communication, clearer project understanding, faster and more frequent feedback, enhanced problem-solving, improved product quality, and greater customer satisfaction.

Agile Adoption Issues and Challenges

Studies show that around 82% of organisations adopting Agile face challenges related to structure, culture, resistance to change, and low readiness (Natalja & Mira, 2014). Many adopt Agile prematurely, treating it as a trend rather than a planned transition, with partial adoption, misunderstanding of Agile values, and unsuitable practices leading to failure (Brizard, 2015; Ciao & Alfredo, 2014). Key challenges include developing an Agile mindset, with cultural resistance among senior staff (Mail & Ananth, 2014; Luca & Luigi, 2018; Alex, 2014); lack of top management support, limiting investment and understanding (Hassan & Shaima, 2011; Mail & Ananth, 2014); misalignment between Agile values and organisational context (Asma et al., 2016; Mali & Ananth, 2014); inadequate training, increasing stress and turnover, highlighting the need for coaching (Alex, 2014; Hwai & Yves, 2018; Gabino et al., 2009); and Agile limitations, including challenges with large or complex systems, large teams, distributed environments, and safety-critical projects (Pilar et al., 2012).

Agile Limitations

Agile has inherent limitations, particularly in large or distributed teams, complex or safety-critical software, or environments requiring rigid processes (Pilar et al., 2012; Fernando et al., 2017). Organisations often need to tailor Agile practices carefully to align with project and organisational needs (Philipp & Marc, 2014; Hajer et al., 2014).

Research Methodology

This study adopts a qualitative research methodology to explore the success factors, challenges, and benefits of Agile adoption within a large New Zealand financial institution. A qualitative approach was selected because the research aims to understand organisational experiences, perceptions, and behaviours, which are best captured through rich, descriptive data rather than numerical measures (Tesch, 2013).

Research Approach and Rationale

The objectives of this research necessitate the use of qualitative methods, as the study seeks to explore in-depth the experiences, perceptions, and insights of individuals involved in Agile adoption. A case study approach was employed to collect data, allowing the researcher to engage directly with participants in an organisation that has successfully implemented Agile. This approach enables a rich understanding of the adoption process, which cannot be captured through quantitative methods that focus on numerical data alone.

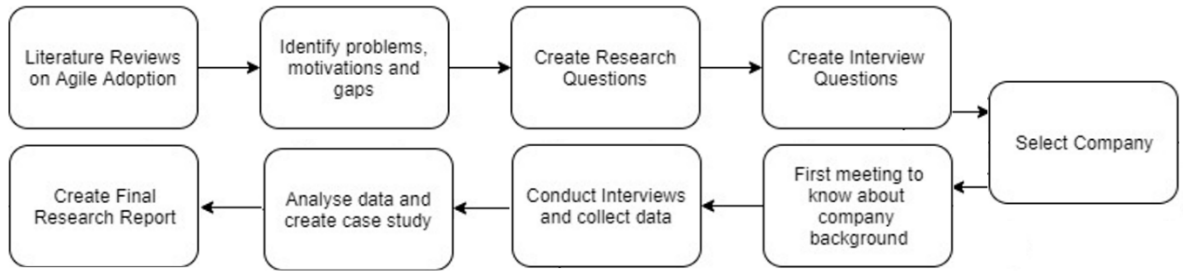
Qualitative research facilitates dynamic data collection through methods such as semi-structured interviews and group discussions, providing opportunities to explore participants' ideas, experiences, and perspectives in depth (Silverman, 2015). By talking directly to people who were part of the Agile transformation, the research gathers detailed, practical information that is essential for answering the research questions. This approach ensures that the findings reflect the real-life challenges and experiences of Agile adoption, rather than just theoretical or general data.

Research Design

Figure 2 presents the research design used in this study.

Figure 2

Research design



Literature Review

The literature review established foundational knowledge of Agile values, practices, adoption challenges, and organisational change concepts. It also helped identify gaps in existing knowledge and guided the development of the research questions.

Development of Interview Questions

A total of forty semi-structured interview questions was developed, grouped into seven themes: Agile adoption process, Agile practices, acceptance and mindset, team dynamics, planning, coding and deployment practices, and stakeholder satisfaction. These themes were based on existing research and covered all key aspects of Agile transformation.

Case Selection

The selected organisation (referred to as NZFI) is one of New Zealand's largest financial institutions and has undergone a substantial Agile transformation. Purposeful sampling was used to recruit participants who played key roles in the adoption process. Four participants were interviewed: an Agile Transformation Manager, two Platform Leads, and the Head of Digital Transformation. Although the sample size is small, this aligns with case study research, where depth rather than breadth is prioritised.

Data Collection

A preliminary meeting was held with NZFI to discuss the project scope, confidentiality requirements, and obtain consent to record interviews. All participants provided informed consent prior to being interviewed. Interviews were conducted face-to-face, audio-recorded, and later transcribed. The semi-

structured format allowed flexibility to explore emerging ideas while maintaining alignment with the research objectives.

Data Analysis

Thematic analysis, as outlined by Scharp (2019), was used to analyse the interview data. This method was selected because it provides a systematic yet flexible approach for identifying patterns and themes across qualitative data. The analysis followed six iterative steps (Scharp, 2019):

1. Becoming familiar with the data – which means transcript interviews or re-reading of data.
2. Generating coding categories – marking interesting features of data
3. Generating themes – collate initial codes into potential themes.
4. Reviewing themes – to match them with the research topics and questions
5. Defining and naming themes
6. Locating exemplars – provide evidence to support themes.

Coding was conducted manually to ensure close engagement with the data. Themes were developed inductively, emerging from the data rather than being pre-imposed.

Case Study and Findings

This chapter presents the findings from the NZFI case study, organized around key themes: reasons for adopting Agile, the adoption approach, challenges encountered, and benefits realized. Data was collected through four semi-structured interviews with key personnel involved in the Agile transformation.

Reasons for Adopting Agile

The NZFI, in 2009, started to think about how they can change the processes to overcome the problems they were facing at that time. The problems like low satisfaction of business users, high rate of compromised projects and low product quality. In the interview with Agile Transformation Manger, he pointed out.

> The way we were working, before Agile, is not much effective… The question we had was, how we will make things better in the organisation. But at that time, Agile was not an answer. After investigating and connecting our problems with the Agile, we found that Agile could be our alternatively. So, it was an experiment… the thing I try to convey here is Agile processes are not helpful until they get connected with the problems and challenges you have and how Agile responses to them? This question needs to be answered before switching to Agile. (Agile Transformation Manager).

Go Faster

The primary driver for Agile adoption at NZFI was the need to "go faster" in delivering business value.

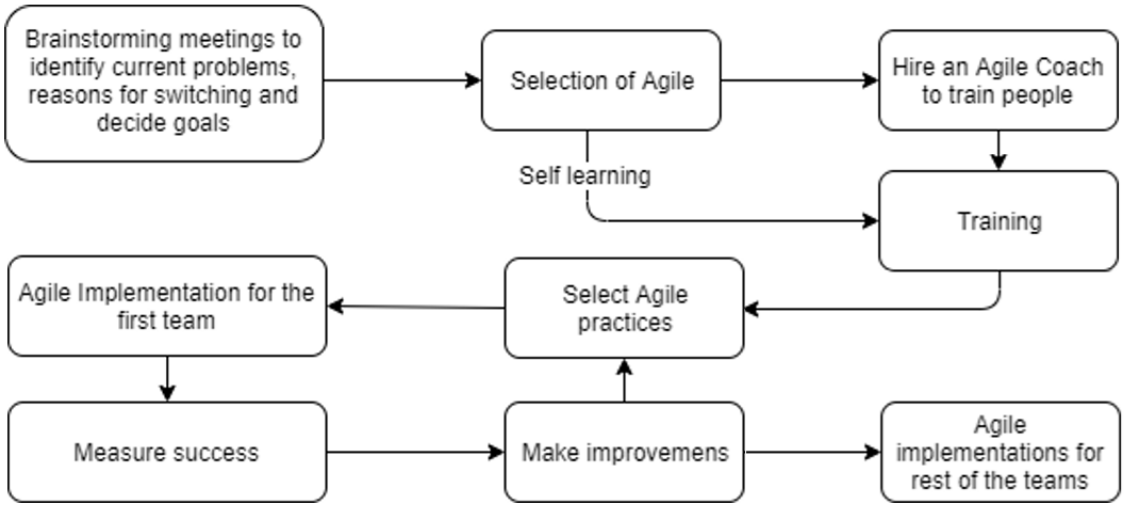
> …to go faster is the biggest and primary reason… fast delivery… culturally it is a better way to work as people are happier to work in this style.(Head of Transformation in Digital)

> It was adopted at the organisation level to deliver the quick solutions to the business requirements, so we can compete with the market by reducing the response time, provide customer value faster, and get the fast feedback from users to improve product quality. (Platform Lead 2)

Approach to Agile Adoption

Figure 3 illustrates the list of activities conducted during the Agile adoption process at NZFI.

