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Hybrid Project Management and Certified Sustainability Performance in Infrastructure Megaprojects: Evidence from the LaGuardia Terminal B Redevelopment

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Abstract

Infrastructure megaprojects increasingly face the dual challenge of regulatory compliance and sustainability-driven adaptability. Traditional project management approaches often struggle to address this complexity, while purely agile or lean models encounter governance and contractual limitations. This study investigates how hybrid project management configurations can reconcile these competing demands in a sustainability-certified infrastructure megaproject. Using a structured documentary case study of the LaGuardia Terminal B redevelopment, the research analyzes the integration of traditional, agile, and lean practices across project phases. A systematic coding framework was applied to multiple high-reliability project documents to identify methodological distribution, enabling conditions, and performance associations. The results reveal a structured–iterative hybrid configuration in which traditional practices dominate planning and closure, agile practices support iterative design and construction, and lean practices enhance process efficiency during execution. Digital maturity, adaptive governance, and method tailoring emerged as critical enablers of hybrid integration. Performance analysis indicates that the hybrid configuration is associated with favourable delivery and sustainability outcomes, including schedule adherence, cost control, waste diversion, energy reduction, and water conservation, as documented in verified project certification records. The study contributes empirical evidence to hybrid project management theory in a regulated infrastructure context and highlights sustainability certification as a key boundary condition shaping hybrid governance.

Keywords

Hybrid project management, sustainable infrastructure, megaprojects, agile project management, sustainability certification.

1. Introduction

Infrastructure projects are under increasing pressure to deliver certified sustainability outcomes while maintaining cost and schedule control. Traditional project management (TPM) offers structure but lacks adaptability; agile and lean methods provide flexibility and waste reduction but struggle with regulatory rigour. Hybrid project management (HPM) — integrating TPM, agile, and lean practices — has been proposed as a solution, yet empirical validation in regulated, sustainability-certified contexts remains limited.

This paper presents a documentary case study of the LaGuardia Terminal B redevelopment, the first airport terminal to achieve both LEED Gold v4 and Envision Platinum certifications (D012_ISI_2023; D013_LEED_2023). The study addresses four research questions: (RQ1) What hybrid practices were implemented? (RQ2) How were they distributed across project phases? (RQ3) What conditions enabled effective integration? (RQ4) How did hybrid integration affect performance?

The remainder of this paper is structured as follows. Section 2 reviews the literature on traditional, agile, lean, and hybrid project management, as well as sustainability certification systems. Section 3 describes the research methodology. Section 4 presents results and discussion. Section 5 outlines limitations and future research directions, and Section 6 concludes with key findings and implications.

The objective of this study is to empirically examine how hybrid project management supports certified sustainability outcomes in complex infrastructure delivery. Specifically, the paper aims to: (1) define the hybrid configuration of traditional, agile, and lean practices applied in the LaGuardia Terminal B redevelopment; (2) map the distribution of these practices across project phases; (3) identify enabling conditions — such as digital maturity, governance structures, and team culture — that facilitate effective integration; (4) assess the association between hybrid integration and project performance indicators including schedule, cost, waste, energy, and water; and (5) provide a transferable governance model to guide future sustainability-driven megaprojects.

2. Literature Review

Sustainable infrastructure projects are increasingly expected to achieve rigorous certification standards such as LEED and Envision while adhering to strict budgetary and scheduling constraints (Kineber et al. 2024). Traditional Project Management (TPM), rooted in the PMBOK® Guide (Project Management Institute 2021), provides a structured, phase-gated approach that ensures predictability and compliance with regulatory frameworks. However, its linear nature is often criticized for rigidity and poor responsiveness to evolving stakeholder requirements or unforeseen site challenges (Leong et al. 2023).

In contrast, Agile methodologies — originating in software development (Beck et al. 2001) — emphasize iterative development, cross-functional collaboration, and adaptability through practices such as sprints and daily stand-ups. While Agile enhances flexibility and client engagement, its application in heavily regulated, capital-intensive construction projects faces significant hurdles, including traditional lump-sum contracts and rigid approval processes (Kineber et al. 2024). Lean construction principles, derived from the Toyota Production System (Ohno 1988), focus on maximizing value and minimizing waste through tools such as the Last Planner System® and Value Stream Mapping. Lean has demonstrated success in improving workflow reliability and reducing material waste (Koskela 1992; Li et al. 2023), yet its integration with overarching project control systems remains a persistent challenge.

