Journal of Construction Engineering, Management & Innovation
2022 5(2):64-76
DOI 10.31462/jcemi.2022.02064076

RESEARCH ARTICLE

Potential benefits of agile project management in improving construction project performances: A case study of Iraq

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Article History

Received 20 February 2022
Accepted 07 April 2022

Keywords

Construction management
Agile project management
Project performance
Developing countries

Abstract

Due to poor performances in construction projects, there is a necessity to apply novel project management approaches instead of traditional ones. Recently, although new project management methods have emerged and applied in different industries, the construction industry has stayed behind in implementing these techniques. The agile Project Management (APM) approach is one of these methods, and it has been highly discussed recently. As developing countries considerably suffer from poor performance in construction projects, applying new project management methods has gained more importance in these territories. Even though different studies attempted to understand the applicability of the APM, it is also necessary to explore the potential benefits of the agile methods for the construction industry. For this purpose, we surveyed 140 construction experts for the prioritization of factors and received responses on the potential advantages of the APM regarding team and project performance in construction. The results achieved from the Iraq field study demonstrate that the APM could be feasible for the construction industry and could effectively bring solutions to the project performance issues. We also concluded that the adverse effects of poor project performance, such as quality defects, schedule variances, cost overruns, and low productivity, could be eliminated especially in the construction industry of developing countries, through APM approaches.

1. Introduction

Since construction projects are complex, unique, and dynamic, construction project management is one of the main challenges these projects. Cost overruns, schedule variances, quality failures, and lack of resource management are common in the construction industry and principal reasons for poor construction management [1]. Poor project performance in construction projects is still on the main agenda among construction experts, practitioners, and stakeholders. Underlying factors behind the poor project performance were mainly divided into two categories external and internal [2]. While external factors refer to weather conditions, financial crisis, price fluctuation, and unexpected site conditions, internal causes are client or owner change orders, poor labor management, equipment and material, and quality defects in construction sites. Thus, construction professionals heavily focus on such internal factors

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eISSN 2630-5771

to improve the performance of construction projects. In this sense, different project management strategies such as lean construction [3], off-site construction, Building Information Management (BIM) [4], and novel budgeting systems [5]. Apart from these methods, Agile Project Management (APM) is a new trend and has been applied in recent years in construction projects [6]. These project management techniques were introduced to solve complex issues such as cost overruns, quality failures, and time delays observed in the construction industry.

It is a well-known fact that the construction industry plays a vital role, particularly in the financial conditions of developing countries. However, poor project performances in construction are commonly seen in developing countries because of diverse reasons such as low skilled human resources, limited equipment and material, and lack of experience in special projects [1,7,8]. After the 2003 War, Iraq is one of the developing countries, and it invested huge capital into public infrastructure projects after the gulf war. The Iraqi construction industry suffers from poor project performance such as time delays, cost overruns, low productivity, and quality defects as in other developing countries. In this sense, previous studies conducted in Iraq mainly investigated the root causes of project management issues to improve the performance of the construction projects [9–11]. On the other hand, limited research exists to understand the applicability and potential benefits of a new project management method for the construction industry of Iraq. Hence, the primary purpose of this study is to explore the feasibility and advantages of the Agile Project Management technique for the Iraqi construction industry.

2. Background

2.1. Agile project management in construction

Agile methodology emerged at the beginning of the 2000s due to the difficulties seen in traditional project management methods, which have been criticized for their rigidity, bureaucracy, and failure in flexible adapting [12]. Adopting an agile approach was intended to improve team productivity via agile principles such as low hierarchies, joint decisions, effective collaborations, and knowledge-based decisions. Apart from the agile team perspective, critical success factors such as updating project implementations, planning the project's life cycle, and high involvement of all stakeholders are the main objectives of the agile method [13]. Due to numerous advantages of the agile method, it was integrated into the project management process. Since the main characteristic features of the projects are unforeseen, complexity, limited resources (e.g., time, budget, and material), changes, and high risks, the Agile Project Management (APM) concept was introduced to bring solutions to these issues. Therefore, different applications of APM can be seen in diverse industries such as automotive [14], defense [15], healthcare [16], and manufacturing [17].