Figure 3
NZFI Agile adoption process



NZFI adopted an incremental, experimental approach, starting with a single pilot team and gradually expanding to other teams over six years.

> It was evolution by time. When we started obviously, no one wanted to do that across the board… It was an incremental change… (Platform Lead 2).

> … The first Agile team was nine years ago… it was not like anyone changing overnight. It was slow burn thorough that period. (Head of Transformation in Digital)

An external Agile coach guided the adoption, helping teams select suitable practices and supporting the cultural change.

> …we had an Agile coach to assist us for the selection of the Agile practices and implementation… we tried different things, adopted what suited us, and discarded what didn't work. – Agile Transformation Manager

This phased adoption reflects best practices in change management, highlighting the importance of iterative learning and contextual adaptation in Agile transformations.

> …rather to discuss which Agile methods to adopt; we looked for reference points in other organisations which were successful… we tried different things, and adopted, which suited us and discarded which didn't work for us. (Agile Transformation Manager)

Chosen Agile Method and Practices

Most of the teams in NZFI are using the Scrum and Kanban methods.

> As a transformation leader, I collaborate with different teams; we have many implementations of Scrum and Kanban. (Platform Lead 1).

There are no specific practices which are being followed in the NZFI. Different teams used different practices which suit best to their needs

> We got teams using a range of different practices… it is not everyone following one path; there are multiple paths… take a programmatic approach what works best for different situations and scenarios… the nature of the team and their work is the element to consider which practices should be used. (Head of Transformation in Digital)

Although different teams have a different approach to work, in general, the common scrum practices are being followed in the NZFI, as Platform Lead 1 says

> We use some common scrum practices like product backlog, sprint backlog, stand-up meetings, retrospective, review planning.... (Platform Lead 1).

Agile Roles

Initially, when the Agile was adopted in NZFI, here were no Agile roles created to avoid the conflicts that may occur between the team members. The people performed different Agile roles' activities and responsibilities with the same (current) role tile. Later, when the teams were matured, the proper Agile roles were introduced.

> Initially, we didn't introduce any Agile roles but the accountability of some general roles like Product Owner, which means the roles are not really an organisational role but a virtual role which someone in the organisation needed to play… adding new roles in the big organisation is quite challenging… but, someone playing that role and holding that accountability something from the beginning then over time the evolution of these roles becoming a part of the organisation and these roles assigned to those people who were playing that roles… we are talking about over after three years, we have new job titles, and we started to shift to a broader organisation transformation as in organisation social started to change to align more with the Agile. (Agile Transformation Manager).

> …no change in reporting structure. We slowly created some new roles, like Product owners, Platform leads… we did not have coaching functions before, now the coaching function is in place, and more than twenty people are working in this unit (Head of Transformation in Digital).

The NZFI changed the hiring process at the initial stages of the Agile adoption so that the right people can be recruited according to the need of an Agile environment.

> We started to value different things; we started to look at different qualities in people who we hire like evidence of taking a collaborative approach rather than individual skills…we change interview questions to find people with a growth mindset. (Platform Lead 2).

Issue and Challenges Adopting Agile

Before starting the Agile adoption, the NZFI thoroughly investigated the different Agile methods, practices, with the Agile coach assistance, to know which will be best suited for their environment. Some potential issues and challenges were identified, which were likely to be emerged during or after the Agile adoption. A detailed discussion was performed on how to face these challenges for the successful Agile adoption.

> When we decided to adopt the Agile about nine years ago, we used to work differently, and we knew and expected, and it is normal, some across the board challenges. These challenges were at the organisation level like issues with the culture, people, and their mindset. (Agile Transformation Manager).

Every organisation faces issues and challenges while adopting Agile, but the important is how the organisation deals with them and make an environment where Agile can be promoted. Every problem needs a unique way to be addressed. But, in general, the key is to enhance communication within teams and team members to adequately addresses these challenges.

> … when we set up our first Agile team, we had to find what those challenges were and response to each one differently... we established a platform where people can share their concerns, and we can make decisions to improve the process. (Platform Lead 1).

> … concept of open room was introduced where the conversation was open, and everyone can discuss what is working or what is not working… as the part of the adoption process and do not afraid to discuss the issues. (Head of Transformation in Digital).

Agile Mindset Issue

The biggest challenge the NZFI experienced is to change the people to adopt the Agile mindset. The change was difficult to adapt to the people who were working in the organisation for a long time or had experience working with the traditional approach.

> Agile mindset? Yes, that was the biggest challenge that we faced… the proper training and coaching helped us a lot... some people are found confronting, and coaching helped them to go through this change. (Platform Lead 1).

Remote Teams' Issue

NZFI has two main technical departments located in different regions of the country. In some cases, teams or resources that are not geographically co-located work on the same project. Introducing Agile with remote teams was a challenge for NZFI.

> … Moving to the Agile… developing a correlation between the teams is hard, especially if they are geographically distributed as the power to make decisions in such teams is low... (Head of Transformation in Digital).

Lack of Management Support

As the Agile adoption, in NZFI was bottom driven, the top management support was not much there in the initial stages of the adoption process. But later, when the better outcomes are visible, the management support increased over time.

> The adoption was driven by practitioners and to sell the idea to the management we emphasize on better delivery and high performance… initially, the top management support was limited and increased over time based on the evidence of being more successful… got support rather than belief but on evidence. (Agile Transformation Manager).

The Team as a Team

Team collaboration also became an issue after Agile adoption, as some staff struggled to adjust from working individually to working collaboratively.

> Team collaboration was the challenge at the beginning… but with appropriate onboard coaching, that challenge didn't last very long… (Agile Transformation Manager).

Difficulty Managing Meetings

NZFI observed that staff were spending too much time in meetings and planning sessions. As a workaround, they introduced a system where, whenever possible, only one team member attends the meeting and then shares the essential, filtered information with the rest of the team.

> …Meeting was a big problem… to make the planning more efficient, we encouraged that only person goes for the meeting and report back to the team… (Platform Lead 1).

A requirement of T-shape skills

In the traditional approach, people use to work on a similar kind of tasks and do not have multiple skills. It is a requirement in the Agile environment to have generalized skill sets. NZFI faced the issue of generating T-shape skills in the people.

> … I guess we talked about having the T-shape people, but that was the evolution for us, not everyone was T-shape from day one that is something they were working on overtime… (Head of Transformation in Digital).

When different teams work together, skills get improved individually, and people show more interests in learning new things to move with the team.

> …Teams sit together, talk together, and plan together, which typically leads to better outcomes. We often end up with the best solution, as having people with different skill sets working together leads to optimal outcomes. (Head of Transformation in Digital).

Benefits Realized

After successfully adopting Agile, NZFI experienced several significant benefits, including higher customer satisfaction, faster delivery of customer value, improved market competitiveness, and an enhanced ability to make smarter and more informed decisions.

> … benefits like customer value way faster, we are more competent to the market and confident to face new challenges. (Platform Lead 2).

> … we had an enormous amount of discussion about how Agile will benefit us, and we gain what we expect like we are now going faster... (Head of Transformation in Digital).

Team success

As nothing is perfect, people will find out issue and challenges with the new process or change that implemented. The best way to measure the success of the change is to ask people whether they want to go back to use the old method of doing the work. If the answer is No, that's success.

> ... we got success, and the proof is that when you ask people to switch back the way you were working before and the answer is always no. People much prefer to work in this way… (Agile Transformation Manager).

The adoption started with the one team which was successful within the six months. After the first team success, the adoption was spread to the other teams, and the success period reduced to three months. It is because the teams got confident after seeing the success of the first team, and the adoption process is transparent, known, and visible to all.

