



Using Agile Construction Management Principles for Reducing Delay in Iraqi Construction Industry

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Abstract:-

The failure to reconcile goals of the construction process is one of the main problems faced by the projects, where the delay in completing any phase of the project or completion of the entire project considers is the most important problems. This problem is suffered by all countries in the world, especially Iraq because of the negative impact of delay on the goals of the construction project. The aim of this study is to propose appropriate procedures to address the problem of delay in the construction projects of Iraq based on the principles of Agile construction management related to reducing delay. Therefore, the researcher reviewed the relevant literature to identify the key factors causes the delay. Then interviews with experts have been conducted to achieve the study aim. The results of this study were identified eleven principles of Agile construction management can by it reduce the delay in Iraqi construction projects. As well as twenty-five procedures to reduce delay has been proposed in the Planning and Design phase and the most important is "The use of advanced programs and modern methods in the preparation of designs such as the use of engineering programs those operating according to the building information modeling methodology (BIM)". Moreover, twenty-three procedures to reduce delay has been proposed in the Contracting phase, the most important of it is "Put an item in the contract document obliging the employer not to delay the contractor's payments". In additional, twenty-nine procedures to reduce delay has been proposed in the Construction phase, the most important of it is " Entering of a partner to contribute to finance or borrow from banks to cover work expenses in case of lack of financial capacity ".

Key-words: Construction project, Delay, Agile principles, Agile Construction Management

1. Introduction

Delay in construction projects is considered one of the most common

problems causing a multitude of negative effects on the project and its participating parties [1]. In the United Kingdom, at 2001, the National Audit



Office made a report entitled “Modernizing Construction”, according to this report 70% of the projects undertaken by Government department and agencies were delivered late [18]. Moreover, the size of delay in Indonesia, [24] identified that only 47% of the projects were completed within the schedule, 15% ahead of schedule, and 38% were behind schedule. [22] stated that about 57% of Indian construction projects are experiencing time overrun. In addition, the most construction projects in Lagos (Nigeria’s largest city) faced an average delay of 51% on their planned duration [5]. [3] reported that 70% of public construction projects in Saudi Arabia are delayed.

While in Iraq, most of the construction projects have been delayed in their implementation and it can be said that it very rarely finds a project has been implemented within the specified duration without any delay. The current period is critical because of Iraq is going through difficult conditions in all areas. The most important of these areas is the construction industry, which plays a major role in the growth of the national economy by the creation of jobs and wealth of the country. In order to overcome all the problems and difficulties facing the construction industry, especially reducing the delay in the construction projects, required study and analysis for those problems and takes the necessary measures as Agile construction management

(ACM) to reduce delays and achieve the objectives of the construction project.

2. Agile Construction Management

The Agile methods are therefore described as empirical – they are based entirely on practical experiences and work methods that are proven to work [16]. An agile construction management consists of the four phases: feasibility study, planning , implementation, handing-over, and closing. These different phases can be found in projects that are not Agile as well but what might differ from other projects is the way the different phases are executed [12].

Nevertheless, although originating in the IT industry, agile project management is now moving into other businesses. Although there is extensive evidence of Agile project management used in software development, there is a lack of empirical studies in other types of industries and projects. Pope-Ruark states that Agile is not only popular in software development; a quick Google search reveals its reach in design, marketing, publishing, energy management, financial services, and civil and mechanical engineering, to name a few [21].

The issues, which were discussed and agreed upon during the meeting in



Snowbird, became the “Agile Manifesto”. The Agile Manifesto was stated four values and twelve principles of Agile [7].

The Agile values are [23], [17]:

1. Individuals and interactions over processes and tools
2. Working software over comprehensive documentation
3. Customer collaboration over contract negotiation
4. Responding to change over following a plan

To further explain these values it was represented by twelve principles according to agile manifesto, which are presented below: [8], [13]

Principles No.1- *Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.* Delivery of the construction project in the form of stages gives the beneficiary and the contractor the opportunity to test the project success and doing the necessary modifications and changes required before the final delivery stage to achieve the satisfaction of the client.