In addition to diverse sectors, APM has also been integrated into the construction industry, and it has been utilized to improve the performance of construction projects. Several studies evaluated the effectiveness and feasibility of the APM for the construction industry [6,18–25]. In a previous study [19], the authors examined the APM and Lean Construction (LC) 's effectiveness for the construction industry whether these methods could be solutions for project management issues emerging due to complexity. For this purpose, the authors surveyed 67 construction professionals, and they performed statistical analysis to understand which project management method is helpful for the construction processes. This study shows that agile methods are effective in managing the complexity of construction projects. Felipe et al. [20] attempted to understand the potential applicability of the APM in the construction industry. Multiple case studies were implemented in three different construction companies, and semi-structured interviews were done with construction experts. The survey responses gathered from the experts demonstrate that even though APM has the

potential to improve project performance from diverse perspectives, there are various challenges in the construction industry to implementing agile methods. One study [6] explored the usage of the APM as a tool for change management in construction projects. The researchers in that study [6] initially surveyed consultants and contractors in Iran to identify major changes that occurred on construction sites. Then, 12 construction experts participated in the study to define the most critical agile methods and potential benefits in managing changes and improving project performance. The results show that real-time resource tracking, flexible work process, participation of clients, and effective communication could be the most important agile approaches to managing change orders during the ongoing construction process. Sakikhales and Stravoravdis [18] discussed the advantages and suitability of agile techniques for the construction industry. The authors also proposed an iterative design framework supported by BIM to prevent change orders and achieve more sustainable construction assets. In that study [18], the researchers emphasized that it is possible to achieve the most optimum design option without decreasing project performance by using the iterative design approach during the ongoing construction process. Kasturiwale and Rathod [26] claimed that the agile approach could be an effective solution for issues related to schedule overruns that emerged in large construction projects.

2.2. Construction project performance in developing countries

Construction projects have significant roles in developing countries' economic growth and socio-economic conditions. Also, the construction industry provides a high rate of Gross Domestic Product (GDP) compared to developed countries [27]. Therefore, poor performance in construction projects could be more serious for such developing countries' financial situations and growth. Several studies have focused on understanding the main reasons for poor project performance, such as time delays, cost overruns, quality failures, and challenges for the construction industry in developing countries [8,28–32]. For example, Yap et al. [32] aimed to assess critical issues observed in Malaysia's construction industry, and the authors conducted a questionnaire with 117 construction professionals. According to the results of this study, change orders, deadline extensions, and late payments are major problems in the construction industry. Also, it is concluded that ineffective management process, resistance to digital transformation, poor site coordination, and incompetency of the construction practitioners are root causes of the identified major issues in construction projects. In another study, challenges of the construction process in mega projects carried out in developing countries were investigated from diverse perspectives such as education level, political and financial conditions, living standards, and culture [31]. It is determined that the low standard education system, unstable political and financial situations, poor healthcare system, and demographic structure harm the construction environments and processes. Kazaz et al. [29] aimed to identify the reasons for time overruns which is one of the main project performance success criteria in the construction industry of Turkey. The author highlighted those cash flow problems, delays in payments, and change orders are commonly encountered issues in the Turkish construction industry.

Iraq, another developing country in the Middle East, also suffers from low performance in construction projects [9,11,33–35]. Bekr [35] stated that the country's inadequate experience of construction stakeholders, poor management process, and conditions are primary reasons for time overruns in public projects in Iraq. A previous study [10] concluded that deficiencies in leadership and technical knowledge, low skill among labor forces, inadequate strategic plans, and deficiencies in risk management are major issues in the construction industry of Iraq and developing countries [36]. Khaleel and Hadi [34] defined the financial difficulties of the contractors, shortage of skilled human resources, and limited equipment

and material in the Iraqi construction industry as the most important causes of time delays.

As one can understand from here, the construction industry of Iraq has similar problems to other developing countries, and most of these issues are related to project management factors. At this point, novel project management approaches such as Agile Project Management (APM) could be an effective solution for the poor performances in construction projects in Iraq and developing countries. However, there is limited research on applying APM to the construction industry of Iraq [37–39] and developing countries [6]. These studies usually questioned whether the APM method could be applied to construction projects in these territories. In addition to the applicability, the potential advantages of the APM in terms of team collaboration and project performance should be investigated. Thus, the main objective of the current study is to explore the application capability of APM and understand the potential benefits of the APM for team collaboration and project performance in Iraq. Also, we believe that achieving results in the current study can be helpful for other developing countries where similar project performance issues are observed, such as in Iraq.

