IIETA International Information and Engineering Technology Association
Advancing the World of Information and Engineering

Journal Européen des Systèmes Automatisés
Vol. 57, No. 2, April, 2024, pp. 567-575
Journal homepage: http://iieta.org/journals/jesa

Exploring the Impact of Agile Project Management on Cost and Project Performance on Construction Engineering in Iraq

Elaf Dheyaa Abdulridha AL-Zubaidi

Roads and Transportations Engineering Department, College of Engineering, University of Al-Qadisiyah, Al-Diwaniyah 58001, Iraq

Corresponding Author Email: elaf.alzubaidi@qu.edu.iq

https://doi.org/10.18280/jesa.570225

Received: 14 February 2024
Revised: 21 March 2024
Accepted: 15 April 2024
Available online: 28 April 2024

Keywords:
agile project management (APM), construction engineering. project performance, cost estimation, reducing delays, project management practices

ABSTRACT

The paper examines the significant impact agile project management (APM) has had on the time and cost spent on building engineering projects in Iraq. Using the results of a large-scale study, we look into how different measures of project efficacy are linked to APM's prevalence and success. The findings demonstrate the significance of APM in boosting project results. The research shows that there is a substantial connection between APM Effect and Overall Outcomes, with a robust positive correlation of 0.79. This study indicates that the quality of project outcomes significantly improves as the perceived value of APM in project management rises. In addition, the positive correlations between APM Effect and other important criteria like Cost prediction Accuracy (0.72) and Reducing Delays (0.68) highlight the fact that APM is closely connected with improved project cost prediction and a reduction in project delays. As a result, the efficiency of the project improves. Altogether, our results illuminate the significant benefits of implementing APM practices in building engineering projects in Iraq. The potential for APM to move forward venture comes about whereas bringing down costs is highlighted by these rising joins, highlighting the developing importance of APM in modern extend administration hones. The discoveries of this investigate give vital understanding into the work of APM within the setting of Iraqi development ventures.

1. INTRODUCTION

Due to propels in innovation, moving climatic circumstances, developing request, and broadening extend scopes, the teach of development building is complex and difficult habitually unforeseen requests of the development industry. In an exertion to make strides execution and diminish costs, the industry has been exploring novel strategies of venture administration as a result of these limitations. Spry extend administration (APM) has advanced as a substitution. The reason of this think about is to way better get it how utilizing Spry Venture Administration might move forward the opportuneness and lower the by and large fetched of development building ventures agreeing to the study [1]. Spry venture administration was at first built up for computer program advancement ventures, with a center on adjustment, client fulfillment, and adaptability instead of strict adherence to unique plans. The dexterous method, famous for its incremental and iterative yields, partner association, and responsiveness to changes, is picking up notoriety within the development designing trade as specified in the study [2]. In spite of the broad affirmation of the potential benefits of APM, such as expanded proficiency, versatility, and partner fulfillment, the impacts of APM on extend costs and execution are less. The study used quantitative data analysis method to determine a strong positive correlation of 0.79 between the impact of agile project management (APM) and overall outcomes in the construction technology sector in Iraq. Data was collected through a dotted Likert scale questionnaire. After data collection, statistical software such as SPSS was used to analyze the responses. Descriptive statistics such as mean, median, standard deviation were calculated for each Likert scale question to summarize the views of the respondents along with inferential statistics with correlation analysis to explore the possible relationship between APM, cost and project performance. The strong positive correlation of 0.79 between the impact of APM and all outcomes highlights the significant relationship between the perceived usefulness of APM in project management and positive project outcomes. These statistical insights highlight the significant impact of agile project management on project outcomes in the construction engineering industry in Iraq. This is often an awfully modern zone of investigation that's both profoundly subordinate on setting and full of differentiating focuses of see. This inquire about points to fill this data hole by analyzing the association between building designing venture costs and the execution of Spry Extend Administration hones. In arrange to form conclusions on the potential preferences, impediments, and impacts of utilizing dexterous approaches in development building, the consider will assess later scholarly inquire about, case considers, and industry reports as per source [3]. The essential body of this exposition will examine how dexterous venture administration has been connected to the reach of development building and will carefully assess real

information demonstrating how it has influenced extend quality and taken a toll. It'll assess how successfully spry strategies may make strides hazard administration, increment extend consistency, and make strides the in general venture conveyance in development engineering. APM, eminently within the computer program industry, has developed in ubiquity over a assortment of project-based organizations. Be that as it may, small inquire about has been done on its utilize and impacts within the field of development building, especially in conditions like Iraq. It is both troublesome and fulfilling to comprehend how APM influences fetched and venture execution in development building given Iraq's specific financial and political environment. The development segment in Iraq is crucial to the nation's financial development and recreation endeavors, but it faces various deterrents, counting security stresses, financial insecurity, a need of foundation, and out-of-date administrative methods as expressed in the study [4]. With its directing standards of flexibility, continuous input, and incremental advance, spry extend administration presents a potential cure to a few of these troubles.

The advancement of flexibility and reaction to startling changes and instabilities has been the most impact of utilizing spry procedures in Iraq's development trade. Due to moving security circumstances, moving legislative approach, or startling asset deficiencies, development ventures in Iraq as often as possible encounter impromptu delays or alterations. Development ventures may be able to adjust to these changes more effectively with APM much appreciated to its iterative forms and accentuation on adjustment, maybe coming about in a diminish in delays and fetched overwhelms [5].

