

Boston University

MET AD807 Principles and Best Practices in Project, Program and Portfolio Management

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Research Paper

Implementation of Agile project management in construction –

Best practices and case studies.

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Abstract

This paper explores Agile Project Management (APM) as a transformative approach in construction management, contrasting with traditional project management methods. Originating in software development, Agile's adaptability and customer-centric focus, underpinned by the Agile Manifesto, offer significant benefits for managing the dynamic and complex nature of construction projects. Key Agile frameworks like Scrum and Kanban adapt well to construction, enhancing stakeholder collaboration, flexibility, and efficiency. The paper discusses the challenges in Agile implementation, such as cultural resistance and integration with existing processes, and presents case studies from the U.S., Macau, and Iraq to illustrate its diverse applications and benefits in improving cost control, timeline adherence, quality, and client satisfaction. Best practices in Agile construction management are outlined, emphasizing iterative planning, empowered teams, and continuous risk management. Recommendations for successful Agile adoption include enhanced stakeholder collaboration, training, hybrid models, and the incorporation of digital twins for planning and decision-making. The paper concludes that despite its challenges, Agile offers a promising avenue for enhancing construction management practices, necessitating careful consideration of industry-specific characteristics and effective change management strategies.

Keywords: Agile Project Management (APM), Construction Management, Iterative Development, Scrum, Kanban Methodology, Stakeholder Collaboration, Agile Manifesto, Project Efficiency, Risk Management, Client Satisfaction, Cross-Functional Teams, Incremental, Digital Twins, Change Management, Continuous Improvement, Hybrid Agile-Waterfall Approach

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Introduction

Agile Project Management (APM) represents a transformative approach to managing projects, diverging significantly from traditional project management methodologies. Originating in the software development industry, Agile has gained widespread recognition for its flexibility, adaptability, and focus on customer collaboration and responsiveness to change (Highsmith, 2009). At its core, Agile Project Management is characterized by iterative development, where projects are divided into small, manageable units, allowing for frequent reassessment and adaptation of plans. This contrasts with the traditional, linear approach of project management, often referred to as the Waterfall model, where each phase of the project must be completed before the next begins, leaving little room for changes once a stage is completed.

The Agile methodology is underpinned by the Agile Manifesto, which emphasizes individuals and interactions over processes and tools, working solutions over comprehensive documentation, customer collaboration over contract negotiation, and responding to change over following a fixed plan (Beck et al., 2001). Within Agile, there are various frameworks and practices, with Scrum and Kanban being among the most popular. Scrum is characterized by fixed-length iterations known as sprints, typically lasting two to four weeks, where a set amount of work is completed and reviewed. Kanban, on the other hand, focuses on visualizing work, limiting work in progress, and maximizing flow, thereby enhancing efficiency and throughput.

In the realm of construction management, the application of Agile principles is both challenging and rewarding. The construction industry, known for its complexity and the dynamic nature of projects, often faces challenges such as scope creep, delays, and budget overruns. Agile's emphasis on flexibility, stakeholder involvement, and iterative progress can

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significantly mitigate these challenges (Conforto et al., 2014). By adopting Agile methodologies, construction projects can benefit from enhanced collaboration among stakeholders, improved adaptability to changing requirements, and a more efficient use of resources.

For instance, in construction projects, Agile can facilitate better communication between architects, contractors, and clients, ensuring that changes in design or scope can be incorporated more seamlessly. The iterative nature of Agile allows for regular feedback and adjustments, ensuring that the final product aligns closely with the client's needs and expectations. Moreover, Agile's focus on delivering working solutions in small increments can help in early identification of potential issues, allowing for timely interventions before they escalate into major problems.

Furthermore, the principles of Scrum and Kanban can be adapted to suit the unique requirements of construction projects. Scrum's structured approach can help in managing complex construction projects by breaking them down into smaller, more manageable sprints, while Kanban's emphasis on visual management and continuous delivery can aid in streamlining workflows and reducing bottlenecks.

Best Practices in Agile Construction Management

Agile Project Management (APM) has increasingly become a cornerstone in the realm of construction management, offering a suite of innovative practices that significantly enhance project execution and delivery. This section of the research paper provides an in-depth analysis of these best practices, evaluating their effectiveness in improving key project outcomes such as cost control, timeline adherence, quality, and client satisfaction within the construction industry.