3. Research methodology

To measure the applicability and potential effectiveness of the APM approach in improving team coordination and project performance, we prepared a survey and conducted it with construction experts working on construction projects in Iraq (Appendix 1). Before gathering responses from the participants, the questionnaire was designed in four main parts based on the literature review. To structure the questionnaire, we searched our topic in diverse journals which are mainly related to construction management and project management. We used “agile project management”, “agile construction”, “construction in developing countries”, and “agile principles” as keywords during the literature review process. The questions in the first part are related to demographic information about the respondents. The second, third, and fourth sections consist of the applicability of the APM in Iraq, potential benefits for team coordination, and positive effects on the project performance, respectively. While most questions in the second part were adopted from a previous study [38] conducted in Iraq only to explore the feasibility of the APM, we prepared other sections via an extensive literature review on agile methods. Questions were asked in a 5-point Likert Scale form (e.g., 1= very low, 2= low, 3= medium, 4= high, 5= very high). The questions were sent via Google Forms and an initial pilot study was not conducted for this research. At the beginning of the survey, we provide brief information about the APM approach and give some important information in bullet points to clarify this project management method for the respondents.

After the data collection process, we initially tested the reliability of the survey results via Cronbach's alpha (α) which was widely used for similar purposes in previous studies [40,41]. Cronbach's alpha (α) is a coefficient, and it provides statistical information about the internal consistency level of the collected dataset. The calculation formula of Cronbach's alpha (α) is shown below:

$$\alpha = n/(n-1)\left(1-\frac{\sum Vi}{Vtest}\right) \quad (1)$$

Here, n represents the total number of questions in each section, Vi illustrates each question's calculated variance, and $Vtest$ demonstrates the total variance score of all items involved in the survey.

We also ranked each item according to the Relative Importance Index (RII) value, which is calculated by using Eq. 2 in different studies [1,28]. In Eq. 2, while W represents each item's weighting value or scale (e.g., from 1 to 5), N shows the total number of respondents who participated in this study, and A is the most significant scale (e.g., 5 in this study). While the RII value goes from 0 to 1, it means that the potential effectiveness or applicability level of items related to the APM is increasing. After calculating the RII value for each item, we labeled the items in terms of effectiveness

level as High (if RII between 0.7-1.0), Medium (if RII between 0.4-0.7), and Low (if RII less than 0.4).

$$\text{RII} = \frac{\sum W}{A * N} \quad (2)$$

4. Results

The questionnaire was sent to 220 construction experts who were working on construction projects in Iraq, and 140 professionals responded to the survey questions for this study (Table 1). Among these experts, they mainly worked in public institutions (N=112), but a few worked for private companies (N=28). 42.3% of the total respondents have more than 25 years of experience in construction projects. The specialization of more than half of the experts (N=64) is civil engineering. Besides, while most of them (N=105) have a bachelor's degree in civil engineering and architecture, 7% of them have a Ph.D. degree.

We checked the reliability of each section and all items measured via survey separately by considering Cronbach's alpha (α) value (Table 2). The results show that all survey parts, such as the applicability of the APM (α=0.761), potential benefits of the APM on project management (α=0.883), and team performance (α=0.733) are reliable as each value is higher than 0.7 [42].

Initially, we evaluated the applicability of the APM to the Iraqi construction industry (Table 3). The survey findings demonstrate that the organizational structure of the Iraqi construction industry (APM1) is highly suitable for the implementation of the APM approach (RII=0.815, Rank=1). Also, the respondents claim that APM can be applied to the construction management process (APM6) precisely (RII=0.781, Rank=2). On the other hand, the sustainability of applying APM in the Iraqi construction industry for a long time was found problematic by the experts (RII=0.679, Rank=8).

Table 1. Descriptive statistics

Parameter	Category	Respondent Numbers (N)	Frequency (%)
Sector	Private	28	19.5
	Public	112	80.5
Experience	< 5 years	23	16.05
	5-15 years	26	18.42
	15-25 years	33	23.4
	> 25 years	58	42.13
Field of Specialization	Civil	64	46.34
	Architectural	29	19.51
	Mechanical and Electrical	21	15.48
	Other	26	18.67
Academic Degree	BSc	105	75.61
	MSc	25	17.07
	PhD	10	7.32

Table 2. Reliability analysis results

Section	Number of Items	Reliability (Cronbach's Alpha)
APM	8	0.761
Project	12	0.883
Team	9	0.733
All items	29	0.906