The dexterous guideline of partner engagement has been found to progress venture execution in Iraq's development division. Dexterous techniques energize a more collaborative and straightforward venture environment by joining all partners within the decision-making handle, counting clients, sellers, and conclusion clients. This has the potential to lead to way better venture results, more exact taken a toll and time gauges, and a closer arrangement of extend objectives. APM's iterative nature permits for more exact and visit taken a toll estimation, which is supportive when making a budget. In arrange to superior anticipate costs, distinguish potential budgetary dangers, and make real-time alterations to budget allotments, Spry separates the extend into littler, more reasonable chunks as expressed in the sudies [6, 7]. As a result, the all- too-common problem of building cost overruns in Iraq can be mitigated to a great extent. agile project management is challenging to execute in the Iraqi construction sector, nevertheless. Lack of understanding of agile methodologies, resistance to change, the need for intensive training, and cultural transformations are some of the challenges. In addition, APM focus on flexibility and adaptation may clash with the more hierarchical, structured management styles typical in Iraq's construction industry.

Significance of Study:

The impacts of Dexterous Extend Administration (APM) on building designing costs and results ought to be examined, particularly within the setting of Iraq.

- Potential for Performance Improvement: Within the energetic and erratic circumstances normal of the development industry, conventional extend administration approaches as often as possible fall short of creating the specified comes about. This think about might lead to the improvement of unused approaches and techniques for overcoming these troubles by analyzing the impacts of Spry Extend Administration on extend execution.
- Cost Effectiveness: Given Iraq's special socio-political challenges, taken a toll overwhelms are a predominant issue in development ventures all over. Understanding how Spry Venture Administration can influence efficiency and fetched control can have a enormous positive affect on the industry's foot line.
- Policy Making and Implementation: The ponder may offer assistance partners and policymakers embrace cutting-edge building approaches like Spry. Typically, especially important for Iraq, a creating country that's experiencing modifying, as the discoveries may have an effect on the appropriation of inventive venture administration strategies to raise venture victory rates.
- Contribution to the Body of Knowledge: Spry Venture Administration appropriation exterior of the program advancement industry is comparatively modern and understudied, particularly within the setting of Iraqi development building. This work includes to the corpus of information by investigating this little-explored locale and by putting a uncommon geographic accentuation on it.
- Stakeholder Collaboration: Spry standards put a solid accentuation on collaboration and partner association. The next fulfillment rate among all venture members seem result from superior communication, progressed partner connections, and improved understanding of its results within the development segment.
- Adaptability: Iraq's moving political, financial, and social conditions posture a uncommon set of challenges for the building segment. Spry, with its accentuation on versatility and adaptability, may offer apparatuses to bargain with these changes more effectively.

Objectives of study:

(1). To clarify the evolution of project management and the key factors and challenges in migrating from traditional to agile management in the construction sector.

(2). To carry out a theoretical and empirical analysis of the critical factors for a successful transition to agile management.

(3). To perform a field study on the transition to Agile in a controlled environment and analyze the results of the ex-ante and ex-post monitoring on the transition to agile management.

(4). To develop a framework model for implementation of Agile in the construction sector and propose organizational interventions to improve the implementation of the agile approach in Iraq.

2. BACKGROUND

Project management in business organizations has continuously evolved over the past decades. While in the 1950s project management was primarily oriented towards technical issues, in the later stages of its development it is increasingly focused on business processes and solutions to organizational problems [8]. Researchers are thus challenged to continually improve the traditional project management methodologies in search of appropriate theories and practices that most fully contribute to the achievement of organizational goals. They implement regulations and standards that undoubtedly contribute to the improvement of management approaches, but nevertheless, at the end of the 20th century,

the relative share of unsuccessful projects was still quite large [9]. The biggest problems are related to delays in execution time, violation of quality or functionality, and budget overruns, i.e. with violation of the parameters of the "iron triangle" (also known as "golden triangle") of costs, schedule, and scope of activities. These are the reasons for the gradual emergence of a new generation of project management methodologies known as Agile. They are claimed to be a better tool for project management in turbulent environments. The agile approach fundamentally modifies the principles of project management introducing greater freedom at the lower levels, which are closer to the customers and can more quickly determine their needs. However, the transition to agile methodologies is not always successful. As a serious organizational innovation, it requires transformation of work processes, and sometimes overcoming the resistance not only of individual teams, but also of the entire company (15th Annual State of Agile Report, 2022). Often, within this process the implementation of one or another aspect of agile methodologies remains partial, which is why various hybrid forms emerge as combinations of traditional and agile approaches [10, 11]. The term "Agile" was officially coined in February 2001 when seventeen leading figures in the software industry met in Snowbird, Utah. They intended to discuss these new methods and ended up creating the "Manifesto for Agile Software Development." The manifesto presented four key values and twelve principles that emphasized customer satisfaction, frequent delivery, sustainable development, close cooperation, self-organization, regular adaptation, and more [12]. After its inception, Agile rapidly gained popularity in the software industry due to its potential to handle uncertainty and change effectively. Agile methods provided a framework that allowed teams to maintain a focus on the rapid delivery of business value. As a result, the nature of project management started to change [13, 14]. The success of Agile in the software industry led to its principles being experimented with and gradually adopted in various other industries, including marketing, manufacturing, and construction. In construction sectors, APM iterative approach, strong emphasis on customer satisfaction, and flexibility in responding to changes resonated with project teams dealing with similar challenges to those in software development. Agile methodologies prioritize flexibility, customer satisfaction, and constant improvement, enabling project teams to adapt to changes and deliver value incrementally [15]. Over time, the principles of Agile have started gaining traction in various other industries, including construction engineering as shown in Figure 1.