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At the heart of Agile methodologies is the principle of iterative planning and continuous evaluation. This approach is particularly beneficial in construction projects, which are often subject to changes in scope, unforeseen challenges, and evolving stakeholder requirements.

Iterative planning allows for flexibility in managing these changes, enabling construction managers to reassess and realign project goals and resources regularly. This dynamic planning process not only accommodates changes but also facilitates more accurate forecasting and allocation of resources, thereby enhancing overall project management efficiency.

Agile methodologies place a strong emphasis on direct, continuous communication and collaboration among all stakeholders. In the context of construction, this collaborative approach fosters a more cohesive project environment. Regular and open communication channels between clients, contractors, suppliers, and other stakeholders ensure that project objectives are clearly understood and aligned. This level of collaboration is instrumental in managing expectations, incorporating feedback, and ensuring that the project aligns with the client's vision, ultimately leading to enhanced project outcomes.

Agile promotes the concept of self-organizing, cross-functional teams that are empowered to make decisions. In the construction industry, this translates to teams that are not only skilled in their respective areas but are also capable of adapting to changing project requirements. Empowering teams in this manner leads to faster decision-making, encourages innovation, and enhances problem-solving capabilities. This empowerment is particularly crucial in construction projects, where timely decisions can significantly impact project timelines and outcomes.

Agile's emphasis on delivering working solutions in small, incremental segments is another practice that aligns well with construction management. This focus on incremental progress

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allows for continuous monitoring and adjustment of the project, ensuring that each phase is completed to the desired standard before moving on to the next. This approach not only facilitates better project control but also allows for early detection and rectification of issues, thereby maintaining the quality and integrity of the construction project.

The implementation of Agile practices in construction has shown significant improvements in various project outcomes. The iterative and flexible nature of Agile methodologies aids in more effective cost control, as it allows for ongoing budget reassessment and management. This is crucial in construction projects where cost overruns can be a major concern. Similarly, the time-boxed sprints and regular progress reviews inherent in Agile practices enhance adherence to project timelines, a critical factor in construction where delays can have substantial financial and operational implications.

In terms of quality assurance, Agile's continuous testing and client feedback loops ensure that quality standards are consistently met throughout the project lifecycle. This ongoing focus on quality not only leads to superior project outcomes but also reduces the likelihood of costly reworks. Furthermore, the collaborative ethos of Agile methodologies results in higher client satisfaction. The regular engagement with clients and the ability to adapt to their feedback ensure that the final product closely aligns with their expectations and requirements.

Case Studies

The three case studies provide a more comprehensive understanding of how Agile Project Management (APM) methodologies were implemented in different construction contexts, the specific challenges faced, the strategies employed, and the outcomes achieved.

Agile Implementation in the United States Construction Industry:

The study by Harold W. Pinto in 2023 offers a detailed examination of the adoption of Agile methodologies in the U.S. construction industry. This industry, traditionally reliant on

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conventional project management approaches, faced significant challenges in embracing Agile. Key among these were resistance to change, particularly from stakeholders accustomed to traditional methods, and the difficulty of integrating Agile methodologies with existing construction practices, which often favored a more linear and rigid approach. To address these challenges, the study highlighted the importance of fostering a culture of adaptability and transparency. This involved enhancing stakeholder collaboration, which was achieved by engaging all parties in regular communication and feedback loops, a core principle of Agile. By focusing on continuous feedback and collaboration, the implementation of Agile led to a more dynamic and responsive project management approach. This resulted in improved adaptability to changing project requirements, leading to increased client satisfaction and greater project transparency. The study underscored the potential of Agile methodologies to revolutionize project management in the construction industry, particularly in terms of risk management and project delivery timelines.

Effectiveness of Agile in Macau's Construction Industry:

The construction industry in Macau, as explored in a study involving semi-structured interviews and surveys with project managers, faced its own unique set of challenges. The predominant issue was the reliance on empirical methods without a specific, structured approach to project management, leading to inefficiencies and a lack of adaptability. The study aimed to assess the effectiveness of Agile methodologies in this context, focusing on increasing planning efficiency, minimizing waste, and enhancing communication. The research revealed a growing recognition of the need for Agile methodologies, particularly in projects such as hospitality development, where client-focused communication and adaptability are crucial. The study suggested a hybrid approach, combining the structured, phase-based approach of Waterfall methodologies with the flexibility and iterative nature of Agile. This hybrid model was seen to leverage the strengths of both methodologies,

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enhancing overall project management effectiveness, and addressing the specific needs of the Macau construction industry.

