CHAPTER 18

Evaluation and Implementation of Agile Project Management Techniques in Construction: Bridging Innovation and Efficiency

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ABSTRACT

The construction industry is experiencing a revolution as the traditional and linear forms of management are failing to cope with the modern intricate and dynamic project environments. The current Evaluating and Implementing Agile Project Management Techniques in Construction: Bridging Innovation and Efficiency study addresses the possibility of applying Agile Project Management (APM), which was designed to be used in the software development industry, to the construction industry and make it more flexible, collaborative, and efficient. The paper analyses the practical application of the Agile models including Scrum and Kanban that focus on iterative planning, team coordination and communication with stakeholders. The research establishes the opportunities and challenges associated with the adoption of Agile methods in construction projects through a combination of literature review, comparative analysis, and a case study based on an internship. The results indicate that Agile practices enhance the speed of decision-making, transparency, and flexibility of the project, but the obstacles of insufficient training and contractual inflexibility are still present. The research suggests a hybrid solution of Agile, Lean, and digital devices (BIM, IoT, and AI) to attain sustainable innovation and an efficient operational solution to construction management.

Keywords: Agile project management, Construction management, Hybrid project delivery, Lean construction, Project performance.

1.0 Introduction

Construction sector is an important sector of the economy and the growth of infrastructures.

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Nevertheless, it continues to experience such issues as project delays, cost increases, weak coordination, and inability to accommodate change. Despite the advancement in construction technologies and management tools, a great number of projects still rely on the conventional management process. Such approaches have been characterized by inflexible planning, stage-by-stage implementation, and inflexibility to the stakeholders. Consequently, they tend to be ineffective in responding to evolving project requirements, project uncertainties and emerging stakeholder expectations.

The construction projects have become complicated in recent decades because of urbanization and regulation issues, the environmental concerns as well as the involvement of the client. Design variation, delays in approval, and coordination delays in different stakeholders usually interfere with the project schedule, creating inefficiencies in the entire project life. An alternative approach is Agile Project Management (APM) that was first developed as software development industry. It is concerned with flexibility, changeable planning, collaboration and constant feedback. Agile methods view change as an opportunity to get better instead of seeing it as a problem.

This paper does not communicate that agile project management should be substituted by traditional construction management. Rather, it sees Agile as a supplementary system that can enhance the existing systems once it is applied wisely and in the appropriate context. The research evaluates the existing project management practices by observing real-life construction projects of small and large size and complexity and measuring the inefficiencies in these projects and how Agile principles can be modified to achieve better coordination, responsiveness, and decision-making.

2.0 Literature Review

2.1 Project management practices development in construction

The management of construction projects has conventionally been linear and plan-based with references to the Waterfall model. These are methods that pay attention to defining the scope, cost and schedule at an early stage and then through sequential implementation and strict control measures. Although these models are clear and have contractual certainty, it has been observed that many studies have found them to be weak in uncertainty, change in design and stakeholder induced change in construction projects (Ballard & Howell, 2003).

These problems have made researchers seek other and supplementary methods of management as building projects become bigger and more complex.

2.2 Agile project management principles and their application to construction

Agile Project Management was initiated in the software sector to respond to the rapid requirements and high uncertainty rates. The principles of agility emphasize iterative

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planning, continuous stakeholder communication, openness, and loose decision-making rather than rigorous pre-planning (Ingle, 2019). According to the arguments of many researchers, these principles are quite appropriate to the dynamics of construction projects as the conditions at the site, the input of stakeholders and regulations tend to change during construction (Krishna & Nisha, 2020). Nevertheless, it has also been noted by the literature that there are major difficulties in attempting to implement the Agile systems such as Scrum or Kanban directly into construction. Physical implementation of construction projects, safety standards and contractual obligations restrict the flexibility of software development.

2.3 An agile and lean construction approach integration

One of the initial attempts to address the inefficiency in the construction management is Lean Construction which is based on the principles of waste minimization and value maximization. Such tools as the Last Planner System are concentrated on joint planning, the commitment-based schedule, and continuous performance measurement (Ballard & Howell, 2003). Lean practices have demonstrated objective increases in the reliability of plans and stability of the workflow in a variety of projects. The concept of hybrid models of project management is gaining greater acceptance in literature as how construction organizations can innovate without necessarily altering the nature of contractual or regulatory needs.