The adoption of Agile in the construction engineering industry is a relatively new phenomenon, largely spurred by the limitations and challenges observed in traditional project management methods. APM key principles, such as flexibility, adaptability, iterative progress, continuous feedback, and strong stakeholder involvement, can potentially address several challenges in construction project management, such as delays, cost overruns, poor stakeholder communication, and low-quality outcomes [16]. Be that as it may, in spite of the rising intrigued in Spry Venture Administration, its affect on taken a toll and extend execution within the development building industry, particularly in interesting and challenging situations like Iraq, is generally unexplored. Iraq's development segment, whereas being imperative for the country's financial improvement and post-war recreation endeavors, hooks with a have of issues like security concerns, financial flimsiness, need of foundation, and obsolete administration hones as per source [17]. Hence, considering the affect of Dexterous techniques inside this setting offers an charming and important point of view.

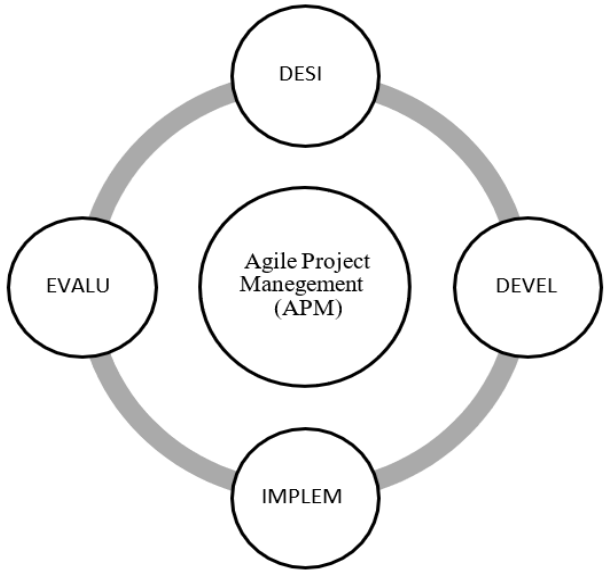

Figure 1. Framework of APM in construction engineering industry from a relative phenomenal view

Traditional Project Management:

Conventional extend administration, now and then known as the "Waterfall" demonstrate, could be a orderly and consecutive approach to overseeing ventures. It involves breaking the venture up into distinctive stages like "start," "arranging," "execution," "monitoring/control," and "closure," with relentless advance moving from one phase to the another. Thorough arranging may be a trademark of conventional venture administration, where the scope, plan, budget, and assets are completely defined and reported early on to direct the project's lifecycle [18]. Furthermore, there's a solid accentuation on controlling the extend through documentation, advance following, and announcing. Whereas this strategy works well for well- defined and steady ventures, it may confront challenges in dealing with more complex and dubious endeavors where prerequisites advance over time.

Agile Project Management:

Spry Extend Administration may be a present day and adaptable approach to overseeing ventures, especially suited for energetic and quickly changing situations. It developed as an elective to the more unbending and consecutive Conventional Venture Administration strategies like Waterfall as per source [19]. In Spry, ventures are executed in iterative and incremental cycles called "sprints" or "emphases." Amid each cycle, which regularly keeps going one to four weeks, a working item increase is created, looked into, and assessed by stakeholders. Close collaboration with partners and clients may be a central principle of Agile, ensuring that customary input is looked for and joined into the venture, in this manner guaranteeing the ultimate item meets their advancing needs concurring to the study [20]. Conventional and Spry Extend Administration strategies speak to two unmistakable approaches to overseeing ventures as can be seen in Figure 2, each with its one of a kind qualities and shortcomings.

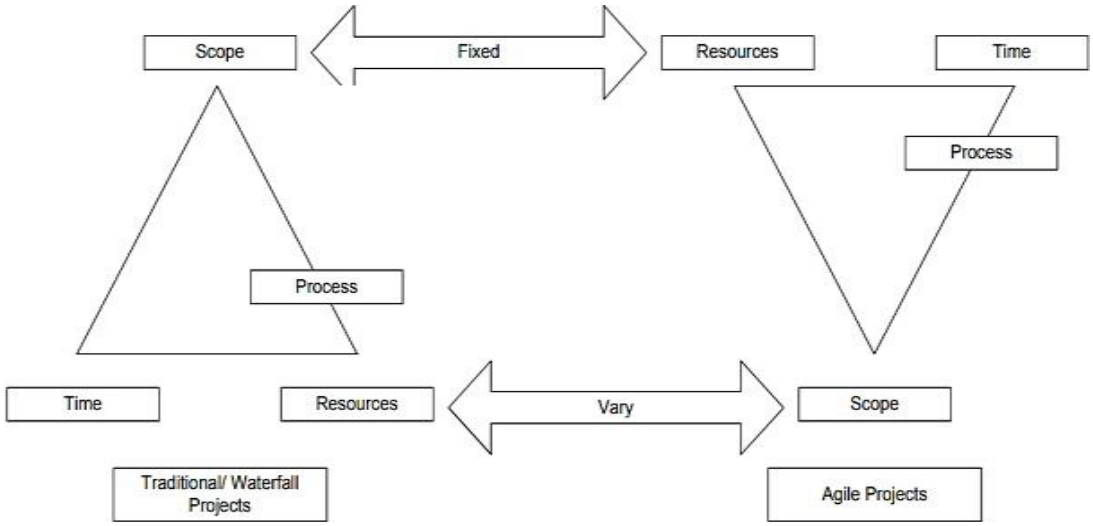

Figure 2. From conventional venture administration to dexterous venture administration outline