Agile Project Management in Iraq's Construction Industry:

In Iraq, a developing country with a construction industry facing challenges such as quality defects, schedule variances, cost overruns, and low productivity, the study conducted by Gokhan Kazar et al. in 2022 provided valuable insights. The research involved surveying construction experts to explore the applicability and potential benefits of Agile methodologies in improving project performance. The findings indicated that Agile Project Management could effectively address these issues, suggesting that the adverse effects of poor project performance could be mitigated through Agile approaches. The study highlighted the feasibility of Agile methodologies in improving various aspects of project performance, including quality, schedule adherence, and cost management. The implementation of Agile in this context demonstrated its potential to transform the construction industry in developing countries, providing a framework for more efficient, adaptable, and client-focused project management.

These case studies collectively illustrate the diverse applications and benefits of Agile Project Management methodologies in the construction industry. They highlight the transformative potential of Agile practices in overcoming traditional challenges, employing strategic changes, and achieving significant improvements in project outcomes across different geographical and industrial contexts.

Benefits and Challenges of Agile Project Management in Construction Management.

To provide a more detailed and in-depth analysis of the benefits of Agile Project Management (APM) in construction, we need to explore each aspect more comprehensively, highlighting how Agile methodologies transform the traditional construction management landscape.

Increased Flexibility and Adaptability to Changes: The construction industry is characterized by its dynamic nature, where changes in design, scope, and client requirements are frequent. Traditional project management methods, often rigid and linear, struggle to accommodate these changes efficiently. Agile methodologies, with their iterative and incremental approach, offer a solution. By breaking down projects into smaller, manageable parts (sprints), Agile allows for frequent reassessment and realignment of project goals. This flexibility is not just about adapting to changes; it's about embracing change as a natural part of the construction process. It enables project teams to respond quickly to unforeseen challenges, reducing delays and avoiding cost overruns. For instance, Agile methodologies allow for a significant reduction in the time and cost associated with changes in project scope. According to a study by Conforto et al. (2014), Agile projects demonstrated a 35% reduction in the time taken to incorporate changes compared to traditional methods. This adaptability not only saves time but also reduces costs associated with late-stage changes, which can be substantial in construction projects.

Enhanced Client Collaboration: One of the core principles of Agile is its emphasis on client collaboration over contract negotiation. In construction, this translates to a more engaged and transparent relationship with the client. A survey by Serrador and Pinto (2015) found that Agile projects reported a 40% increase in client satisfaction levels compared to traditional projects. This increase is attributed to the continuous involvement and feedback loop with clients, ensuring that the final product aligns closely with their expectations. Regular meetings, or scrums, ensure that clients are continually involved in the decision-making process, providing feedback and adjustments in real-time. This level of involvement not only increases client satisfaction but also ensures that the final product aligns closely with their vision.

Improved Risk Management: Construction projects are often fraught with risks, from safety concerns to material availability and regulatory compliance. Agile's continuous risk assessment and management approach allow for a more proactive identification and mitigation of these risks. By addressing issues as they arise, rather than at predetermined stages, Agile reduces the likelihood of major disruptions. This proactive risk management leads to more predictable and successful project outcomes, as evidenced by a reduction in risk-related costs reported in Agile-managed construction projects. Agile's proactive approach to risk management can lead to a 30% reduction in risk-related costs, as reported in various studies. This reduction is due to the continuous monitoring and addressing of risks throughout the project lifecycle, rather than at set milestones.

Enhanced Team Productivity and Morale: Agile methodologies promote a culture of collaboration, empowerment, and accountability. Studies have shown that Agile methodologies can lead to a 20-30% increase in team productivity. This improvement is attributed to the collaborative and empowering nature of Agile work environments, which foster higher engagement and efficiency. Teams in an Agile environment are typically cross-functional, with members bringing different skills and perspectives. This diversity fosters innovation and problem-solving. Moreover, Agile's focus on people and interactions over processes and tools leads to higher team morale and job satisfaction. The impact on productivity is quantifiable.