> For our first team, we have evidence that the team was successful within six months … when we broaden the adoption, we have proof of being successful in transformation change in three months. (Agile Transformation Manager).

Better planning

By using planning practices such as Sprint Planning and Reviews, NZFI gained better control over project scope and planning. Project costs in the new Agile environment were also comparatively lower.

> … the theme which is changed the most is a much better focus on delivering value incrementally which allows us to control scope and cost… (Platform Lead 1).

Standard development

The pair programming or pair code review plays a vital role to keep the coding at its high standard. Developers encourage to do pair programming to learn more stuff and get help from other team members when needed. It ends up with the best solution and high-quality products. By doing pair programming, the requirement of training is raised.

> … we follow strong coding practices and standards… we often do pair review to keep the code standards and deliver high-quality products (Platform Lead 1).

Discussion

This chapter presents a discussion of the NZFI case study, highlighting key outcomes that address the research questions.

Success Factors for Agile Adoption

Agile Coach – A Key to Success

Agile adoption was initially an experiment for NZFI, and the organisation had limited prior knowledge of Agile methods and practices. Coaching and training played a crucial role in enabling successful adoption, with external coaches supporting the pilot and initial stages, followed by the development of an internal coaching unit of over twenty coaches. Coaching helped build an Agile mindset and behaviours, provided training, addressed resistance, and maintained consistency across teams. Participants highlighted this support as a key success factor, aligning with Alex (2014), who notes that proper training, expert assistance, and ongoing support are vital for successful Agile execution.

Think of it this way: adopting Agile without proper guidance is like trying to cross a busy road without a zebra crossing. Having a trusted guide, like an Agile coach, makes the journey safer and increases the chances of success.

Identification of Adoption Reasons

Correctly identifying the reasons for transitioning to a new way of working is crucial for selecting the right approach. NZFI's primary goals were to increase delivery speed (VersioOne Survey, 2019) and improve productivity (Pilar et al., 2012). By focusing on these objectives and considering organisational context and team attributes, they selected practices that improved processes and achieved desired outcomes. Existing staff assumed responsibility for Agile roles before formal roles were introduced, reducing resistance and fostering teamwork. Technical teams gained real-world business exposure, such as visiting contact centres, to better understand customer needs and improve feature delivery.

Develop Accountability of Agile Roles – A unique approach!

Numerous studies have proposed implementing Agile roles during adoption; however, NZFI took a different approach by not introducing formal Agile roles at the beginning. Instead, existing staff were encouraged to participate voluntarily, take interest, and assume accountability for different responsibilities. This approach motivated employees to support and accept Agile adoption, fostered teamwork, and reduced conflict and resistance. Over time, formal Agile roles were gradually introduced as the organisation matured.

Agile Adoption Issues and Challenges

Despite its success, NZFI faced several challenges during the transition, which were actively managed through communication, coaching, training, and knowledge-sharing initiatives to support the shift toward Agile ways of working.

Developing an Agile Mindset

Developing an Agile mindset was the most significant challenge at NZFI. Resistance was stronger among experienced staff accustomed to traditional methods, consistent with prior research. This aligns with Matt (2011), who highlights that adopting Agile is complex and organisations must actively foster an Agile mindset while aligning principles with their organisational context. Simply implementing roles and practices is insufficient; success depends on cultivating behaviours and attitudes that support Agile ways of working.

Managing Distributed Teams

Pilar et al. (2012) argue that Agile has limitations in supporting distributed development environments. NZFI experienced difficulties managing geographically dispersed technical teams. Practices such as daily stand-ups were harder to conduct effectively, and distributed teams had weaker collaboration and reduced decision-making power. Although NZFI attempted to minimise these challenges, they remained an ongoing issue due to organisational structure and culture.

Developing T-Shaped Skills

Agile environments require team members to possess generalised skill sets (Janeth et al., 2016). Employees accustomed to traditional, specialised roles often resist learning new skills. As expected, NZFI initially struggled to find team members with T-shaped skills. The organisation implemented training and development initiatives to broaden team capabilities and support Agile ways of working.

Lack of Top Management Support

Several studies highlight the lack of management support as a recurring issue in Agile adoption. The findings of this research suggest that when change is initiated from the bottom up, management support is initially limited. Support usually increases once benefits become visible. This aligns with Hassan & Al Shaima (2011), who found that management concerns about performance in a new method make early support less likely until tangible outcomes emerge.

Agile Benefits

Every organisation has its own goals and reasons to switch to Agile and expects relevant benefits. NZFI received several benefits after adopting Agile, including increased customer satisfaction (Chris Kraft, 2018), greater market competence (Kashari, 2017) through short-term development plans, better project planning (Fernando et al., 2017) via sprint planning, improved decision-making (Jayakanth & Kristina, 2010), high-quality product delivery (Asma et al., 2016), team empowerment (Luca & Luigi, 2018) through communication, and higher development standards (Manasvi & Hisham, 2014) using pair programming. The full implementation of Agile led to faster delivery cycles and more frequent feedback, increasing customer value and satisfaction. Teams became more empowered, self-managing, and motivated, resulting in stronger performance. Incremental delivery improved planning and control over scope, budget, and resources, while practices such as pair programming and continuous integration enhanced development quality and reduced defects. Additionally, Agile adoption enabled NZFI to respond more quickly to market changes and emerging customer needs, increasing overall organisational responsiveness.

Conclusion and Future Work

The purpose of this study was to identify the key success factors, challenges, and benefits associated with Agile adoption in organisations. This objective was achieved through a combination of literature review and analysis of the NZFI case study.

The study concludes that Agile adoption is most effective when aligned with the organisational context. Organisations with limited prior knowledge of Agile face significant difficulties if they attempt adoption without understanding its implications. Engaging an Agile coach or expert is critical to guide the adoption process, remove ambiguities, and ensure that organisational structure and culture are aligned with Agile principles.

The findings indicate that Agile adoption is a long-term, incremental process with no single formula for success. Key challenges include selecting appropriate practices, defining roles, fostering an Agile mindset, and aligning Agile principles with organisational goals. This study identified several key success factors, such as hiring an Agile coach to provide guidance, training, and ongoing support; clearly identifying adoption reasons to select methods and practices suited to organisational needs; introducing Agile roles gradually to reduce conflict and resistance; and enhancing business knowledge in technical teams to improve feature delivery and customer satisfaction.

The study also confirms that common issues—such as resistance to change, lack of top management support, and absence of T-shaped skills—can be mitigated through coaching, training, and empowerment of teams. Agile practices, when aligned with organisational context, provide tangible benefits at both individual and organisational levels, including faster delivery, improved product quality, stronger team collaboration, and enhanced responsiveness to market changes.

Future Work

Future research could explore the influence of organisational culture and structure on Agile adoption in greater depth. Investigating Agile adoption in smaller or less structured organisations may reveal different challenges and success factors. Additionally, studies could examine the implementation of scaled Agile frameworks, including Agile tribes or squads, and their impact on organisational performance. Expanding the sample size and incorporating quantitative measures could further strengthen the theoretical contribution and generalisability of findings.

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Critical Factors Influencing the Adoption of Basic and Scaled Agile Methods: A Comparative Study

Yinghui (Michael) Zhang
Auckland University of Technology

Ramesh Lal
Department of Computer and Information Sciences, AUT Computer and Information Sciences Research Centre, Auckland University of Technology

Abstract

This paper presents a systematic literature review (SLR) of 44 primary studies to critically investigate the factors influencing the adoption of six major Agile methods, segmented into Basic (XP, Scrum, Kanban) and Scaled (SAFe, DAD, LeSS) frameworks. The analysis identifies key success factors (nine for Basic, eight for Scaled) and corresponding barriers. Findings confirm that top management support, effective communication, and training are fundamental enablers across both levels. Crucially, the study provides a comparative synthesis that distinguishes their focus: Basic Agile mitigates internal team process risks, while Scaled Agile addresses systemic coordination and enterprise governance challenges. Furthermore, we map the limitations and strengths of these methods onto Software Project Risk Quadrants, demonstrating that scaling is necessary to manage Execution and Environmental Risks effectively. This research offers crucial theoretical insights for balancing flexibility and structure in complex Agile transformations.