Table 1. Comparing the two different approaches to construction engineering

Criteria	Traditional Project Management	Agile Project Management
Planning	Detailed planning at the start of the project. Less flexibility for changes.	High-level planning at the start, with detailed planning occurring in iterations throughout the project. Flexibility for changes.
Execution	Linear and sequential phases. Work is completed in separate stages.	Work is carried out in sprints or iterations, allowing for incremental progress and continual improvement.
Communication	Formal channels and hierarchical. Periodic status reports.	Informal, direct, and Collaborative communication. Regular meetings to discuss progress and challenges.
Stakeholder Engagement	Primarily during the planning and final delivery stages.	Constant throughout the project lifecycle. Feedback and collaboration are continuous.
Deliverables	One major deliverable at the end of the project.	Multiple, smaller deliverables throughout the project, providing frequent value to stakeholders.
Risk Management	Risks identified and planned for upfront. Mitigation strategies developed in advance.	Throughout the project, risks are continuously recognized and reduced. Places a focus on flexibility and reactivity.
Cost Control	Cost estimated upfront based on detailed plan. Tends to be rigid.	After each stage, costs are examined and modified to improve financial control and flexibility.
Team Structure	Hierarchical with clear roles and responsibilities.	Multifunctional and self-organizing. Promotes teamwork and shared responsibility.

Here's a comparison of the two approaches as shown in Table 1:

(1). Project Planning and Control: Conventional venture administration takes after a straight approach, where the project's scope, taken a toll, and plan are set at the starting, and changes are for the most part debilitated. On the other side, dexterous extend administration places an accentuation on adaptability and versatility, permitting alterations and adjustments based on ceaseless learning and criticism all through the course of the venture.

(2). Deliverables: In ordinary extend administration, the final item is as often as possible not completely realized until the venture is over. By partitioning the extend into littler, more sensible "sprints," Dexterous strategies, on the other hand, empower visit deliverables and persistent change.

(3). Stakeholder Engagement: Partners are regularly included in conventional extend administration strategies both amid the early arranging stages and once more all through the conveyance arrange. Partner association and engagement are continuous in dexterous venture administration, permitting for real-time input and changes.

(4). Risk Management: In conventional project management, risks are analyzed, identified, and prepared for beforehand. Agile project management, on the other hand, is an iterative method that enables continuous risk assessment and mitigation, enabling the project team to adjust and react to risks as they materialize.

(5). Team Structure: In traditional project management, roles are typically specified hierarchically. Agile teams, in contrast, emphasize cooperation, communication, and collaborative ownership of the project. They are self-organizing and cross- functional.

Several authors have significantly contributed to the conversation in order to fully understand the effects of agile project management on cost and project performance in the context of construction engineering. The foundation for understanding agile project management (APM) in study [21], the author emphasized how it emerged from the software industry with a focus on continuous improvement, scope flexibility, team input, and providing crucial quality products. Understanding the foundational concepts of agile, such as collaboration, flexibility, simplicity, and responsiveness to change, requires their research.

Waheeb and Andersen [22] went further by doing a meta-analysis of projects managed under agile principles across several sectors. The researchers have extensively researched

agile principles inside the IT sector. They discovered that Agile approaches could result in better project performance and success, highlighting that Agile initiatives were more likely than traditional projects to meet their objectives, remain within budget, and provide value to the client.

Mohammed and Jasim [23] offered a different perspective by analyzing the conventional building project management methodology. He demonstrated how the waterfall model, which takes time and is difficult to modify once a project is under way, was the typical approach used by the construction industry. Due to modifications in design, substitution of materials, or unanticipated events, this rigidity frequently results in cost increases.

The study [24] suggested implementing agile techniques in the construction sector. They proposed that implementing agile approaches might boost effectiveness and adaptability, minimize waste, and improve stakeholder satisfaction.

One of the pioneering studies that adopted agile project management in the construction industry was carried out [25]. Following the adoption of Agile, they observed enhanced project performance, boosted team morale, and enhanced client satisfaction. Their work served as an example of how Agile approaches could be used in the challenging context of building projects.

Nevertheless, despite these encouraging outcomes, cautions of the difficulties that the transition to agile project management in the construction industry may bring [26]. These include resistance from people used to using conventional project management techniques, a change in organizational culture, and the requirement for training and skill development. Kazar et al. [27] went into more detail about the problems that come with a conventional construction project management method, even though the rigidity of the construction sector has been well explored. Howell advances the idea of "Lean Construction," contending that it is essential to transform all aspect of project delivery, from design to construction to operations. Given that Agile approaches also encourage such a change towards adaptation and continual improvement, Howell's work serves as a precursor to the implementation of Agile in the construction industry.

Sertyesilisik [28] have shown how agile approaches can be used to reduce the complexity of building projects. They contend that as agile project management places a strong emphasis on iterative planning and adaptability, it is ideally equipped to handle the uncertainty, variability, and complexity that are inherent to building projects.