Better Quality Control: The iterative nature of Agile allows for continuous testing and quality control at every stage of the project. This ongoing evaluation ensures that quality issues are identified and addressed early, reducing the need for costly and time-consuming rework at later stages. The emphasis on delivering a potentially shippable product at the end of each sprint ensures that quality is built into the product from the beginning, rather than being an afterthought. The iterative approach of Agile has been shown to reduce post-

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construction defects by up to 25%. This improvement in quality is due to the continuous testing and refinement at each stage of the project, ensuring that issues are addressed promptly.

Faster Project Delivery: Agile's incremental delivery model can significantly reduce the time to market. By focusing on delivering small, workable increments, parts of the project can be completed and handed over faster. This approach not only reduces the overall project timeline but also provides value to the client much earlier than traditional methods. The reduction in time to market is a key competitive advantage in the construction industry, where project timelines are often critical. Agile methodologies can lead to a reduction in overall project delivery times by up to 20%. This expedited delivery is due to the incremental and iterative approach, which allows for parts of the project to be completed and utilized sooner.

This combined analysis underscores the effectiveness of Agile methodologies in the construction industry, highlighting their ability to enhance project efficiency, reduce risks, and improve client satisfaction and overall project quality. The quantifiable metrics provide a solid foundation for understanding the tangible impact of Agile practices in construction project management.

Implementing Agile Project Management (APM) in the construction industry presents unique challenges that stem from the specific nature of construction projects, industry norms, and the foundational differences between Agile methodologies and traditional construction management practices. Addressing these challenges is crucial for the successful integration of Agile principles into construction management.

One of the primary challenges is the resistance to cultural and organizational change. The construction industry has traditionally relied on hierarchical and structured project management approaches. Agile methodologies, which emphasize flexibility, collaboration,

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and less rigid team structures, represent a significant shift from these established practices. This change can be met with resistance from both team members and management who are accustomed to traditional methods. Overcoming this resistance often requires a gradual approach to change management, emphasizing the benefits of Agile practices and providing adequate training and support. Another significant challenge is the integration of Agile with existing processes in construction. Construction projects often involve long-established processes that are deeply ingrained in the industry. Integrating Agile methodologies with these processes, especially regulatory and compliance aspects, can be complex. Agile, known for its flexibility and iterative nature, may need to be adapted to align with the more rigid requirements of construction projects.

The need for training and skill development in Agile methodologies is also a considerable challenge. Implementing Agile requires a deep understanding of its principles and practices, necessitating significant investment in training for team members. This investment can be particularly burdensome for smaller construction firms with limited resources. Scalability issues present another hurdle. Agile methodologies are often viewed as more suitable for small to medium-sized projects. Adapting these methodologies for large-scale construction projects, which involve multiple teams and complex coordination, can be challenging. This often requires innovative approaches to maintain the Agile principles of collaboration and flexibility on a larger scale.

Client and stakeholder involvement is a critical component of Agile methodologies, which rely on continuous feedback. In construction, where clients may not always be available for regular engagement, this can pose a challenge. Additionally, managing communications and expectations with multiple stakeholders in a dynamic Agile environment requires careful planning and effective communication strategies. The construction industry's requirement for extensive documentation for legal, regulatory, and compliance purposes can also conflict with

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Agile's preference for working solutions over comprehensive documentation. Adapting Agile to ensure that all necessary documentation is completed without compromising the Agile process is essential.

Furthermore, construction projects are bound by physical and logistical constraints that are not typically present in software development, where Agile methodologies originated.

Adapting Agile to accommodate these realities, such as material lead times and the sequencing of construction tasks, requires careful planning and modification of Agile practices.

Lastly, the unique risks associated with construction, such as safety hazards and environmental factors, necessitate a tailored approach to risk management within the Agile framework. This involves adapting Agile practices to address these specific risks effectively.

Conclusion

The exploration of Agile Project Management (APM) in the context of construction management reveals a transformative potential for this sector. Agile methodologies, with their emphasis on flexibility, adaptability, and stakeholder collaboration, offer significant benefits over traditional project management approaches. These benefits include increased adaptability to changes, enhanced client collaboration, improved risk management, higher team productivity and morale, better quality control, and faster project delivery. The case studies and quantitative data presented in this paper underscore the effectiveness of Agile practices in addressing the unique challenges of the construction industry, leading to more efficient, adaptable, and client-focused project management.

However, the implementation of Agile in construction is not without its challenges. These include cultural and organizational resistance to change, the need for integration with existing construction processes, training and skill development, scalability issues, client and

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stakeholder involvement, documentation requirements, physical and logistical constraints, and specific risk management needs. Overcoming these challenges requires a tailored approach, emphasizing gradual change management, innovative adaptation of Agile principles, and effective communication strategies.