The concept of Hybrid Project Management (HPM) has emerged as a pragmatic synthesis, seeking to blend the predictive control of TPM with the adaptability of Agile and the efficiency of Lean (Thesing et al. 2021). Early frameworks, such as the PMI Practice Guide for Hybrid Agile (Project Management Institute 2014), acknowledge the need for tailored approaches but offer limited guidance for physical infrastructure. Recent studies have begun exploring HPM in construction (Adedokun et al. 2025; Binder 2022), yet a conspicuous gap remains: there is a scarcity of empirical, quantitative evidence demonstrating how HPM specifically contributes to achieving certified sustainability outcomes in large-scale, regulated megaprojects. This study aims to address these gaps through a detailed, evidence-based case study of HPM implementation in a sustainability-driven airport redevelopment.

The two certification systems relevant to this study impose substantive governance demands. LEED v4, administered by the U.S. Green Building Council, employs a point-based framework across eight credit categories, with Gold certification requiring a minimum of 60 out of 110 points (USGBC 2019). Envision, developed by the Institute for Sustainable Infrastructure, evaluates projects across five categories — quality of life, leadership, resource allocation, natural world, and climate and resilience — with Platinum certification requiring exceptional performance and independent third-party verification (ISI 2018). Achieving both certifications simultaneously is rare in the infrastructure sector, making the LaGuardia Terminal B case particularly instructive for studying hybrid project management.

3. Methods

This study adopted a single-case, exploratory documentary research design, appropriate for examining a contemporary phenomenon within its real-life context where the researcher has no control over behavioral events (Yin 2018). The LaGuardia Terminal B redevelopment was selected as a critical case due to its achievement of dual sustainability certifications (LEED Gold v4 and Envision Platinum; D013_LEED_2023; D012_ISI_2023) and its recognition as a large-scale public infrastructure megaproject delivered through innovative governance and delivery arrangements. The study follows an analytic generalization logic, aiming to contribute to theory building on hybrid project management.

3.1 Data Collection and Document Selection

Data were collected exclusively from publicly available, high-reliability documentary sources produced by project stakeholders or independent certification and industry bodies. A purposive sampling strategy was applied using the following inclusion criteria: (1) public accessibility through official organizational websites or reputable industry platforms; (2) publication between 2016 and 2023; (3) authorship by primary project stakeholders (e.g., PANYNJ, Skanska, WSP, HOK) or independent certification bodies (e.g., USGBC, ISI); and (4) presence of empirical information related to project management practices, sustainability performance, or enabling conditions. This process resulted in a final corpus of eight key documents, including sustainability certification dossiers, owner and contractor reports, and professional engineering case studies.

3.2 Data Analysis Procedure

A hybrid deductive–inductive content analysis approach was employed (Bowen 2009). A preliminary coding framework was developed from the literature review and research questions, and subsequently refined through iterative engagement with the data. The coding framework comprised four main analytical dimensions: (1) Hybrid practices (TPM, Agile, Lean); (2) Project phase (planning, design, construction, close-out, operations); (3) Enablers (digital tools, leadership and governance, team culture, method tailoring); and (4) Performance outcomes (schedule, cost, waste, energy, water).

The author coded the full document corpus, resulting in the extraction of 142 relevant excerpts. To assess intercoder reliability, a second independent coder a fellow Master's student in the same program with knowledge of the subject matter independently coded 20% of the corpus using the finalized codebook. Cohen's Kappa was calculated, yielding a value of 0.87, indicating a high level of agreement. Coding discrepancies were resolved through discussion, and the codebook was refined accordingly.

3.3 Digital Maturity Index (DMI)

To operationalize digital capability, a Digital Maturity Index (DMI) was developed as a composite indicator on a 0–1 scale, drawing on Succar's (2010) BIM Maturity Matrix and Paulk et al.'s (1993) staged capability model. The index is based on three equally weighted components: (1) BIM integration across 3D, 4D, and 5D dimensions; (2) real-time project dashboards for progress and sustainability monitoring; and (3) simulation and digital twin applications for scenario analysis. Each component was scored on a binary basis (0 = no documentary evidence; 1 = explicit documentary confirmation). The LaGuardia project achieved a composite DMI score of 1.0, reflecting full documentary confirmation of advanced digital integration across all three components.

3.4 Ethical Considerations

This study employed exclusively publicly available documentary sources, thereby eliminating risks to human subjects. All data were obtained from official organizational websites, certification body publications, and reputable industry platforms. No proprietary, confidential, or personal information was accessed or used.