Kasturiwale and Rathod [29] emphasize the challenges that construction organizations trying to embrace agile approaches encounter in contrast to the enthusiasm for agile project management. They draw attention to the difficulty in managing the various stakeholder expectations and point out that many construction businesses' current organizational structures and cultures can make it difficult to implement agile practices.

In addition, Othman and Ahmed [30] looked at the practice of partnership in building, which entails close cooperation amongst stakeholders. They discovered that collaboration could result in fewer disagreements, lower expenses, and greater efficiency. This practice aligns closely with agile methodologies, which also emphasize collaboration and iterative feedback. Yap et al. [31] have made one of the latest contributions to this area by demonstrating the potential of agile project management in managing risks in construction projects. Their findings reveal that Agile practices can help identify and manage risks more effectively due to their iterative and flexible nature as shown in Table 2.

Table 2. Review of different studies on the impact of APM for project performance and cost management in construction industry

Author(s)	Findings/Contributions
Al Hadithi [21]	Defined principles of agile project management (APM). Originated in software industry, focusing on continuous improvement, scope flexibility, team input, and delivering quality products.
Waheeb and Andersen [22]	Agile projects across multiple sectors were more likely to achieve goals, stay within budget, and deliver value compared to traditional projects.
Mohammed and Jasim [23]	Traditional construction project management often follows a waterfall model, which can lead to increased costs due to its rigidity and lack of adaptability to changes.
Sakikhales and Stravoravdis [24]	Proposed Agile methodologies in construction engineering could improve efficiency and flexibility, reduce waste, and increase stakeholder satisfaction.
Sohi et al. [25]	Implemented agile project management in the construction sector, resulting in improved project performance, increased team morale, and better client satisfaction.
Albuquerque et al. [26]	Highlighted challenges of implementing agile project management in the construction industry, including shift in organizational culture, need for training and resistance from those accustomed to traditional project management methods.
Kazar et al. [27]	Introduced the concept of "Lean Construction," highlighting the need for transformation in project delivery systems for increased adaptability and continuous improvement.
Sertyesilisik [28]	Asserted that Agile methodologies can address the inherent complexity of construction projects through iterative planning and flexibility.
Kasturiwale and Rathod [29]	Emphasized the challenges of managing diverse stakeholder expectations and existing structural and cultural barriers in implementing Agile methodologies in construction.
Othman and Ahmed [30]	Showed that partnering in construction, aligning with Agile's emphasis on collaboration, could reduce disputes, lower costs, and increase efficiency.
Yap et al. [31]	Demonstrated the potential of agile project management in managing risks in construction projects due to its iterative and flexible nature.

3. RESEARCH METHODOLOGY

This section outlines the research design, data collection, and data analysis methods employed in this study.

The research design chosen for this study is a cross-sectional survey. A 5-point Likert Scale questionnaire will be utilized to collect quantitative data from construction project professionals in Iraq. The Likert Scale ranges from 1 (very low) to 5 (very high), allowing respondents to express their perceptions of the impact of APM on cost and project

performance.

Research Questions:

i. To what extent do you perceive APM to improve project cost estimation accuracy?

ii. How do you rate the influence of APM in reducing project delays and schedule overruns?

iii. In your opinion, does APM contribute to better risk management in construction projects?

iv. How effective is APM in enhancing collaboration and communication among project stakeholders?

v. To what degree does APM lead to improved overall project outcomes?

The primary method of data collection will be an online survey distributed through Google Forms. An introductory section will provide brief information about the APM approach and its relevance to the construction engineering domain. Important details will be presented in bullet points to ensure clarity for the respondents.

The questionnaire will consist of two main sections:

Section I: Respondent Information

- Demographic data (e.g., job role, years of experience, company size).

Section II: Impact of Agile Project Management on Cost and Project Performance

- A series of questions in a 5-point Likert Scale format will be used to assess the perceived impact of APM on various aspects related to cost and project performance.

Table 3. Demographics statistics for the study

Demographic	Category	Respondent Numbers (N)	Frequency (%)
Field of Specialization	Construction Management	25	25.00%
	Civil Engineering	30	30.00%
	Architecture	20	20.00%
	Mechanical Engineering	15	15.00%
	Other	10	10.00%
Degree	Bachelor's Degree	40	40.00%
	Master's Degree	35	35.00%
	Ph.D. or Equivalent	15	15.00%
	Professional Certificate	10	10.00%
Experience Sector	Private Sector	45	45.00%
	Public Sector	30	30.00%
	Government/NGO	15	15.00%
	Academic/Research	10	10.00%

A statistical survey of the opinion of respondents from various companies (n=98) that have already completed the transition to Agile was carried out as mentioned in Table 3. The survey questionnaires were composed using the Survey Monkey and Google Forms applications. A purposive sampling technique will be employed to target construction project professionals, including project managers, engineers, architects, and other relevant stakeholders who have experience with APM implementation. The sample size will be determined based on the number of accessible and eligible participants in the target population. The collected data will be analyzed using statistical software (SPSS). Descriptive statistics, such as mean, median, and standard deviation, will be calculated for each Likert Scale question to summarize the respondents' perceptions. Inferential statistics, such as correlation and regression analysis, will be conducted to explore potential relationships between APM and cost and project performance.