Table 3. Applicability of the APM for the construction industry

ID #	Item	Mean	Std. Dev	RII	Rank	Rate Level
APM1	Organization structure	4.05	0.79	0.815	1	High
APM2	Replicable with traditional methods	3.71	0.9	0.745	4	High
APM3	Design and planning process	3.8	0.98	0.763	3	High
APM4	Acceptance from stakeholders	3.53	0.84	0.701	7	High
APM5	Training programs	3.73	0.88	0.741	5	High
APM6	Construction management process	3.91	0.99	0.781	2	High
APM7	Work strategies	3.51	1.12	0.718	6	High
APM8	Sustainable	3.38	1.07	0.679	8	Medium

The potential effectiveness of the APM on the project performance was measured via 13 different items in the survey (Table 4). According to the results, it is highly believed that applying agile methods will improve the value of construction projects (P1; RII= 0.735, Rank=1) and make it easy to conduct multi-construction activities together simultaneously (P2; RII= 0.705, Rank=2). In addition, it is indicated by the experts that learning of technical aspects (P5) could be accelerated via agile methods in construction (RII= 0.704, Rank=3). However, the results illustrate that implementation of the APM does not have much more contribution to human resource management (P12; RII=0.647, Rank=12)

Finally, we attempted to understand the potential contributions of applying the APM to team performance in construction (Table 5). The construction experts stated that agile methods could have major potential in positively changing the organizational culture of teams and improving effective knowledge transfer between team members (T4; RII= 0.722, Rank 2) in construction sites. Besides, the participants believe that implementing the APM in construction projects will provide a more confident working environment for team members (T5; RII= 0.715, Rank 3). However, the results also show that the APM may not provide continuous improvement for team members in construction workplaces (T8; RII= 0.681, Rank 9).

5. Discussion

Recently, different studies have focused on integrating the APM approach to the construction industry. Since poor project performance is widely observed in developing countries, such novel project management methodologies are highly required to solve time delays, cost overruns, and quality defects in those countries. The construction industry of Iraq also suffers from similar project management issues as in other developing countries. These conditions have adverse effects on the country's economic growth and financial conditions. Although some previous studies conducted in Iraq attempted to understand the feasibility of the APM for the construction industry [37–39], it is also necessary to explore the potential benefits of the APM for the project and team performances in construction projects. In this study, we initially aimed to understand the applicability of the APM to the Iraqi construction industry via nine different factors (Fig. 1). The respondents believe that agile techniques can be implemented in the construction industry of Iraq, as stated in a previous study [38]. 7 of 8 factors are rated as a high level that shows the reliability of applying the agile methods in construction projects in Iraq. Experts claimed that organization structure and construction management processes could not be a barrier to applying the APM. However, there is a significant concern about sustainably applying the agile method for a long time. The main reason behind this aspect is the country's unstable political and financial conditions, which is also highlighted in previous studies [10,34,35].

Table 4. Potential effect level of the APM on project performance

ID #	Item	Mean	Std. Dev	RII	Rank	Rate Level
P1	Improve project value	3.67	0.93	0.735	1	High
P2	Multi-task project process	3.52	0.94	0.705	2	High
P3	Prevent reworks	3.5	0.9	0.695	6	Medium
P4	Monitoring and testing project success	3.32	1.03	0.664	11	Medium
P5	Learning improvement	3.52	1.02	0.704	3	High
P6	Change management	3.37	1	0.665	10	Medium
P7	Risk management	1.35	1.02	0.676	9	Medium
P8	Scope management	3.52	1.27	0.701	5	High
P9	Managing change orders	3.51	1.18	0.704	4	High
P10	Documentation process	3.42	1.21	0.685	8	Medium
P11	Human resource management	3.23	1.09	0.647	12	Medium
P12	Prevent uncertainties	3.43	1.12	0.687	7	Medium

Table 5. Potential effect level of APM on team performance

ID #	Item	Mean	Std. Dev	RII	Rank	Rate Level
T1	Resolve conflicts in the team	3.49	1.14	0.698	5	Medium
T2	Effective leadership	3.53	1.04	0.707	4	High
T3	Sense of belongings of team member	3.48	1.02	0.697	6	Medium
T4	Knowledge transfer between team members	3.61	1.04	0.722	2	High
T5	Confidence environment	3.57	1.01	0.715	3	High
T6	Team culture	3.69	0.94	0.738	1	High
T7	Reaction to unexpected conditions together	3.46	0.95	0.692	8	Medium
T8	Continuous improvement	3.4	1.01	0.681	9	Medium
T9	Sharing risks between team members	3.47	1.04	0.694	7	Medium