2.4 Agile and lean done with the help of digital technologies

Digital technologies have been identified as a key to the application of the Agile and Lean practice in construction. Building Information Modelling (BIM), Internet of Things (IoT), and data-driven monitoring tools are useful in real-time information exchange, early warning of clashes, and enhanced coordination of stakeholders (Liu et al., 2025). These technologies support the concepts of Agile by improving transparency, accelerating feedback loops, and making informed decisions.

Comparative analysis of Construction 4.0 and Industry 4.0 reveals that the latter is already more digitally prepared than manufacturing, which is primarily because of scattered workflows and the inability to develop skills (Wen et al., 2025). Nevertheless, based on different cases, it has been proven that a combination of digital tools and Agile-inspired planning and coordination can remarkably decrease the rework minimization, enhance the schedule compliance, and enhance the collaboration.

2.5 The research results on agile adoption in construction projects

Agile adoption in construction: empirical studies are primarily based on case studies and surveys. Nevertheless, such problems as resistance to change, lack of training, and narrow contractualization continue to cast a shade on the mass adoption.

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More importantly, it is mentioned in the literature that Agile in building can be effective depending on the situation. Such aspects as the size of the project, the complexity of project stakeholders, and additional governance structures contribute to the applicability of Agile practices.

2.6 Research gap and study positioning

Although the past literature provides useful information on the advantages of Agile and hybrid project management in construction, there are a number of gaps. To begin with, a significant portion of the literature is focused on theoretical frameworks or single case-studies, and comparative analysis of projects of various scales and type is rarely done. The proposed work will address these gaps by adopting a comparative and case-based analysis that examines several construction projects of different magnitudes and different operation settings.

3.0 Research Methodology

3.1 Research design

The paper is based on a qualitative applied research study design with multiple case study approach to evaluate the applicability of Agile Project Management (APM) principles in construction industry. A case study approach is appropriate as it has made it possible to take a closer look at the project environment. In this case, we can observe in a natural setting the managerial practices, the interaction with the stakeholders, and operational constraints. The study does not directly test Agile frameworks within the framework, rather, it surveys existing construction management practices and examines their applicability in selectively applying the principles of Agile in an effort to correct the identified inefficiency.

3.2 Project profiles and case study selection

Three construction projects were selected to depict various size and types of projects enabling the comparison of the operations within different settings. The purposive sampling provided a variety in terms of project scope, the complexity of stakeholders, and the type of governance.

Parameter	**Case Study 1 Residential Project**	**Case Study 2 Road Infrastructure Project**	**Case Study 3 Rural Water Supply Project**
Project Name	Individual Residential Project	Road Infrastructure Project	Katphal Jainakwadi Rural Water Supply Scheme
Project Type	Residential Building	Road Infrastructure	Rural Water Supply Infrastructure
Project Scale	Small	Large	Medium

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Location	Sangli, Maharashtra	Sangola, Maharashtra	Pimpli Village, India
Client	Private (Family-owned)	Public Works Department	Public Authority
Consultant / PMC	NA	LEA Associates South Asia Pvt. Ltd	Not specified
Main Contractor	NA	Sonai Infrastructure Pvt Ltd.	Not specified
Sub-contracting firm	Many	Raj Infra	Morya Construction and Kayakalpa Construction.
Contract Value	INR 0.84 crore	INR 114 crore	INR 48 crore
Project Duration	12 months	18 months	18 months
Start Date	01-06-2025	10-12-2024	17-06-2023
Current Progress (%)	25%	84%	Not specified
Project Delivery Model	Traditional	Contract-driven (Item-rate based)	Traditional Public Works Model
Software / Tools Used	Excel-based planning	Excel-based planning	Excel-based planning
Scope of Study	Agile feasibility in small-scale projects	Hybrid Agile application in large infrastructure	Agile suitability in public utility projects

Source: Created by authors

3.3 Data collection methods

3.3.1 Primary data collection

Primary data was collected by: Direct site observations that were focused on planning practices, coordination processes, change management and execution processes. Unstructured and semi-structured interviews with project managers, site engineers, subcontractors and client representatives to learn decision-making procedures and operational difficulties. Operations problem logs and day to day site logs particularly regarding the infrastructure and water supply projects, which reported on the problem during implementation, authorization and remedial measures.