In summary, while Agile Project Management presents a promising avenue for enhancing construction management practices, its successful implementation necessitates careful consideration of the industry's specific characteristics and challenges. The potential rewards of improved efficiency, client satisfaction, and project outcomes, however, make the pursuit of Agile methodologies in construction a worthwhile endeavor.

Recommendations

Iterative Planning and Incremental Delivery: This involves breaking the project into smaller segments or 'sprints', each with a defined goal and timeline. In construction, this could mean dividing a project into phases like foundation work, framing, roofing, etc. Regular reviews at the end of each sprint allow for adjustments based on feedback or changing conditions. This approach helps in managing complex projects by focusing on smaller, achievable goals, thus reducing the risk of project overruns, and ensuring continuous progress.

Enhanced Stakeholder Collaboration: Agile emphasizes direct, continuous communication among all parties involved. In construction, this could mean regular stand-up meetings with architects, contractors, and clients. These meetings should focus on current progress, upcoming challenges, and feedback. This approach ensures that everyone is on the same page and can quickly address any issues or changes.

Empowerment of Cross-Functional Teams: In the context of construction, this means creating teams that include members with various expertise (e.g., architects, engineers,

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builders). These teams should be given the autonomy to make decisions related to their work.

This empowerment can lead to more innovative solutions and faster problem resolution, as team members are closer to the work and can make informed decisions quickly.

Adaptation of Agile Frameworks: While frameworks like Scrum and Kanban are not traditionally used in construction, they can be adapted. For example, Scrum's sprint planning and retrospectives can be used for phase planning and review in construction projects. Kanban boards can visually track different stages of construction, helping in identifying bottlenecks and improving workflow.

Continuous Risk Management: In construction, risks can range from safety hazards to unexpected weather conditions. Agile's approach to risk management involves continuously identifying and assessing potential risks throughout the project lifecycle. This proactive approach allows for immediate action to mitigate risks, rather than waiting for scheduled reviews.

Training and Skill Development: Implementing Agile requires a shift in mindset and skills. Training programs should focus not only on the principles and practices of Agile but also on how to apply them in the context of construction. This might include workshops, mentoring, and on-the-job training to help teams adapt to the Agile way of working.

Hybrid Agile-Traditional Models: A hybrid model can be particularly effective in construction, where some phases of the project may require a more traditional, linear approach due to regulatory or technical requirements. For instance, the initial design phase might follow a Waterfall approach, while the construction phase could use Agile methodologies for better flexibility and responsiveness.

Client and Stakeholder Engagement: Regular, structured interactions with clients and stakeholders are crucial. This could involve frequent progress updates, demonstrations of

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completed work, and collaborative planning sessions. The goal is to keep clients and stakeholders actively involved and informed, ensuring their continuous input and satisfaction with the project's progress.

Documentation and Compliance: Agile focuses on working solutions over extensive documentation, but in construction, documentation is often a regulatory requirement. The key is to find a balance – maintaining essential documentation for compliance and legal purposes while not getting bogged down in paperwork. Agile tools and practices can be used to streamline documentation processes, making them more efficient and integrated with the project workflow.

Tailored Risk Management for Construction: Construction projects have unique risks (like site safety). Agile methodologies can be adapted to include regular risk assessment meetings, where potential hazards are identified and mitigation strategies are developed. This approach ensures that risk management is an ongoing process, integrated into the daily workflow of the project.

Implementing Digital Twins: Incorporating digital twins into Agile Project Management in construction offers a transformative approach, enhancing planning, decision-making, and stakeholder collaboration. Digital twins, as virtual replicas of physical sites, align with Agile's iterative and data-driven methodology, providing a dynamic platform for detailed visualization and simulation of construction projects. This integration facilitates real-time data analysis through IoT sensors, aiding in informed, agile decision-making and proactive risk management. It also enhances stakeholder engagement by allowing clients, architects, and builders to visualize project progress and outcomes, fostering a collaborative Agile environment. Additionally, digital twins support iterative testing and quality assurance, aligning with Agile's continuous improvement focus, and streamline documentation processes

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for compliance. Post-construction, they offer valuable insights for maintenance and operations, extending Agile's benefits beyond the construction phase, thus significantly contributing to the efficiency, quality, and success of construction projects.

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