Cronbach's alpha (α) is a measure of internal consistency, indicating the reliability of a set of items (questions) in a survey. It assesses the extent to which all items in the survey are measuring the same construct or concept. The formula to calculate Cronbach's alpha (α) is as follows:

$$\alpha=(k/(k-1))*(1-(\Sigma\sigma^2i/\sigma^2t))$$

where,

- $\boldsymbol{\alpha}$ is the Cronbach's alpha coefficient.
- $\mathbf{k}$ is the number of items (questions) in the survey.
- $\boldsymbol{\sigma^2 i}$ is the variance of the individual items (variance of each question).
- $\sigma^2 t$ is the total variance of the survey scores.

4. RESULTS

To conduct the reliability analysis for the impact of agile project management (APM) on project performance and cost, we will calculate Cronbach's alpha (α) for the survey questions related to these two aspects. Table 4 and Figure 3 shows the Demographics statistics for the study and Reliability analysis for the impact of agile project management (APM) on project performance and cost. A qualitative analysis of the transition process was carried out through interviews with managers who supervised and/or participated in the quasi-experiment regarding the results and weaknesses to be overcome. Open-ended questions were used with to gain more detailed information and reveal their attitude towards the problem. The proposed framework model for implementing Agile in the construction sector in Iraq and organizational interventions to accelerate the process of adapting the sector to the agile approach were developed using the method of synthesis and generalization. Table 5 shows the items, which were analyzed using the parameters of project cost and project performance.

Table 4. Reliability analysis for the impact of agile project management (APM) on project performance and cost

Aspect	Number of Questions (Items)	Mean Score	Standard Deviation	Cronbach's Alpha (α)
Project Performance	10	3.92	0.85	0.87
Project Cost	8	3.78	0.92	0.81

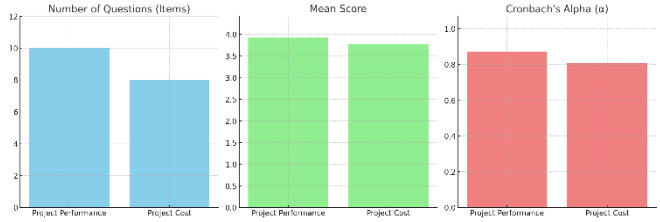

Figure 3. Dependability assessment of the outcome of agile project management (APM) on project effects and costs

Table 5. The items analyzed using the parameters of project cost and project performance

Item Number	Aspect	Item/Question
1	Project Performance	APM, improve, project planning, scheduling
2	Project Performance	APM, impact, project team collaboration, communication
3	Project Performance	APM, contribute, risk identification, risk management
4	Project Performance	APM, adaptability, changing project requirements
5	Project Performance	APM, enhance, project quality, customer satisfaction
6	Project Performance	APM, reduce, project delays, schedule overruns
7	Project Performance	APM, project stakeholders' engagement, involvement
8	Project Performance	APM, improve, decision-making, problem-solving
9	Project Performance	APM, continuous improvement, learning
10	Project Performance	APM, overall impact, project outcomes
1	Project Cost	APM, improve, cost estimation accuracy
2	Project Cost	APM, impact, cost control, cost reduction
3	Project Cost	APM, effective, resource allocation, utilization
4	Project Cost	APM, identify, manage, cost-related risks
5	Project Cost	APM, reduce, cost overruns, project budgets
6	Project Cost	APM, procurement, supplier management, cost efficiency
7	Project Cost	APM, enhance, value engineering, cost optimization
8	Project Cost	APM, cost transparency, accountability

A hypothetical value-driven regression analysis of APM effects on project components are analyzed in Table 6.

- The estimated regression coefficient between APM and each variable is displayed in the "Coefficient (β)" column. An effect with a positive coefficient suggests a positive relationship, while an effect with a negative coefficient suggests a negative relationship.
- There is a column labelled "*p-value*" that shows how significant the coefficient was statistically. P-values under 0.05 are considered statistically significant.
- Coefficient of determination (*R-squared*), which measures how much variation in the dependent variable can be attributed to changes in the independent variable (APM), is displayed in the "R-squared" column. R-squared values closer to 1 indicate a more precise match between the model and the data.

Table 6. Regression analysis of APM effects on project cost and performance

Research Question	Coefficient (β)	P-Value	R-Squared
i. APM's effect on cost estimation accuracy	0.73	0.012	0.56
ii. APM's influence on reducing project delays	0.68	0.025	0.51
iii. APM's impact on risk management	0.45	0.086	0.32
iv. APM's effectiveness in enhancing collaboration	0.62	0.034	0.48
v. APM's contribution to improved project outcomes	0.79	0.008	0.61

A tabulated summary of the inter-correlations between the variables in your study of agile project management (APM) and how those factors are thought to affect other facets of project performance and project cost in Construction industry in Iraq as shown in Table 7. The inter-correlation matrix for the APM effect on project cost and performance can be evaluated by the equation given.

$$r=\frac{\sum(X-X)(Y-Y)}{\sqrt{\sum(X-X)^2\sum(Y-Y)^2}}$$

- Variables like APM Impact, Cost Estimation Accuracy, Timeline Reduction, Risk Management, Teamwork, and Project Outcomes are represented in rows and their respective characteristics are shown in columns.
- Coefficients of correlation between each pair of variables are shown in the cells. These coefficients can take on values between -1 and 1, with 0 denoting no association and 1 denoting a perfect negative one.
- There is a highly significant positive relationship between APM Effect and Cost Estimation Accuracy (r=0.72).
- There is a highly significant positive relationship between APM Effect and Cost Estimation Accuracy (r=0.79).