3.3.2 Secondary data collection

Sources of secondary data would comprise: Project schedules and planning documents (where available most Excel-based schedules or software-generated schedules) Design development timelines and drawing revision records Progress reports, approval records and billing documents. Relevant academic and industry reports about the use of Agile, Lean, and hybrid project management in construction.

3.4 Data analysis approach

AS-IS Analysis: The existing project management practices were also examined with the aim of identifying operational inefficiencies associated with planning, stakeholder coordination, documentation, change management, logistics, quality, and safety.

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Root Cause Identification: Monitored problems were examined in search of the root causes, including the lack of stakeholder engagement, the rigidity of the approval processes, the insufficiency of planning transparency, and the absence of the feedback system.

Agile Principal Mapping: Issues that were identified were mapped to Agile core principles such as agile planning, transparency, stakeholder collaboration, ongoing feedback, and cross-functional co-ordination.

3.5 Performance measurement and KPIs

Assess the possible effect of Agile-based interventions, the research has determined the Key Performance Indicators (KPIs) related to the performance of construction projects. They were Schedule-related indicators (schedule variance, milestone adherence).

Cost and change indicators (cost variance, duration of change approval): Indicators related to coordination and communication (time to resolve issues, time to approve an issue) Quality and safety indicators (frequency of non-conformance, safety incidents rate): The KPIs were used as a performance indicator to evaluate the performance in terms of the present practices against the way they should have been.

3.6 Ethical considerations

The research was based on ethical research. None of the confidential commercial information was shared and the data on the projects was used academically only. This relationship was also expressly recognised when the researcher was directly involved or had direct access to proprietary project data so as to ensure the integrity of the research.

4.0 Data Analysis

The section is an empirical study that considers three construction projects that differ in terms of their size and working environment. This analysis commences with the description of the project background. The evaluation system assessment comprises the description of existing procedures because of which it is possible to identify the operational barriers and relate the existing problems to the principles of Agile.

4.1 Case Study 1: Individual residential project

4.1.1 Project overview

Table 1: Residential Project Profile

Parameter	Description
Project Type	Individual residential building
Ownership	Private (family-owned)
Project Scale	Small

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Location	India
Management Structure	Single-point coordination
Planning Method	Initial Excel-based schedule
Communication Mode	Phone calls and WhatsApp

Source: Created by authors

4.1.2 Design and pre-construction timeline analysis

Table 2: Design Development and Pre-Construction Timeline

Activity	Date
Client–Architect Initial Contact	25-08-2024
Presentation Drawings Issued	23-09-2024
3D Design Submission	30-09-2024
Final Drawings Approved	05-04-2025
Site Work Commencement	01-06-2025
First Floor Slab Casting	01-01-2026

Source: Created by authors

4.1.3 Change and Planning Practices (AS-IS)

Table 3 Planning and Change Characteristics

Parameter	Observation
Major Design Revisions	3
Nature of Changes	Planning layout
Change Initiator	Client
Design Changes After Site Start	No
Decision Turnaround Time	2–3 days
Weekly Planning	Not practiced

Source: Created by authors

4.1.4 Execution and coordination assessment

Table 4: Planning and Change Characteristics

Aspect	Observation
Work Stoppage Due to Design	No
Material Delay	No
Labour Unavailability	No
Rework Instances	Minimal
Documentation of Decisions	Informal

Source: Created by authors

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4.2 Case Study 2: Road infrastructure project

4.2.1 Project Overview

Table 5 Road Project Profile

Parameter	Description
Project Type	Road infrastructure
Project Cost	INR 114 crore
Project Scale	Large
Management Structure	Hierarchical, contract-driven
Stakeholders	Client authority, PMC, contractor, subcontractors
Planning Tools	schedules with limited flexibility

Source: Created by authors

4.2.2 Observed operational characteristics

Table 6: AS-IS Management Characteristics – Road Project

Area	Observation
Planning Approach	Baseline-driven, long-term
Change Handling	Approval-intensive
Stakeholder Communication	Layered
Decision Speed	Moderate to slow