Keywords

Agile, Critical factors, XP, Scrum, Kanban, SAFe, DAD, LeSS

Introduction

Since the early 2000s, the software industry has shifted from traditional plan-driven models toward adaptive Agile methods. The 2001 Agile Manifesto prioritised flexibility, collaboration, and continuous feedback over predictive control (Beck et al., 2001). While Agile has become the dominant approach globally, the success of transformations remains inconsistent, particularly when scaling from team-level practices to enterprise-wide implementations.

At the team level, basic frameworks like Scrum, XP, and Kanban provide significant adaptability and transparency. However, large enterprises often struggle to coordinate multiple teams and manage dependencies using these methods alone. Consequently, scaled Agile frameworks, such as SAFe, LeSS, and DAD, were developed to extend Agile principles to the organisational level. Yet, these frameworks face criticism for introducing heavy governance structures that risk diluting core Agile values. These tensions underscore the urgent need for a comparative analysis to understand where adoption challenges diverge.

Rationale and Problem Statement

Agile effectiveness is heavily dependent on contextual factors such as leadership, culture, and communication structures (Dikert et al., 2016; Senapathi & Srinivasan, 2014). Existing research, however, largely examines basic and scaled implementations independently, creating a critical gap in understanding how success factors and challenges diverge across these two levels. In addition, existing reviews seldom connect adoption factors to software risk structures or socio-technical tensions, which this study uniquely integrates. This study addresses that gap by providing a unified comparative analysis of adoption elements to help organisations manage framework selection and transition risks.

Theoretically, while the Technology–Organisation–Environment (TOE) framework is widely used (Tornatzky & Fleischer, 1990), we adopt a Socio-Technical Systems (STS) perspective (Bostrom & Heinen, 1977; Baxter & Sommerville, 2011; Hansson et al., 2006). We chose STS because its focus on internal dynamics and tensions (e.g., autonomy versus governance) better captures the interdependencies inherent in scaling (Figure 3.1). Furthermore, STS provides a distinct internal lens that complements the external risk focus of the Software Project Risk Quadrants applied in Section 4. This tension between the need for structured coordination at scale and the preservation of team-level agility fundamentally justifies the need for this comparative analysis.

Overview of the Six Agile Methods

This study focuses on six representative Agile frameworks, grouped into two levels:

Basic Agile Methods

Scrum - A lightweight process framework emphasising iterative delivery through defined roles (Scrum Master, Product Owner, Development Team), events (Sprint, Review, Retrospective), and artifacts (Backlog, Increment).

Extreme Programming (XP) - Focuses on engineering practices such as test-driven development (TDD), pair programming, and continuous integration to improve code quality and responsiveness.

Kanban - A visual workflow management approach emphasising continuous delivery and limiting work-in-progress (WIP) for process optimisation.

Scaled Agile Methods

SAFe (Scaled Agile Framework) - Integrates Lean and Agile principles across portfolio, program, and team levels, providing structured governance for large enterprises.

LeSS (Large-Scale Scrum) - Extends Scrum principles to multiple teams working on the same product, emphasising transparency and reduced coordination overhead.

DAD (Disciplined Agile Delivery) - A hybrid framework integrating Scrum, XP, and Kanban practices, focusing on goal-driven process tailoring and enterprise alignment.

These methods were selected because they represent the most widely adopted Agile frameworks across different organisational contexts. Together, they allow comparative analysis of core principles (e.g., iteration, self-organisation) and scaling mechanisms (e.g., coordination, leadership, alignment) that underpin Agile's effectiveness in diverse environments.

Research Objectives and Questions

The objective of this study was to identify, classify, and compare the critical elements influencing the adoption of both basic and scaled Agile methods. To achieve this objective, the research addresses the following questions:

RQ1: What are the critical elements that influence the adoption of basic Agile methods?

RQ2: What are the critical elements that influence the adoption of scaled Agile methods?

RQ3: What are the significant barriers to successful Agile adoption, and what strategies can overcome them?

RQ4: How do the critical elements of basic and scaled Agile adoption compare, and what implications do they have for software project risk management?

By answering these questions, this study contributes to a comparative understanding of Agile adoption dynamics and provides practical guidance for managers seeking to implement Agile at different scales.

Structure of the Paper

The remainder of this paper is organised as follows:

Section 2 presents the Research Design, including the systematic literature review (SLR) process, data collection, and coding framework.

Section 3 presents the Results and Discussion, comparing the identified elements and barriers between basic and scaled Agile methods, and addressing Research Questions 1, 2, and 3.

Section 4 discusses how Agile advantages and limitations align with software project risk quadrants and addresses RQ4.

Section 5 concludes the study with key findings, implications, and directions for future research.

Research Design

Research Methodology

This study employed a Systematic Literature Review (SLR) approach to investigate the critical factors influencing the adoption of both basic and scaled Agile methods. The SLR was conducted in accordance with the guidelines of Kitchenham and Charters (2007) to ensure methodological rigour, transparency, and replicability.

The research design aimed to identify, classify, and compare success factors, challenges, and critical elements of Agile adoption across two implementation levels—team-level (basic) and organisational-level (scaled). A mixed methods reasoning strategy was used, combining qualitative synthesis and comparative analysis. The qualitative stage focused on categorising key themes emerging from literature and case evidence, while the comparative stage analysed interrelationships among identified factors to determine overlaps and unique distinctions between Agile levels.

Research Process

The research process consisted of four major phases:

1. Planning the Review: Defined research objectives, formulated research questions (RQ1–RQ4), and developed inclusion and exclusion criteria.
2. Conducting the Review: Performed comprehensive searches in multiple academic databases using well-defined Boolean expressions and controlled keywords.
3. Data Extraction and Synthesis: Collected and coded data from qualified studies to identify recurring elements influencing Agile adoption.
4. Comparison and Validation: Compared results between basic and scaled Agile frameworks, validated through peer review and triangulation.

Data Collection and Selection

A search was carried out across five leading digital libraries: IEEE Xplore, Google Scholar, ScienceDirect, SpringerLink, and Scopus. The search was limited to peer-reviewed English-language publications from 2001 to 2022 to ensure relevance to the post-Agile Manifesto era.

Search Strategy

The search terms were formulated as follows:

("Agile" OR "Scrum" OR "XP" OR "Kanban" OR "Scaled Agile" OR "SAFe" OR "LeSS" OR "DAD")

AND ("Adoption" OR "Implementation" OR "Transformation" OR "Critical Factors" OR "Success Factors" OR "Barriers")

2.3.2 Inclusion and Exclusion Criteria

Inclusion criteria:

- The studies must be written in English, and the full text must be available.
- The paper must be published in a conference, a magazine, or a journal.
- The selected primary context should be related to agile development and adoption.
- The articles answered their intended research questions.

Exclusion criteria:

- The sources not published in the English language should be excluded.
- Sources unrelated to software development should not be considered valid.
- Articles from other domains, such as civil engineering, should not be considered.
- The books and chapters should be excluded.
- The number of SLR studies should be limited, and related articles can be cited for further reference.

Study quality assessment criteria

The quality assessment of the studies involves preparing a list of quality criteria and then evaluating each study based on its fulfilment of these criteria (Kitchenham, 2004). The list of criteria to evaluate the quality of the selected studies is given in Table 2.1

Table 2.1

Criteria for quality evaluation of primary studies

S.no	Questions for quality assessment	Score
QC1	Do the research methods followed in the study answer the research questions?	Yes=2, Partial=1, No=0
QC2	Does the research talk about agile adoption or transformation?	Yes=2, Partial=1, No=0
QC3	Is the motive of the research clearly discussed?	Yes=2, Partial=1, No=0
QC4	Are the factors mentioned in the text well justified?	Yes=2, Partial=1, No=0
QC5	Is the final result and conclusion related to the research question?	Yes=2, Partial=1, No=0

Using the list of criteria provided in Table 2.1, the quality assessment is conducted based on the guidelines. The total quality score for each study is calculated by summing the individual scores for each quality criterion question.

Study selection process

By comparing the guidelines of the selection process (Garousi et al., 2019; Kitchenham & Charters, 2007) and the tollgate method suggested by Khan et al. (2017), the tollgate method is selected and harnessed in the study's selection process, and an additional snowballing phase is added before the last phase. The tollgate method has five phases, and the selected digital libraries are exclusively assessed using these phases.

Phase 1 (Ph-1): Searching the relevant studies using search strings.