4. Results and Discussion

4.1 Document Corpus and Analytical Overview

The analysis was based on eight publicly available, high-reliability documents related to the LaGuardia Terminal B redevelopment (see Appendix A). A total of 142 excerpts were extracted and coded by two independent coders using the structured analytical framework, achieving a Cohen’s Kappa value of 0.87 (Table 1 and Table 2). The analysis combined descriptive quantification of methodological practices and performance indicators with thematic interpretation of enabling conditions (Figure 1 and Figure 2).

Table 1. Sample Excerpts from the Documentary Coding Framework

Document ID	Excerpt	Primary Code	Phase	Indicator Type	Value	Unit	Reliability
D012_ISI_2023	"37% reduction in electricity demand"	PERF_ENERGY	Operations	Performance	37	%	High
D017_WSP_2022	"98.4% of waste diverted from landfills"	PERF_WASTE	Construction	Performance	98.4	%	High
D014_PANYNJ_2023	"Innovative public–private partnership"	GOVERNANCE	Design	Enabler	—	—	High

Table 2. Summary of Coded Excerpts by Category

Category	No. of Excerpts	Percentage
Hybrid Practices – TPM	35	24.6%
Hybrid Practices – Agile	28	19.7%
Hybrid Practices – Lean	22	15.5%
Enablers – Digital Tools	18	12.7%
Enablers – Governance	15	10.6%
Enablers – Team Culture	12	8.5%
Enablers – Method Tailoring	12	8.5%
Total	142	100%

4.2 Hybrid Practices and Phase-Wise Integration (RQ1 & RQ2)

The findings indicate that the project adopted a structured–iterative hybrid configuration, in which traditional, agile, and lean practices were deliberately distributed across project phases and integrated through Virtual Design and Construction (VDC) tools. Traditional project management practices, including Work Breakdown Structures, Gantt charts, and Earned Value Management, dominated the planning and close-out phases. Agile practices, such as design sprints, backlog prioritization, and daily coordination meetings, were most prominent during the design and construction phases. Lean practices, including waste segregation, Kaizen cycles, and value stream mapping, were primarily concentrated during construction. VDC tools — including BIM-based 3D/4D/5D modeling and real-time dashboards — were consistently present across all phases, functioning as the primary integration mechanism. The phase-specific intensity of each methodology is illustrated in Figure 1.

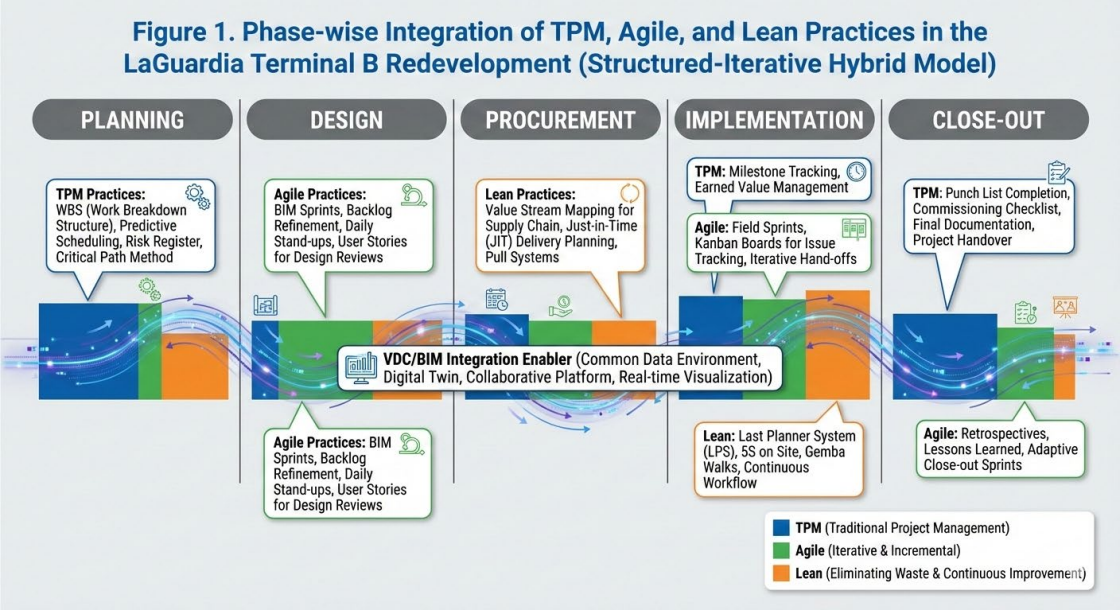

Figure 1. Phase-Wise Intensity of Hybrid Methodologies.