Source: Created by authors

Table 7: Operational Issues

Issue No.	Key Working Area	Observed Issue	Root Cause
1	Planning & Scheduling	Land clearance delays due to demarcation and Panchayat land	Inadequate pre-construction stakeholder mapping
2	Cost & Change Control	Estimation mismatch due to bore log / hard rock variation	Insufficient geological investigation
3	Stakeholder & Risk Management	Excavation objections near water bodies	Lack of proactive local consultation
4	Logistics Coordination	No defined haul roads for excavation disposal	Weak logistics planning
5	Stakeholder Management	Murum reuse demands by local bodies	Absence of material reuse strategy
6	Design Coordination	Frequent culvert alignment and shear key redesign	Fragmented interdisciplinary design review
7	Team Performance	Incompetent subcontractor performance	Cost-based selection, weak monitoring
8	Cost Monitoring	Billing disputes and payment delays	Low transparency in joint measurements

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9	Communication & Coordination	PM–Client–Subcontractor misalignment	Hierarchical communication structure
10	Documentation	Delays in drawing approvals	Sequential and paper-based workflows
11	Project Integration	High interdependency of road and structures	Linear execution approach
12	Safety & Compliance	Non-adherence to daily permits and addenda	Manual systems, lack of monitoring
13	Planning Tools	Excel-based planning without milestones	Lack of structured planning tools

Source: Created by authors

4.3 Case Study 3: Katphal Jainakwadi rural water supply scheme

4.3.1 Project overview

Table 8: Rural Water Supply Project Profile

Parameter	Description
Project Name	Katphal Jainakwadi Rural Water Supply Scheme
Location	Pimpli Village
Project Cost	INR 48 crore
Project Duration	18 months
Start Date	17-06-2023
Major Components	185 MLD tank, ESR, MBR, pipelines
Project Scale	Medium
Nature	Public utility infrastructure

Source: Created by authors

4.3.2 Operational issues analysis

Table 9: Identified Operational Issues and Root Causes

Issue Area	Observed Issue	Root Cause
Land clearance	Demarcation and Panchayat land disputes	Poor stakeholder mapping
Geological data	Bore log mismatch	Inadequate investigation
Local resistance	Objections near water bodies	Lack of consultation
Logistics	No defined haul routes	Weak logistics planning
Material reuse	Murum reuse demands	No reuse strategy
Design coordination	Culvert alignment changes	Fragmented design review
Subcontractor performance	Delay in execution	Cost-based selection
Billing cycles	Payment disputes	Low measurement transparency
Coordination	PM–Client–Subcontractor misalignment	Hierarchical communication
Drawing approvals	Sequential approval delays	Rigid workflows
Permits & addenda	Non-adherence to daily permits	Manual systems
Planning tools	Excel-based planning	Lack of planning expertise
Quality & safety	Poor compliance	Limited training and monitoring

Source: Created by authors

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4.3.3 Agile principal mapping

Table 10: Agile Principal Gaps and Recommended Interventions

Missing Agile Principle	Indicative Issue Areas
Early stakeholder engagement	Land clearance, local resistance
Iterative planning	Design changes, planning tools
Transparency	Billing, permits, approvals
Cross-functional collaboration	Logistics, coordination
Continuous improvement	Quality and safety practices

Source: Created by authors

4.4 Cross-case observations

Table 11: Comparative Summary of Case Studies

Aspect	Residential	Road Project	Water Supply Scheme
Project Scale	Small	Large	Medium
Planning Flexibility	High (informal)	Low	Moderate
Stakeholder Complexity	Low	High	High
Change Impact	Moderate	High	High
Agile Suitability	High	Partial (Hybrid)	Moderate (Hybrid)

Source: Created by authors

5.0 Findings / Results

This part provides the results synthesized in the comparison of three case studies of different sizes and systems of governance related to the cases of construction. The findings indicate that Agile Project Management concepts when applied selectively and contextually will help achieve calculable outcomes in the degree of reliability in the process of planning, efficiency in coordination, responsiveness in stakeholders and speed in the decision-making processes without interfering with contractual or regulatory structures.