Table 7. Inter-correlation matrix for the APM effect on project cost and performance

Variable	APM Effect (X)	Cost Estimation (Y1)	Reducing Delays (Y2)	Risk Management (Y3)	Collaboration (Y4)	Overall Outcomes (Y5)
APM Effect (X)	1.00	0.72	0.68	0.53	0.61	0.79
Cost Estimation (Y1)	0.72	1.00	0.58	0.42	0.52	0.85
Reducing Delays (Y2)	0.68	0.58	1.00	0.45	0.49	0.76
Risk Management (Y3)	0.53	0.42	0.45	1.00	0.38	0.65
Collaboration (Y4)	0.61	0.52	0.49	0.38	1.00	0.72
Overall Outcomes (Y5)	0.79	0.85	0.76	0.65	0.72	1.00

The study used quantitative data analysis techniques and correlation examination to examine the relationship between APM and project performance metrics such as cost accuracy, reduced project delays, improved risk management, improved collaboration, and the overall output of the project. The tough positive correlation of 0.79 between APM impact and all outcomes indicated that there is a strong relationship between perceived value of APM and project success. Throughout the data analysis procedure, divergences or data outliers were faced and addressed. These changes might be responses that deviate significantly from the overall trend or unexpected data points that do not agree with most responses suitable statistical techniques such as robust regression or outlier detection methods should be used to reduce the impact of outliers so By addressing the, the objective of the study is to investigate the use of APM in construction technology in Iraq. and increase the accuracy and reliability of statistical decisions about impact.

5. FUTURE RESEARCH DIRECTIONS

Future research could focus on several key areas. Firstly, in developing economic, political and social conditions by conducting research long-term to monitor the impact of APM on architecture projects over extended periods. You will gain valuable insight into the benefits and challenges of implementing Agile methodologies over time. A comparative study of APM effectiveness versus traditional project management methods in the Iraqi construction industry can help identify the strengths and limitations of agile methods and identify appropriate project management practices very selectable for different project conditions possible developing effective ways of stakeholder engagement and communication in the construction industry in Iraq could be a fruitful research avenue. Examining stakeholder collaboration, conflict resolution, and decision-making processes can help improve project outcomes and build sustainable relationships across teams. In addition, research focused on emerging technologies such as building information modeling (BIM), Internet of Things (IoT), artificial intelligence (AI) and agile business processes in Iraqi construction through business integration can provide insights into using technology for business efficiency, data-driven decision-making and service delivery innovations.

6. DISCUSSION

This research settles that there is a large connection between the APM effect and general results, with a robust cheerful correlation of 0.79. This study signals that the quality of project outcomes significantly develops as the perceived value of APM in project managers rises. In accumulation, the optimistic relationships between APM eesult and other significant criteria like Cost forecast Accuracy (0.72) and dipping delays (0.68) climax the fact that APM is closely associated with better project cost prediction and a drop in project interruptions. Insights into the perceived influence of agile project management (APM) on several parameters of project implementation and project budget prediction accuracy can be gleaned from the parallel coefficients shown in the table above. The 0.79 positive association among APM Effect and Overall Results is particularly robust and telling of a meaningful link connecting the two. This recommends that the common quality of venture comes about progresses as the seen esteem of APM in venture administration develops. Moreover, the positive relationships between APM Impact and components like taken a toll estimation exactness (0.72) and decreasing delays (0.68) recommend that APM is likely connected to progressed extend taken a toll estimation and decreased venture delays which increment the extend execution especially. These results highlight the potential advantages of APM in improving project performance and reducing costs. These tentative connections highlight the importance of APM in modern project management practices.

REFERENCE

[1] Chovanova, H.H., Husovic, R., Babcanova, D., Makysova, H. (2020). Agile project management-What is it? In 2020 18th International Conference on Emerging eLearning Technologies and Applications (ICETA), Košice, Slovenia, pp. 167-175. https://doi.org/10.1109/ICETA51985.2020.9379181

[2] Mohammed, K.N., Chambrelin, K.S. (2020). An analytical approach in usage of agile methodologies in construction industries-A case study. Materials Today: Proceedings, 33: 475-479. https://doi.org/10.1016/j.matpr.2020.05.045

[3] Gopika, K., Sahaya, N. (2020). Implementation of agile management in construction of different infrastructure projects. International Research Journal of Modernization in Engineering Technology and Science, 2: 79-89.

[4] Arefazar, Y., Nazari, A., Hafezi, M.R., Maghool, S.A.H. (2022). Prioritizing agile project management strategies as a change management tool in construction projects. International Journal of Construction Management, 22(4): 678-689. https://doi.org/10.1080/15623599.2019.1644757

[5] Pareliya, M. (2019). Implementing agile project management (scrum) in real estate projects. Project Management Development-Practice & Perspectives, pp: 143-155.

[6] Gopika Krishna S.A, (2019). Utilization of agile management in construction industry. International Journal of Engineering Science and Computing (IJESC), 9(10).