4.3 Enabling Conditions for Effective Integration (RQ3)

Four enabling conditions were identified as central to effective hybrid integration. First, digital maturity was rated as high, supported by a DMI score of 1.0. The integrated use of BIM, dashboards, and simulation tools created a shared digital environment allowing predictive planning and iterative control to coexist. Second, leadership and governance exhibited adaptive characteristics. The Public–Private Partnership governance structure promoted collaborative decision-making and facilitated iterative review cycles while maintaining contractual accountability (D019_ENR_2023). Third, team culture reflected moderate levels of collaboration and transparency, evidenced by co-located teams and open access to digital platforms (D015_LGP_2023; D018_SKANSKA_2022). Fourth, method tailoring was consistently observed — the project adapted methodologies to contextual constraints, including contractual, regulatory, and sustainability requirements.

4.4 Comparative Performance Outcomes (RQ4)

A thorough review of publicly available project documentation confirmed that comparable non-hybrid infrastructure projects do not systematically publish sustainability performance metrics required for valid empirical comparison. This absence is itself analytically significant: detailed sustainability reporting is structurally tied to formal certification processes, which hybrid and sustainability-committed projects are disproportionately more likely to pursue. Accordingly, performance outcomes for LaGuardia Terminal B are interpreted relative to general industry benchmarks reported in the literature (Kineber et al. 2024; Li et al. 2023; Olanrewaju et al. 2024).

The documented performance record includes: a 37% reduction in electricity demand (D012_ISI_2023); diversion of 98.4% of construction waste from landfill (D017_WSP_2022); a 40% indoor water use reduction, verified by the official LEED v4 scorecard at 4/6 points on the Indoor Water Use Reduction credit (D013_LEED_2023); and schedule delivery within contractual milestones despite the project's phased, live-airport operational constraints (D014_PANYNJ_2023; D019_ENR_2023). Regarding cost performance, delivery within the approved PPP financial framework is consistent with cost control being maintained throughout execution. These outcomes represent performance well above conventional North American infrastructure benchmarks.

4.5 Synthesis and Discussion

The results provide consistent evidence addressing the research questions. For RQ1–RQ2, hybrid practices were systematically distributed across project phases and integrated through VDC tools. For RQ3, digital maturity and method tailoring emerged as the most influential enabling conditions, supported by adaptive governance and collaborative culture. For RQ4, the hybrid configuration was associated with favourable delivery and sustainability performance indicators relative to general industry benchmarks.

These findings extend existing HPM theory by empirically validating a structured–iterative model and introducing sustainability certification as a key boundary condition influencing hybrid configuration. Consistent with Olanrewaju et al. (2024), the LaGuardia case illustrates how BIM, dashboards, and simulation tools enable transparency and informed decision-making. The case further reinforces that hybridization is a socio-technical process: methodological integration is supported not only by tools and contracts, but also by leadership attitudes, transparency, and collaborative culture. A practical implementation roadmap and the proportional distribution of hybrid methodologies are presented in Figures 2 and 3.

Hybrid PM Implementation Roadmap

Phase	Recommended Practices	Digital Integration	Governance & Culture
Planning	TPM tools (WBS, Earned Value)	BIM dashboards	Compliance-focused governance
Design	Agile practices (sprints, backlog)	BIM/VDC integration	Stakeholder collaboration culture
Construction	Lean methods (Last Planner, Kaizen, waste segregation)	Real-time dashboards	Servant leadership and collaborative culture
Close-out	TPM reporting and certification compliance	BIM-based reporting	Structured governance and contractual closure

Figure 2. Hybrid PM Implementation Roadmap.