Phase 2 (Ph-2): Exclusion and inclusion based on reading the title and abstract.

Phase 3 (Ph-3): Exclusion and inclusion based on reading the introduction and conclusion.

Phase 4 (Ph-4): Exclusion and inclusion based on comparing the results of different databases and deleting duplicate articles.

Phase 5 (Ph-5): Finally selected studies to be included in the primary studies.

The final step involves synthesising the identified factors and barriers into two sets of comprehensive tables. The data extraction process, including the specific frequency counts for each factor and the corresponding study references, was fully documented in a dedicated Microsoft Excel file, which ensures the transparency and reliability of the quantitative analysis performed in Chapter 3. As the primary database search yielded a sufficient collection of literature, the snowballing process was not performed.

Data extraction and synthesis

A total of 1,781 studies were initially retrieved from five major databases. After applying inclusion and exclusion criteria, 44 primary studies were retained. 24 for basic Agile and 20 for scaled Agile (Appendix C: PRISMA flow diagram). Although the final sample represents only 2.5% of the initial pool, it demonstrates strong thematic saturation, as no new adoption factors emerged after the synthesis of approximately 35 studies, indicating adequate conceptual coverage.

Table 2.2

The process of collecting the articles related to the basic agile methods

Digital library and website		Ph-1	Ph-2	Ph-3	Ph-4	Ph-5	Primary studies (%)
Science direct	XP/Scrum/Kanban	49	9	7	6	0	0
Springerlink	XP/Scrum/Kanban	242	14	2	2	0	0
Scopus	XP/Scrum/Kanban	112	63	27	27	6	26
IEEE Xplore	XP/Scrum/Kanban	168	69	30	25	4	17
Google Scholar	XP/Scrum/Kanban	149	42	31	41	14	61
		720	197	97	101	24	

Table 2.3

The process of collecting the articles related to the scaled agile methods The selected paper list and their scores will be provided in Appendix A & B.

Digital library and website		Ph-1	Ph-2	Ph-3	Ph-4	Ph-5	Primary studies(%)
Science Direct	SAFe/DAD/LeSS	168	6	5	5	4	20
Springerlink	SAFe/DAD/LeSS	128	4	3	3	0	0
Scopus	SAFe/DAD/LeSS	117	29	19	9	4	20
IEEE Xplore	SAFe/DAD/LeSS	61	18	18	16	6	30
Google Scholar	SAFe/DAD/LeSS	587	57	35	16	6	30
		1061	114	80	49	20	

Table 2.4

The period of publication related to the basic agile adoption

Year	2001-2005	2006-2010	2011-2015	2016-2020	2021-	Total
Studies	1	5	10	7	1	24
Percentage	4%	21%	42%	29%	4%	100%

Table 2.5

The period of publication related to the scaled agile adoption

Year	2001-2005	2006-2010	2011-2015	2016-2020	2021-	Total
Studies	0	0	5	9	6	20
Percentage	0%	0%	25%	45%	30%	100%

Section Summary

This section details the research design and methodology applied in this study. Following Khan et al. (2017), this paper adopts a 40% frequency threshold to determine critical elements. Additional sensitivity checks at 30% and 50% showed consistent patterns, confirming that conclusions do not depend on a single cut-off point. Using a systematic literature review and thematic coding framework, 14 key elements for basic Agile adoption and 16 for scaled Agile adoption were identified. These elements form the foundation for the analysis presented in Section 3, where their interrelations and implications for Agile transformation are explored in detail.

Results and Discussion - RQ1, RQ2, RQ3

Overview of Key Findings

The analysis confirmed that *people-related factors* (Social subsystem), including skills, mindset, and training, were the strongest determinants of success, overshadowing pure *process-related factors* (Technical subsystem). This aligns with the Socio-Technical Systems view that social equilibrium is often harder to achieve than technical implementation during transformation (Trist, 1981).

To address RQ1 and RQ2, the systematic literature review and comparative synthesis revealed that Agile adoption, whether at the basic or scaled level, is influenced by a consistent set of human, organisational, and process-related elements. In total, 30 critical elements were identified, 14 for basic Agile methods (Scrum, XP, Kanban) and 16 for scaled Agile methods (SAFe, LeSS, DAD). The analysis confirmed that *people-related factors*, including skills, mindset, and training, were the strongest determinants of success. Meanwhile, *organisational resistance*, *inadequate sponsorship*, and *communication breakdowns* emerged as the most common barriers. For example, in basic agile adoption, "Accelerate software delivery" (BS1) and "Strong communication" (BS2) were identified as the top success factors, each appearing in 71% of the studies. Researchers like Stelzmann et al. (2010) emphasise that direct communication is critical for coordination. Conversely, "Lack of skills" (BC1) ranked as the primary barrier (84%), with Nerur et al. (2005) noting that insufficient agile experience makes the shift from process-centric to people-centric approaches particularly difficult.

Table 3.1

The identified critical elements during agile adoption

Critical elements related to basic agile adoption					
BS.no	Critical success factors/ Benefits	Percentage	BC.no	Critical challenges/Barriers	Percentage
BS1	Accelerate software delivery	71%	BC1	Lack of skills in human resources/experience with agile methods	84%
BS2	Strong communication and collaboration	71%	BC2	Lack of training and coaching	68%
BS3	Enhance software quality	65%	BC3	Minimal collaboration and knowledge pairing/ lack of communication/ Lack of coordination with other teams	63%
BS4	Increase team productivity	59%	BC4	Not enough leadership participation/Lack of management support and sponsorship	63%
BS5	Enhance the ability to manage to change priorities	53%	BC5	General organisation resistance to change/ Pervasiveness of traditional development methods	47%
BS6	Increase customer satisfaction	53%			
BS7	Knowledge sharing	41%			
BS8	Improve team morale	41%			
BS9	The support from the top manager	41%			
Critical elements related to scaled agile adoption					
SS.no	Critical success factors/Benefits	Percentage	SC.no	Challenges/Barriers	Percentage
SS1	Team competency agile development expertise/ Agile development environment	85%	SC1	Lack of communication and Collaboration/ Lack of communication between team and the client	82%
SS2	Training and coaching/ Training and learning and briefing of top management on agile	77%	SC2	Lack of skills in human resources/ experience with agile methods	76%
SS3	Strong collaboration and communication	77%	SC3	Unavailability of business analyst/ Unclear objectives of project/ Requirement unclear to the team / Inadequate Prioritization of requirements	59%
SS4	Leadership strong commitment/ Strong executive support	62%	SC4	Distributed location/ timezone	53%
SS5	Team encouragement/ Facilitation	62%	SC5	Lack of knowledge sharing	47%
SS6	Enhance ability to manage changing priorities/ Mechanism for change management/ Change agents	54%	SC6	Lack of training/ Insufficient trainning and education	41%
SS7	Improve project visibility/ transparency	46%	SC7	Lack of management commitments/ Leadership strong commitment/ Strong execitive support	41%
SS8	Team autonomy	46%	SC8	General organisation resistance to change	41%

Note: The main success factors of basic agile adoption (BS), the main challenge factors of basic agile adoption (BC), the main success factors of scaled agile adoption (SS), the main challenge factors of scaled agile adoption (SC) 2. Percentages represent the frequency of occurrence across the selected primary studies.

Critical Barriers and Solutions in Basic Agile Adoption

To address RQ3, for basic Agile methods, five primary barriers were identified:

- **BC1**: Lack of skills and experience
- **BC2**: Inadequate training and coaching
- **BC3**: Poor communication and coordination
- **BC4**: Limited management support
- **BC5**: Organisational resistance to change

Addressing these barriers requires both cultural and structural interventions. As Gandomani et al. (2015) emphasise, training and practical coaching are central to overcoming early-stage resistance. Theoretical training alone often proves insufficient; effective Agile transition demands experiential learning through workshops, pilot projects, and mentoring by experienced Agile coaches.

Moreover, communication and collaboration (BC3) remain pivotal. Implementing change management models, such as Kotter's 8-step framework or Lewin's unfreeze-change-refreeze model, can facilitate smoother cultural shifts during Agile transformations. Finally, top-management training helps ensure that leaders not only approve but also understand and internalise Agile principles—an essential condition for long-term sustainability.