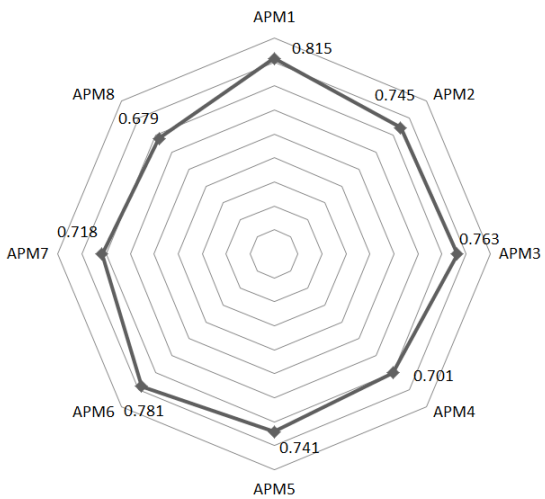

Fig. 1. Applicability of the APM

In the third part of the survey, we measured the potential advantages of the agile methods to achieve successful performance in construction projects in Iraq via 12 different factors (Fig. 2). The results show that the APM could be beneficial for some project performance factors such as improving "Project value" and "Lessons learning" and providing a "Multi-task construction process." On the other hand, the participants pointed out that the agile approaches could be less effective in managing human resources and construction risks. Especially, since the shortage of qualified labor force in Iraq [35] and developing countries [28], both human resource and risk management aspects could be improved through well-established training programs rather than novel project management methodologies in those countries.

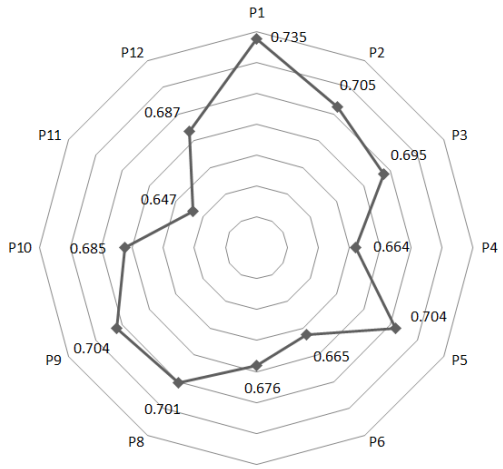

Fig. 2. Effectiveness of the APM on project performance

Fig. 3. Effectiveness of the APM on team performance

Finally, potential benefits of the agile methods for team performance were explored in the last section of the survey by considering nine various factors (Fig.3). According to the survey results, the respondents indicated that some factors related to team performance, such as "organization/team culture," "knowledge transfer between team members," and "confidence working environment," could be improved via agile methods in construction projects. These results also are consistent with the findings achieved in the current study about the effectiveness of the APM on project performance. It is a well-known fact that construction workplaces have complex and dynamic conditions. Therefore, having an interactive and confident working environment is vital for employees. At this point, we can conclude that team and project performance have direct relations with each other, as stated in a previous study [42]. The APM approach has major potential to improve such aspects in construction projects.

In general, poor performance is a common issue in construction projects, and, thus novel project management strategies are highly required. Notably, developing countries make considerable investments in their infrastructure systems, and such decisions stimulate new construction projects. This is why the developing countries and their economies have suffered much more from the issues observed on construction sites. It is highly emphasized that agile methods should be integrated into construction projects to reduce such adverse impacts [6,23]. Also, it is proposed that such novel approaches can be combined with other construction management methods such as BIM [18,39] and the lean approach [19]. We believe that such holistic applications will play major roles in solving management issues and improving performance in construction projects. Productivity and team performance issues due to deficiencies in high qualified human resources can be eliminated by integrating the APM methods into the construction industry. Besides, management and operational factors influencing construction project performance (e.g., effective organization structure, leadership, and managing change orders) could be enhanced via the agile methods.