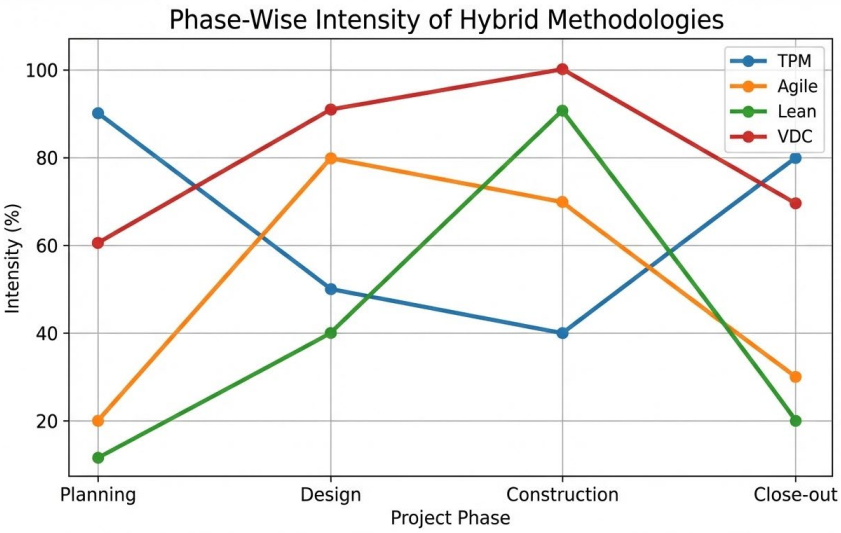

Figure 3. Distribution of Hybrid Methodologies Across Project Phases.

5. Limitations and Future Research

This study is subject to several limitations. First, the single-case documentary design limits statistical generalizability. The findings rely on analytic generalization, emphasizing theoretical transferability rather than population inference. Future studies should replicate the coding framework across multiple infrastructure projects — such as rail terminals, hospitals, and energy facilities — to test the robustness of observed relationships. Second, the exclusive reliance on publicly available documents captures primarily the formal and official project narrative; tacit knowledge and informal dynamics remain underrepresented. Longitudinal qualitative studies incorporating interviews and site observations are

required to uncover these hidden dynamics. Third, the analysis focuses on delivery-phase outcomes; future research should extend into operational performance using post-occupancy evaluations. Finally, rapid advances in digital technologies — including digital twins and AI-enabled predictive analytics — are likely to reshape hybrid governance structures, warranting dedicated investigation.

6. Conclusion

This study provides empirical, evidence-based insights into the role of hybrid project management in achieving certified sustainability outcomes within a regulated infrastructure megaproject. Through a structured documentary case study of the LaGuardia Terminal B redevelopment, the research demonstrates that hybrid configurations — when supported by digital maturity, adaptive governance, and method tailoring — are associated with favourable delivery and sustainability performance. The findings confirm that hybrid project management is not merely a transitional approach between traditional and agile models, but a distinct governance configuration capable of addressing the dual demands of compliance and adaptability. By offering a structured–iterative hybrid model grounded in empirical evidence, this study contributes to both theory development and managerial practice in sustainable infrastructure delivery. As sustainability requirements and project complexity continue to intensify, hybrid project management is likely to play an increasingly central role in the governance of infrastructure megaprojects.

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Biographies

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Appendix A. Inventory of Documentary Sources for the LaGuardia Terminal B Case Study

Document ID	Document Title	Authoring Organization	Year	Document Type	Primary Analytical Relevance
D012_ISI_2023	Envision Platinum Award Dossier – LaGuardia Terminal B	ISI	2023	Certification Dossier	Sustainability performance metrics (RQ4); Governance validation
D013_LEED_2023	LEED v4 Gold Certification Report – Terminal B	USGBC	2023	Certification Dossier	Energy, water, and material performance outcomes (RQ4)
D014_PANYNJ_2023	Sustainability & ESG Report – LaGuardia Terminal B	PANYNJ	2023	Owner Report	Hybrid practices, governance, leadership enablers (RQ1, RQ2, RQ3)
D015_LGP_2023	LaGuardia Gateway Partners – ESG & Community Impact Report	LGP	2023	Owner/Operator Report	Stakeholder engagement, operational outcomes (RQ4)
D017_WSP_2022	Waste Management Documentation – Terminal B Construction	WSP Global	2022	Technical Engineering Report	Lean practices, waste diversion metrics (RQ2, RQ4)
D018_SKANSKA_2022	Sustainability Performance Report – Terminal B	Skanska	2022	Contractor Performance Report	Hybrid practices, digital tools, team culture (RQ1, RQ2, RQ3)
D019_ENR_2023	Industry Award Coverage –	ENR / PANYNJ	2023	Industry Publication	Stakeholder satisfaction, industry recognition (RQ4)

Document ID	Document Title	Authoring Organization	Year	Document Type	Primary Analytical Relevance
	LaGuardia Terminal B				
D020_HOK_2023	Partner Case Study – LaGuardia Airport New Terminal B	HOK Architects	2023	Design Case Study	Agile design practices, stakeholder collaboration (RQ2, RQ3)

Note: Document ID D016 was excluded during the reliability screening process as it was classified as promotional material with no traceable primary data. The remaining document IDs (D012–D020) reflect the original corpus numbering and have been retained as assigned.