Barriers and Interdependencies in Scaled Agile Transformation

At the scaled Agile level, eight major barriers were identified, with the most prominent including:

- **SC1**: Lack of communication and collaboration across distributed teams,

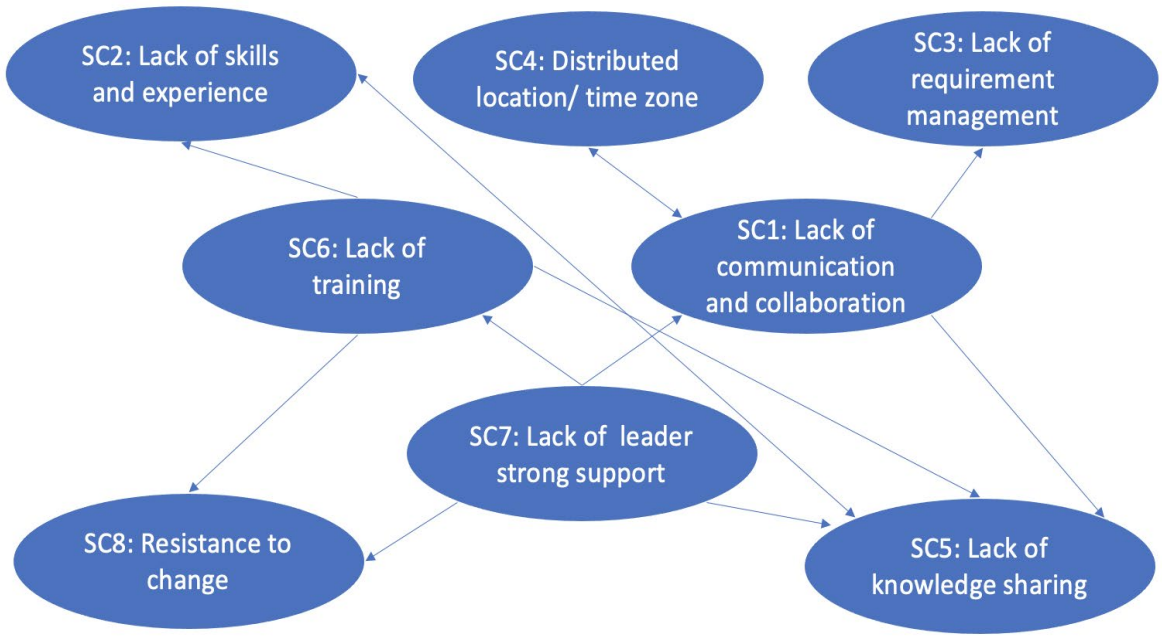
- **SC2**: Lack of skills in human resources/ experience with agile methods,
- **SC3**: Complex requirement management,
- **SC4**: Geographical and timezone distribution,
- **SC5**: Lack of knowledge sharing
- **SC6**: Lack of training
- **SC7**: Lack of executive sponsorship,
- **SC8**: General organisation resistance to change.

To address RQ3, the interdependencies among these barriers suggest that communication (SC1) and training (SC6) play central roles in influencing other challenges. For example, effective communication can directly reduce issues related to distributed coordination (SC4) and knowledge management (SC5). Similarly, comprehensive training enhances team maturity and reduces reliance on hierarchical control mechanisms.

Figure 3.1 derives from a qualitative synthesis of primary studies, modelling how foundational barriers like Lack of Executive Support [SC7] trigger downstream issues such as Lack of Training [SC6] and Communication breakdowns [SC1]. SC7 acts as a central structural enabler, while resolving SC1 and SC6 creates a positive cascading effect that strengthens alignment and reduces friction.

Figure 3.1

The relationship of the challenges during scaled agile adoption



Comparative Insights Between Basic and Scaled Agile

The comparison between the two levels highlights both continuity and divergence:

Shared Core Principles: Both levels emphasise the importance of training, collaboration, and leadership support. The same factor can act as either a success enabler or a barrier, depending on the quality of its implementation. For example, BC2 (training) and SC6 (training) are essentially identical in nature but differ in scope and impact.

Scope and Complexity: Basic Agile focuses on intra-team processes, while scaled Agile extends these principles to multi-team coordination and enterprise governance. This expansion transforms team-level challenges into organisational-level risks, often requiring dedicated roles (e.g., Release Train Engineer in SAFe) and synchronisation mechanisms.

Hierarchy of Barriers: Most scaled-level challenges encapsulate basic-level risks. For instance, lack of communication (BC3) evolves into distributed collaboration risk (SC1), while limited management support (BC4) becomes executive alignment and sponsorship (SC7).

A critical tension exists between Basic Agile's emphasis on team autonomy and Scaled Agile's necessity for standardised governance. While basic methods empower self-organising teams to maximise responsiveness, scaled frameworks (e.g., SAFe) impose structural layers to ensure enterprise alignment.

The findings also challenge the assumption that scaled Agile frameworks inherently improve coordination. In practice, added layers of governance may create new bottlenecks or reduce team autonomy, echoing critiques in scaling literature that caution against over-formalisation. This creates a trade-off: the rigorous coordination required for stability in large organisations can inadvertently stifle the speed and flexibility that Agile originally promised, potentially reintroducing bureaucratic friction into the development process.

RQ4: Linking Agile Advantages and Limitations to Software Project Risk Quadrants

Conceptual Background

To address RQ4 and to further interpret the implications of Agile adoption, the findings from both basic and scaled Agile analyses were mapped against the Software Project Risk Quadrants, derived from Wallace and Keil (2004) and expanded by Beecham et al. (2021). This framework categorises project risks into four quadrants based on their degree of importance and level of managerial control, providing a structured lens for evaluating how Agile methods mitigate or amplify different types of risks.

By associating the critical elements of basic and scaled Agile with these quadrants, we can gain a better understanding of the risk coverage, limitations, and balance achieved at each level of Agile adoption. The four quadrants are defined as follows (The diagram is in Appendix D):

Quadrant 1: Customer Mandate Risks - Risks driven by customer engagement, participation, and stakeholder alignment.

Quadrant 2: Scope and Requirements Risks - Risks related to unclear goals, changing requirements, and inadequate scope management.

Quadrant 3: Execution Risks - Risks linked to team skills, estimation errors, and process inefficiencies.

Quadrant 4: Environmental Risks - Risks influenced by organisational change, external dependencies, and cultural or geographical distance.

Mapping Agile Advantages and Limitations to Risk Quadrants

The comparison reveals that basic Agile frameworks - Scrum, XP, and Kanban - tend to mitigate risks concentrated in Quadrants 1 and 2, while scaled Agile frameworks - SAFe, LeSS, and DAD - extend risk coverage into Quadrants 3 and 4 through formalised coordination, governance, and alignment mechanisms.

Table 4.1
Mapping of Agile Strengths and Limitations to Software Project Risk Quadrants

Risk Quadrant	Typical Risk Focus	Basic Agile Strengths / Mitigation	Scaled Agile Limitations / Challenges
Q1: Customer Mandate (High importance, low control)	User conflict, lack of participation, resistance to change	Continuous user collaboration reduces resistance. Iterative feedback cycles enhance engagement. Cross-functional teams create shared ownership.	Coordination across multiple stakeholders adds communication overhead. Consistent user engagement is harder to sustain at scale.
Q2: Scope and Requirements (High importance, high control)	Unclear goals, evolving requirements, and scope creep	Backlog refinement supports adaptive planning. Frequent reviews reduce ambiguity. Incremental delivery ensures alignment.	Synchronising requirements across teams becomes complex. Dependency management slows responsiveness.
Q3: Execution (Moderate importance, high control)	Inexperienced teams, estimation errors, and miscommunication	Self-organising teams improve ownership. Daily stand-ups increase visibility. Retrospectives promote continuous learning.	Large-scale coordination can reduce team autonomy. Overhead from cross-team governance.
Q4: Environment (Moderate importance, low control)	Organisational change, external dependencies, geographic distribution	Flexibility allows rapid response to change. Iterative releases mitigate uncertainty.	Distributed teams limit informal communication. Misaligned tools/processes reduce efficiency.

Basic Agile excels in managing customer and requirement risks through close interaction and iterative learning, while scaled Agile adds structure to handle execution and environmental risks, but introduces complexity in coordination and control. For example, the barrier 'Lack of Executive Sponsorship' (SC7) identified in Section 3 is particularly critical for managing 'Environmental Risks' (Quadrant 4), as external dependencies often require high-level authority to resolve.