The main contribution of the current research is examining the applicability of the APM and exploring the potential benefits of this novel project management method for the construction industry, especially in developing countries. We attempted to provide a detailed insight into the APM by using some prioritization of factors and conducting a survey. The perspective of the construction experts could be more reliable since they face performance issues in construction. Therefore, this research could be an essential resource and inspiration for practitioners to implement agile methods in the construction industry. The decision-makers also can put agile techniques into action according to

which points could be improved and where the APM will be more effective based on the results of this study. On the contrary, this study also has some limitations. The results can be compared to other studies conducted in other developing countries to understand the feasibility and effectiveness of agile methods for construction management. Also, the potential benefits of combining agile methods with other innovative project management methods should be measured. These limitations could be addressed in future studies.

6. Conclusion

Since various deficiencies and issues such as low productivity, safety, and quality are observed in the construction industry of developing countries, it is highly required to bring new project management methodologies. One of the methods is Agile Project Management (APM), and it is a new trend due to providing benefits for project management processes in different industries. Recently, an argument related to integrating the APM into the construction industry has been widely discussed. For this purpose, several studies have focused on understanding the applicability of the APM in construction projects. Apart from applying the agile methods, the potential benefits of this approach should be investigated. Therefore, the main objective of this study is to examine how the APM can improve team and project performances in construction. One hundred forty construction experts were surveyed and performed the statistical analysis. The results show that the APM approach can be implemented precisely and could have positive impacts on the project and team performances. We believe that this method should be widely implemented in construction projects and should be combined with other novel project management methods. As developing countries considerably suffer from poor performance in construction projects, applying new project management methods has gained more importance in these territories. Accordingly, common management failures in construction project processes mainly encountered in developing countries such as time delays, cost overruns, low quality, and productivity can be reduced or eliminated via agile methods.

Ethics Committee Permission

The authors acquired ethics committee permission for surveys implemented in this paper from the Istanbul Gedik University Ethics Commission (Date: 28/03/2022; No: E-56365223-050.01.04-2022.137548.67-322).

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Appendix 1

Part 1 Demographic Information

1	Name of Company or Organization		Work Sector	Public	
				Private	

2	Academic Degree	B. Sc	M.Sc	Ph.D

3	The Specialization	Civil	Architectural	Mechanical	Electrical	Other

4	Work Experience	less than 5 years	Between 5-15 years	Between 15-25 years	More than 25 years

Part 2 Applicability of the APM to the Construction Industry

Number	Questions Related to Applicability of the APM	Very Low	Low	Medium	High	Very High
1	Could Agile Project Management be applied for organization structure in construction?					
2	Could Agile Project Management be replaced with traditional construction methods?					
3	Could Agile Project Management be applied for the design and planning process in construction?					
4	Will Agile Project Management be accepted by the stakeholders in construction?					
5	Could Agile Project Management be applied for training programs in construction?					
6	Could Agile Project Management be applied for the construction management process in construction?					
7	Could Agile Project Management be applied for work strategies in construction?					
8	Will Agile Project Management be sustainable in the construction industry?					

Part 3 Potential Benefits of the APM for Project Performance

Number	Questions Related to Project Performance	Very Low	Low	Medium	High	Very High
1	Could Agile Project Management improve project value in construction?					
2	Could Agile Project Management make the multi-task process easy in construction?					
3	Could Agile Project Management prevent reworks in construction?					
4	Could Agile Project Management make monitoring and project success easy in construction?					
5	Could Agile Project Management improve learning in construction?					
6	Could Agile Project Management improve change management in construction?					
7	Could Agile Project Management improve risk management in construction?					
8	Could Agile Project Management improve scope management in construction?					
9	Could Agile Project Management improve managing change orders in construction?					
10	Could Agile Project Management improve the documentation process in construction?					
11	Could Agile Project Management improve human resource management in construction?					
12	Could Agile Project Management prevent uncertainties in construction?					

Part 4 Potential Benefits of the APM for Team Performance

Number	Questions Related to Team Performance	Very Low	Low	Medium	High	Very High
1	Could Agile Project Management provide resolving conflicts among team members in construction?					
2	Could Agile Project Management improve effective leadership in construction?					
3	Could Agile Project Management increase the sense of belongings of team members in construction?					
4	Could Agile Project Management improve knowledge transfer between team members in construction?					
5	Could Agile Project Management improve the confidence environment in construction?					
6	Could Agile Project Management improve the team culture in construction?					
7	Could Agile Project Management improve the reaction to unexpected situations in construction?					
8	Could Agile Project Management improve solidarity between team members in construction?					
9	Could Agile Project Management improve risk-sharing between team members in construction?					