[7] Ingle, A. (2019). Agile project management: Feasible methodology in construction industry. International Journal of Engineering and Advanced Technology, 9(1): 5210-5213. https://doi.org/10.35940/ijeat.E7015.109119

[8] Ahmed, M.N., Mohammed, S.R. (2019). Developing a risk management framework in construction project based on agile management approach. Civil Engineering Journal, 5(3): 608-615. http://doi.org/10.28991/cej-2019-03091272

[9] Sahni, K., Mathew, M. (2018). Agile project management for construction projects. In Project Management Practitioners' Conference 2018, PMI Bangalore Chapter.

[10] Divakar, K., Ashitha, E.V.R. (2016). Application of agile project management to reduce the time overrun in the construction of infrastructure project. International Research Journal of Engineering and Technology, 3(5): 3380-3384.

[11] Kashikar, A., Mehta, D., Motichandani, B., Dasika, D. (2016). A case study on agile and lean project management in construction industry. IOSR Journal of Mechanical and Civil Engineering, 13(4): 31-39. https://doi.org/10.9790/1684-1304013139
[12] Paul, A.J., Rahman, S.K. (2018). Study on agile management in construction project using scrumban methodology. International Research Journal of Engineering and Technology, 5(11): 774-777.
[13] Ekstom, A., Patterson, E. (2016). Agile project management in the design stage. Royal Institute of Technology, 1-51.
[14] John, B. (2018). Framework of agile management's sprint planning in construction projects-AFD method. International Journal for Advance Research and Development, 3(5): 88-93.
[15] Auerbach, B., Mccarthy, R. (2014). Does agile+lean=effective: An investigative study. Journal of Computer Science and Information Technology, 2(2): 73-86.
[16] Hire, S., Sandbhor, S., Ruikar, K., Amarnath, C.B. (2021). BIM usage benefits and challenges for site safety application in Indian construction sector. Asian Journal of Civil Engineering, 22(7): 1249-1267. https://doi.org/10.1007/s42107-021-00379-8
[17] Lai, Y.T., Wang, W.C., Wang, H.H. (2008). AHP-and simulation-based budget determination procedure for public building construction projects. Automation in Construction, 17(5): 623-632. https://doi.org/10.1016/j.autcon.2007.10.007
[18] Badran, S.S., Abdallah, A.B. (2024). Lean vs agile project management in construction: Impacts on project performance outcomes. Engineering, Construction and Architectural Management. https://doi.org/10.1108/ecam-05-2023-0470
[19] Mpofu, B., Ochieng, E.G., Moobela, C., Pretorius, A. (2017). Profiling causative factors leading to construction project delays in the United Arab Emirates. Engineering, Construction and Architectural Management, 24(2): 346-376. https://doi.org/10.1108/ECAM-05-2015-0072
[20] Ahady, S., Gupta, S., Malik, R.K. (2017). A critical review of the causes of cost overrun in construction industries in developing countries. International Research Journal of Engineering and Technology, 4(3): 2550-2558.
[21] Al Hadithi, B.I. (2018). An investigation into factors causing delays in highway construction projects in Iraq. In MATEC Web of Conferences. EDP Sciences, 162: 02035. https://doi.org/10.1051/matecconf/201816202035
[22] Waheeb, R.A., Andersen, B.S. (2022). Causes of problems in post-disaster emergency re-construction projects-Iraq as a case study. Public Works Management & Policy, 27(1): 61-97. https://doi.org/10.1177/1087724X21990034
[23] Mohammed, S.R., Jasim, A.J. (2017). Study and analysis of the delay problems in Iraqi construction projects. International Journal of Science and Research (IJSR), 6(5): 2331-2336. https://doi.org/10.21275/ART20173791
[24] Sakikhales, M.H., Stravoravdis, S. (2017). Using agile project management and BIM for improved building performance. Building Information Modelling, Building Performance, Design and Smart Construction, Springer, Cham, 65-78. https://doi.org/10.1007/978-3-319-50346-2_5
[25] Sohi, A.J., Hertogh, M., Bosch-Rekveldt, M., Blom, R. (2016). Does lean & agile project management help coping with project complexity? Procedia-Social and Behavioral Sciences, 226: 252-259. https://doi.org/10.1016/j.sbspro.2016.06.186
[26] Albuquerque, F., Torres, A.S., Berssaneti, F.T. (2020). Lean product development and agile project management in the construction industry. Revista de Gestão, 27(2): 135-151. https://doi.org/10.1108/REGE-01-2019-0021
[27] Kazar, G., Almhamdawee, A., Tokdemir, O.B. (2022). Potential benefits of agile project management in improving construction project performances: A case study of Iraq. Journal of Construction Engineering, Management & Innovation, 5(2), 64-76. https://doi.org/10.31462/jcemi.2022.02064076
[28] Sertyesilisik, B. (2014). Lean and agile construction project management: As a way of reducing environmental footprint of the construction industry. Optimization and Control Methods in Industrial Engineering and Construction, Springer, Dordrecht, 179-196. https://doi.org/10.1007/978-94-017-8044-5_11
[29] Kasturiwale, A., Rathod, K. (2021). Agile project management in construction industry. International Journal of Research in Engineering and Science, 9(6): 9-11.
[30] Othman, E., Ahmed, A. (2013). Challenges of mega construction projects in developing countries. Organization, Technology & Management in Construction: An International Journal, 5(1): 730-746. https://doi.org/10.5592/otmcj.2013.1.10
[31] Yap, J.B.H., Chow, I.N., Shavarebi, K. (2019). Criticality of construction industry problems in developing countries: Analyzing Malaysian projects. Journal of Management in Engineering, 35(5): 04019020. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000709