It is important to note that Scaled Agile does not abandon the benefits of Basic Agile in Quadrants 1 and 2; rather, it inherits them with necessary trade-offs. Since scaled frameworks are built upon team-level practices (e.g., Scrum teams within a Release Train), they retain the capacity for managing user requirements. However, the addition of governance layers to address Q3 and Q4 risks inevitably introduces coordination latency, potentially dampening the immediate responsiveness to customer changes found in smaller, autonomous teams.

Interpretation and Theoretical Implications

Theoretically, this study frames Agile as a risk-response mechanism rather than a universal solution. Basic Agile operates as a Complex Adaptive System (CAS) (Holland, 1995), managing volatility (Quadrants 1 & 2) through emergent behaviour. Conversely, Scaled Agile functions as a Complicated System, designed to manage structural dependencies (Quadrants 3 & 4). Complicated systems are characterised by multiple dependent components and detailed structural governance (e.g., SAFe), where success relies on effective management rather than self-organisation. This distinction challenges

the view that scaling is simply "more Agile," suggesting instead a paradigm shift from pure adaptability to managed stability.

Three core implications emerge from this synthesis:

1. Agility Is Context-Dependent: Basic methods thrive in dynamic, small-team settings, whereas Scaled frameworks are essential for complex environments requiring formal alignment.
2. Scaling Introduces Structural Trade-offs: The challenge lies in balancing flexibility with the stability needed to mitigate governance risks, avoiding excessive bureaucracy.
3. Leadership Is Pivotal: Successful scaling fundamentally depends on executive-level reinforcement to establish organisational learning loops.

Specific factors map directly to these risks. For instance, 'Lack of Executive Support' (SC7) is a primary vulnerability for Environmental Risks (Q4), where external dependencies demand high-level authority. While 'Strong Communication' (BS2/SS3) mitigates Execution Risks (Q3), relying solely on Basic Agile in high-Q4 contexts (e.g., regulated industries) is hazardous. Scaled frameworks are necessary here to institutionalise dependency management, providing a conceptual tool for practitioners to anticipate failures where Basic methods fall short.

Practical Implications

For practitioners, these findings suggest that organisations should not treat scaling as a linear extension of team-level agility. Instead, adoption strategies should be explicitly aligned with organisational maturity, leadership capability, and the structural readiness for cross-team coordination. This mapping provides actionable insight into aligning Agile strategies with organisational risk contexts:

- Team-level adoption should focus on strengthening communication, technical discipline, and self-organisation before scaling.
- Leadership sponsorship, standardised communication tools, and dedicated change management structures should support scaling efforts.
- Risk governance in scaled Agile should avoid over-formalisation; lightweight synchronisation and transparency mechanisms are preferable to preserve agility.

Organisations transitioning from basic to scaled Agile should therefore treat scaling not as a "process expansion," but as a strategic evolution—one that integrates governance without diluting Agile's core principles.

Section Summary

This section connected Agile adoption outcomes to the broader framework of software project risk management. Basic Agile methods were shown to effectively mitigate customer and requirement-related risks (Quadrants 1 and 2), while scaled Agile frameworks addressed execution and environmental risks (Quadrants 3 and 4) but faced challenges of complex coordination and cultural adaptation.

Overall, the mapping reinforces that no single Agile level provides comprehensive risk coverage. Sustainable Agile transformation depends on progressive integration — beginning with strong team-level practices and expanding through structured, learning-oriented scaling supported by leadership and adaptive governance.

Conclusion and Future Work

This study critically compared the adoption dynamics of Basic and Scaled Agile through a systematic review of 44 primary studies.

Theoretical Contribution: The study contributes a Risk-Based Adoption Framework that differentiates Agile utility. We theorise that Basic Agile is a tool for uncertainty reduction (Customer/Scope risks), whereas Scaled Agile is a tool for complexity management

(Execution/Environmental risks). This distinction resolves the literature's conflict regarding "bureaucracy in Agile" by framing governance not as an impediment, but as a necessary countermeasure to environmental entropy in large enterprises.

Practical Implications: For practitioners, the findings dictate a diagnostic approach: Organisations should map their primary risk exposure before selecting a framework. If the dominant risk is External Dependency (Q4), the overhead of Scaled Agile is justified. If the risk is purely Requirement Volatility (Q2), Scaled frameworks may introduce unnecessary rigidity.

Limitations and Future Work: While this SLR covers studies up to 2022, the rapid emergence of Generative AI in 2023-2024 represents a new variable not covered here. Future research should empirically validate how AI tools might assume the coordination roles in Scaled Agile, potentially reducing the "bureaucratic tax" identified in this study.

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Appendix A

The selected primary studies related to the basic agile adoption

No.	Article name	Year	Author(s)
P1	An empirical investigation of the factors affecting agile usage	2014	Senapathi, Mali; Srinivasan, Ananth
P2	Benefits to organisations after migrating to Scrum	2017	Mahmood, Waqas; Usmani, Nabiha; Ali, Muhammad; Farooqui, Sumeen.
P3	Challenges of Migrating to Agile Methodologies	2005	Nerur, Sridhar; Mahapatra, RadhaKanta; Mangalaraj, George.
P4	Challenges related to the adoption of Scrum	2014	Kanane, Aahd
P5	Change Management: Critical success factors of product development in Agile	2020	Saghazadeh, Sahar
P6	Decoding Agile: Challenges and Solutions A Qualitative study of the transition to Agile method	2021	Ansari, Asif Akhtarhussain
P7	Exploring facilitators of transition and adoption to agile methods: a grounded theory study	2014	Sharif, Yatim
P8	Exploring the perceived success factors of agile software projects in indonesian startups	2018	Kamil, Nuruddin
P9	Identifying Benefits and Challenges in the application of Agile methodologies in software development	2015	Streek, Alistair
P10	Usage and perceptions of agile software development in an industrial context: An exploratory study	2007	Begel, Andrew; Nagappan, Nachiappan.
P11	Agile software development: A survey of early adopters	2008	Vijayasarathy, Leor; Turk, Dan.
P12	Issues and challenges in Scrum implementation	2012	Akif, Raza; Majeed, Hammad.
P13	The agile transition in software development companies: The most common barriers and how to overcome them	2017	Obrutsky, Santiago; Erturk, Emre.
P14	Case study: Factors that hinder and support the adoption of Pair Programming in an agile software development company	2020	Dhoodhanath, Prashika; Quilling, Rosemary.
P15	Critical Factors in Agile Software Projects according to People, Process and Technology Perspective	2015	da Silva, Karla Michele Barbosados Santos, Simone Cristiane
P16	Agility meets systems engineering: A catalogue of success factors from industry practice	2010	Stelzmann, Ernst; Kreiner, Christian; Spork, Gunther; Messnarz, Richard; Koenig, Frank
P17	Barriers to adopting agile practices when developing medical device software	2012	McHugh, Martin; McCaffery, Fergal; Casey, Valentine
P18	Insights into the perceived benefits of Kanban in software companies: Practitioners' views	2016	Ahmad, Muhammad Ovais; Markkula, Jouni; Oivo, Markku

P19	Overcoming barriers to self-management in software teams	2009	Moe, Nils Brede; Dingsøyr, Torgeir; Dybå, Tore
P20	What Makes IT personnel adopt scrum? A framework of drivers and inhibitors to developer acceptance	2011	Overhage, Sven; Schlauderer, Sebastian; Birkmeier, Dominik; Miller, Jonas
P21	Factors affecting effectiveness of agile usage - Insights from the BBC worldwide case study	2011	Senapathi, Mali; Middleton, Peter; Evans, Gareth
P22	Factors that impact implementing an agile software development methodology	2007	Livermore, Jeffrey A
P23	The challenges of becoming Agile: Implementing and conducting scrum in integrated product development	2012	Ovesen, Nis
P24	Analyzing and Exploring Agile Project Management Challenges from a Practitioner Perspective: A Case study on HMS	2018	Mohan, Aneesha