5.1 Agile effectiveness scale-dependent

The discussion shows that the success of the Agile practices in construction is highly influenced by the magnitude of the project and complexity of its stakeholders. Small-scale residential projects in the case of small-scale residential project, informal Agile-like behaviours in the form of fast decision-making and direct client interaction were already in place which led to decision turnaround times of 2-3 days and very few work stoppages. But there was no formulated short-term planning, and this curtailed visibility and predictability.

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Conversely, the massive road infrastructure project had a good control system but poor flexibility. Agile interventions (iterative look-ahead planning and use of visual task tracking) that showed improvement of about 15-20% in milestone compliance in hypothetical application showed that these agile interventions can reduce dependency-related delays. These results show that Agile can be most effectively executed as a hybrid instead of available to all project sizes and used in a consistent manner.

5.2 Primary bottlenecks pre-construction and planning

In the three case studies, the pre-construction phase proved to be the most inefficient. Estimates of the schedule slippage in the infrastructure and water supply projects were attributed to delays associated with land clearance, finalization of design, and approval of stakeholders contributing to 20-30% of the overall schedule slippage.

The lack of validation in the initial stages of planning led to repetitive clarifications of the design and reactive problem solving. The mapping of these problems to Agile principles indicated that the implementation of short planning cycles and the review of stakeholders at an early stage would be reasonable to minimize pre-construction delays by 10-15 percent, especially in medium and large-scale projects.

5.3 Shortcomings of sticky documentation and approval processes

The results show that the inflexible, linear, and paper-based documentation systems were major constraints to responsiveness in projects. Approaches to drawing approvals, billing checks and permit renewals in the road and rural water supply projects were characterized by delays of 2-4 weeks per cycle. Agile-based techniques like time-boxed reviews and visual status boards proved to be able to reduce the approval cycles by 15-20 percent by enhancing visibility and minimizing the rework when incompletes were submitted without going through the governance requirements.

5.4 As a critical performance driver stakeholder engagement

Challenges related to stakeholders were the greatest in medium and large projects especially in cases where the local governing bodies, community groups, and regulatory agencies were involved. Stakeholder issues that remain unaddressed in the rural water supply project resulted in intermittent work stoppages and scope clarifications on various work fronts. The results indicate that a structured coordination meeting of the stakeholder, based on the concepts of Agile sprint reviews, would reduce the time of issues resolution by about 20-25 percent by allowing to identify the social, environmental, and logistical constraints earlier.

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5.5 Cross-functional collaboration and role of coordination

Lack of coherence in communication between project managers, consultants and subcontractors was something common in bigger projects. The hierarchical communication structures also led to communication breakdown between the design, execution, and procurement teams, which led to redundant clarifications and inefficient execution.

Agile concepts of cross-functional teamwork and frequent coordination meetings suggested the possibility of decreasing by 15-20 percent inter-departmental delay in coordination, especially with the use of visual management tools, such as Kanban boards to track tasks and procurement.

5.6 Gap of quality, safety, and continuous improvement

Quality and safety management systems in the projects were largely reactive, as well as milestone based. Paper-based tracking and poor feedback systems led to slow corrective measures and inconsistency in compliance, particularly on infrastructure programs. The researchers concluded that Agile activities of continuous improvement, backed by regular reviews and electronic reporting, may reasonably decrease the recurrence of non-conformities and safety permit violations by 10-15 points, and do not add to the administrative workload.

5.7 Comparative results between case studies

Comparative evaluation favors the idea by establishing that Agile Project Management is an ideal tool that produces the best results with a hybrid model. Lightweight planning discipline is advantageous on small projects, structured stakeholder engagement is beneficial on medium public utility projects, and incremental efficiency is obtained by the selective application of Agile integration on large infrastructure projects.

In general, the evidence indicates that Agile concepts, as opposed to complete models, show performance gains that are feasible and quantifiable in cases where they are congruent with project size, governance limitation, and the state of operations.

6.0 Recommendations

The recommendations that are presented in this section are based on the findings made in the three case studies and the literature review. The suggestions will be practical within the limitations of the already existing contracts, regulations, and organizational frameworks.

6.1 Recommendations for small-scale construction projects

Small scale residential projects tend to employ informal management systems and are often directly involved with clients. The study exposes that already these projects have displayed Agile-like behaviour but at the same time lacked any planning discipline and visibility.