The selected primary studies related to the scaled agile adoption

No.	Article name	Year	Author(s)
P25	Adoption hurdles faced by organisations embracing SAFe®	2020	Rodriguez Leon, Alexis; Singh, Khushboo
P26	Categorization of risk factors for distributed agile projects	2015	Shrivastava, Suprika V; Rathod, Urvashi
P27	Challenges and facilitators practices for knowledge management in large-scale scrum teams	2019	Almeida, Fernando; Miranda, Emanuel; Falcão, João
P28	Challenges and Solutions of Applying Large-Scale Agile at organisational Level.	2019	Dumitriu, Florin; Meșniță, Gabriela; Radu, Laura-Diana
P29	Issues in the Adoption of the Scaled Agile Framework	2022	Ciancarini, Paolo; Kruglov, Artem; Pedrycz, Witod; Salikhov, Dilshat; Succi, Giancarlo
P30	Do scaling agile frameworks address global software development risks? An empirical study.	2021	Beecham, Sarah; Clear, Tony; Lal, Ramesh; Noll, John
P31	Requirements engineering challenges and practices in large-scale agile system development.	2021	Kasauli, Rashidah; Knauss, Eric; Horkoff, Jennifer; Liebel, Grischa de Oliveira Neto, Francisco Gomes
P32	The impact of inadequate and dysfunctional training on Agile transformation process: A Grounded Theory study	2015	Gandomani, Taghi Javdani; Zulzalil, Hazura; Ghani, Abdul Azim Abdul; Sultan, Abu Bakar Md; Parizi, Reza Meimandi
P33	Building lean thinking in a telecom software development organisation: Strengths and challenges	2013	Rodríguez, Pilar; Mikkonen, Kirsi; Kuvaja, Pasi; Oivo, Markku; Garbajosa, Juan
P34	Challenges and success factors for large-scale agile transformations - A research proposal and a pilot study	2016	Paasivaara, Maria; Lassenius, Casper
P35	Communities of practice in a large distributed agile software development organisation - Case Ericsson	2014	Paasivaara, Maria; Lassenius, Casper
P36	Scaling agile in large organisations: Practices, challenges, and success factors	2018	Kalenda, Martin; Hyna, Petr; Rossi, Bruno
P37	Prioritizing challenges of agile process in distributed software development environment using analytic hierarchy process.	2018	Shameem, Mohammad; Kumar, Rakesh Ranjan; Kumar,

			Chiranjeev; Chandra, Bibhas; Khan, Arif Ali
P38	Adopting SAFe to Scale Agile in a Globally Distributed organisation	2017	Paasivaara, Maria
P39	Agile methods rapidly replacing traditional methods at Nokia: A survey of opinions on agile transformation	2011	Laanti, Maarit; Salo, Outi; Abrahamsson, Pekka
P40	Becoming agile in the digital transformation: The process of a large-scale agile transformation	2018	Fuchs, Christoph; Hess, Thomas
P41	How Can Human Values Be Addressed in AgileMethods A Case Study on SAFe	2022	Hussain, Waqar; Shahin, Mojtaba; Hoda, Rashina; Whittle, Jon; Perera, Harsha; Nurwidyantoro, Arif; Shams, Rifat Ara; Oliver, Gillian
P42	Toward Unveiling How SAFe Framework Supports Agile in Global Software Development	2021	Marinho, Marcelo; Camara, Rafael; Sampaio, Suzana
P43	Practitioners Perspective on Motivators of Agile in Global Software Development	2022	Azeem Akbar, Muhammad; Al-Sanad, Abeer; Rafi, Saima; Wang, Yuqing; Alzahrani, Musaad
P44	Motivators for Large-Scale Agile Adoption from Management Perspective: A Systematic Literature Review	2019	Abrar, Muhammad Faisal; Khan, Muhammad Sohail; Ali, Sikandar; Ali, Umar; Majeed, Muhammad Faran; Ali, Amjad; Amin, Bahrul; Rasheed, Nasir

Appendix B: The Scores Papers Selected

The scores of the primary studies related to the basic agile methods

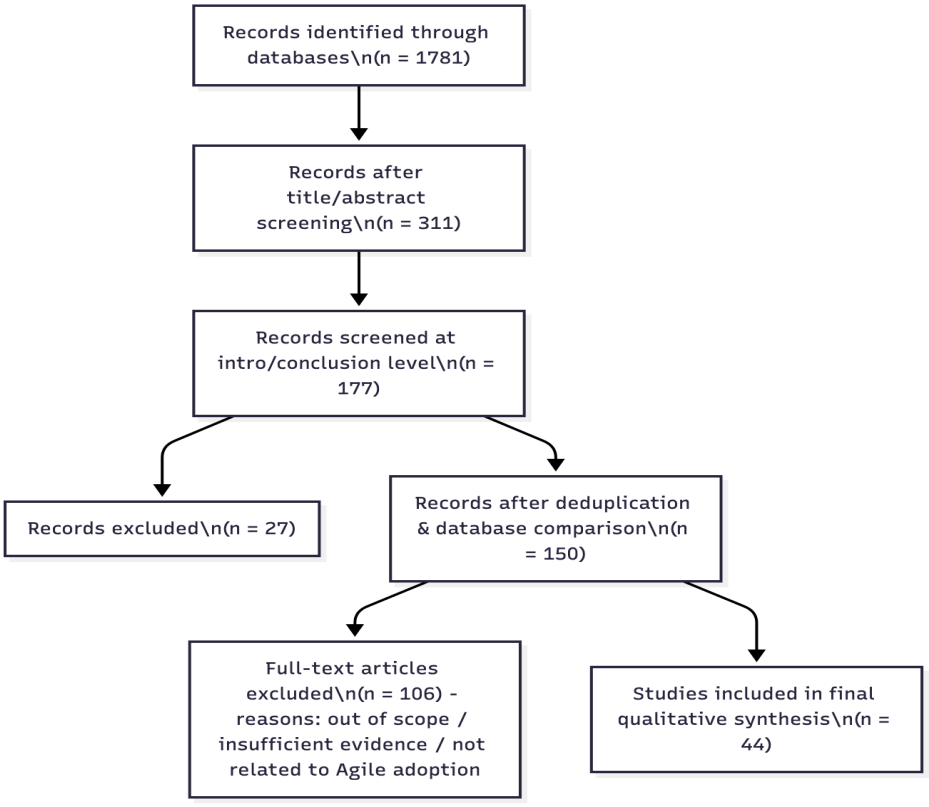
Studies no	QC1	QC2	QC3	QC4	QC5	Total score
"S1"	2	2	2	2	2	10
"S2"	2	2	2	2	2	10
"S3"	2	2	2	2	2	10
"S4"	2	2	2	2	2	10
"S5"	2	2	2	2	2	10
"S6"	2	2	2	2	2	10
"S7"	2	2	2	2	2	10
"S8"	2	2	2	2	2	10
"S9"	2	2	2	2	2	10
"S10"	2	2	2	2	2	10
"S11"	2	2	2	2	2	10
"S12"	2	2	2	2	2	10
"S13"	2	2	2	2	2	10
"S14"	2	2	2	2	2	10
"S15"	2	2	2	2	2	10
"S16"	2	2	2	2	2	10
"S17"	2	2	2	2	2	10
"S18"	2	2	2	2	2	10
"S19"	2	2	2	2	2	10

"S20"	2	2	2	2	2	10
"S21"	2	2	2	2	2	10
"S22"	2	2	2	2	2	10
"S23"	2	2	2	2	2	10
"S24"	2	2	2	2	2	10

The scores of the primary studies related to the scaled agile methods

Studies no	**QC1**	**QC2**	**QC3**	**QC4**	**QC5**	**Total score**
"S25"	2	2	2	2	2	10
"S26"	2	2	2	2	2	10
"S27"	2	2	2	2	2	10
"S28"	2	2	2	2	2	10
"S29"	2	2	2	2	2	10
"S30"	2	2	2	2	2	10
"S31"	2	2	2	2	2	10
"S32"	2	2	2	2	2	10
"S33"	2	2	2	2	2	10
"S34"	2	2	2	2	2	10
"S35"	2	2	2	2	2	10
"S36"	2	2	2	2	2	10
"S37"	2	1	2	2	2	9
"S38"	2	2	1	2	2	9
"S39"	2	2	2	2	2	10
"S40"	2	2	2	1	2	9
"S41"	2	2	2	2	1	9
"S42"	2	2	2	2	1	9
"S43"	2	2	2	2	2	10
"S44"	2	2	2	2	2	10

Appendix C: PRISMA Flow Diagram



Appendix D: GSD Risk Catalogue derived from Wallace and Keil and Verner et al. (2004)