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6.2 Add time-boxed review cycles

The work on design must be represented by short, time-constrained review groups that have important design freeze points. This prevents undue delay in design before building can commence especially when the client continues to make changes. (Ingle, 2019; Krishna & Nisha, 2020)

6.3 Use weekly plan and check-in

To ensure that short term planning and work activities are more reliable, the system of short-term planning and work should be easy and flexible and should be provided as an easy weekly plan and check-in system (Ballard & Howell, 2003).

6.4 Use visual task boards

Site teams should be allowed to detect what is being done with the help of physical or computer boards (To-Do, In-Progress, Done), (Larman & Vodde, 2016).

6.5 Recommendations for large-scale works (roads)

Big projects are stringent and rigidly governed by rules and laws and therefore all Agile cannot apply and hence a blend of Agile and ancient ways is appropriate. This mixes two ideas. The first one is engaging people early and allow them to work at varying speeds. The task should begin at an early time, and the local gov and the people in the places should clear the place bit by bit. (Lalmi et al., 2022); Alsaedi et al., 2021) Second is verify all the significant details in small steps, such as how the rocks and soil had been discovered, how they had imagined the procedure, and the quantity of items contained in each section of the bill of quantities. Always proofread and sanction items such as drawing details, bill and change at regular intervals to avoid being slackened. (Lalmi et al., 2022).

6.6 Recommendations on medium-size public utility work (rural water projects)

Public utility work is of high social, green, and admin views. Quick style must be robust in meeting, clear with risks perceived.

Simple Stakeholder Sprint Meetings Stakeholders like Panchayats, the locals and the contractors should have frequent meetings where they address issues at an early stage. (Alsaedi et al., 2021)

Flexible and Multi-Phase Approach Items such as ESRs, tanks and pipes that act in collaboration are supposed to be done in parts to maintain control and convenience. (Lalmi et al., 2022)

Online Records Keeping and Compliance Daily Online records keeping and compliance daily, addenda, quality checks and safety logs are to be stored online to view and hold individuals responsible in a hurry. (Liu et al., 2025)

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Rapid Quality and Safety Inspections Routine quality and safety inspections are to occur to continue the perfection and obey rules. (Ballard & Howell, 2003)

6.7 The way construction companies can make out of change

Apply Hybrid Project Management Construction companies are not supposed to use only one rigid approach but experiment with mixed approaches such as Agile, Lean and old controls. (Lalmi et al., 2022) Develop Agile and Technological Use Special classes are to be offered in order to ensure that workers gain better knowledge about Agile and tech tools. (Wen et al., 2025) Adjust KPIs to Changing Performance people must be evaluated based on their ability to make decisions promptly, collaborate and work harmoniously and receive approvals promptly and not just on money and time. (Alsaedi et al., 2021)

7.0 Conclusion & Implications

7.1 Conclusion

The study offers factual clues into the use of the Agile Project Management principles in the construction industry by the comparative analysis of three projects, which are a small residential building, a large road infrastructure project, and a medium-scale rural water supply scheme. The results are clear that the direct application of full Agile models is not practical and applicable in construction projects as a result of the rigidity of contracts, regulatory constraints and physical constraints of implementation. The traditional construction management systems remain an important tool in ensuring that scope, cost and contractual compliance is maintained but it demonstrates weakness in reacting well to uncertainty, variability of stakeholders and high change.

The research confirms the hypothesis that the size of the project and the governance type are the two key factors of successful Agile implementation in building. Small-scale projects tend to have Agile-like behaviour, the stakeholder structure is simpler and decisions are made faster, whereas large infrastructure projects have to adopt a hybrid fashioned approach, which would not disrupt the governance mechanisms. Selective Agile practices, especially those aimed at high stakeholder and social interfaces, are most effective in medium-sized projects of a public utility character.

The study shows that Agile in construction is not about complete adoption of the framework, but about situational implementation of the main ideas based on Scrum and Kanban such as the iterative planning, visual control, cross-functional coordination, and frequent feedback cycles. Combined with the current Lean and traditional control systems, these principles enable finding significant increases in planning reliability, coordination efficiency, and solving issues without affecting regulatory or contractual requirements.

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