Principles No.2- *Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.* The

presence of flexibility in the design to do the necessary changes required during the execution phase, through developing a pre-agreed plan between the contractor and the client.

Principles No.3- *Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.* Dividing of the work activities of the project into repetitive processes and each process contains specific objectives and time, and all obstacles are discussed at the beginning of each process, will lead to accomplish the work very quickly and take advantage of the errors that occur in each process.

Principles No.4- *Business people and developers must work together daily throughout the project.* The cooperation between the employees and senior management, and give both the employee and the employer a sense of joint responsibility for the completion of the project.

Principles No.5- *Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.* Follow the management policy depends on the motives of individuals and encourage them, and give them confidence and not subject to pressure to complete the



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- work assigned to them on the dates specified.
- Principles No.6- *The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.* Direct communication between the parties of the construction project to communicate the information and discuss the problems.
- Principles No.7- *Working software is the primary measure of progress.* The project work program is divided into parts of the tasks each of which has a clear definition of what is required to work, helps to test and measure the progress of the project.
- Principles No.8- *Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.* Applying the principles of sustainability in the project and creating a sustainable working environment for workers in terms of environmental, social and economic aspects.
- Principles No.9- *Continuous attention to technical excellence and good design enhances agility.* The continued attention to technical excellence and the good design leads to avoid the rework or over-design. (I.e. work at an adequate
- level of completeness and quality to achieve its intended purpose).
- Principles No.10- *Simplicity "the art of maximizing the amount of work not done" is essential.* Starting a construction project is somewhat simplistic (in terms of requirements) and then expanded if necessary, instead of starting a construction project that is too complex (excessive requirements).
- Principles No.11- *The best architectures, requirements, and designs emerge from self-organizing teams.* The presence of a multi-functional team and skills and competencies in the construction project with the authority to work collectively and in a cooperative way.
- Principles No.12- *At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.* Setting time periods in the construction project during each period can conduct a review of project operations and take prompt corrective actions when necessary, and developed training plans to improve the performance of staff working in the construction project, with an integrated risk management plan.
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3. The key causative factors of delay in Iraq construction projects

Causes of delays are factors or events that occur before and during the construction process that will affect the time of completing a project [2]. Many studies have identified the factors causing the delay in the construction projects. Therefore, there are (seventy-eight) causative factors of delay in the construction projects based on the following studies [19], [20], [15], [11], [9]. The researcher used a questionnaire technique with a sample size numbering (forty-one) engineers who work in the

construction industry of Iraq. The questionnaire data analyzed by using the Five-Likert scale (1: very low, 2: low, 3: medium, 4: high, 5: very high) and the Statistical Program for Social Scientists (SPSS) program to calculate the arithmetic mean (M) and standard deviation (S.D). The results of the analysis process are illustrated in **Table 1**. The researcher used Pareto chart to identify the causative factors of delay that occupy 80% of the delay problem in Iraqi construction projects, as shown in **Fig. 1**. Finally, thirteen of key causative factors of delay in construction projects of Iraq was identified based on the Pareto chart, as shown in the **Table 2**.

Table 1. The arithmetic mean (M), and the standard deviation (S.D) for seventy-eight factors causing the delay in the construction projects.

78 Delay Factors	The Engineers' Opinions					M	S.D
	Very High (5)	High (4)	Medium (3)	Low (2)	Very Low (1)		
1- Delay Factors related to Client							
1) Bad choice of location (construction project location is unsuitable).	6	11	18	5	1	3.39	0.972
2) Delay the contractor's payments by the client	21	14	5	1	0	4.34	0.794
3) The delay in the project location delivery to the contractor.	12	15	11	2	1	3.85	0.989
4) Change the designs by the employer during the execution phase.	11	16	14	0	0	3.93	0.787
5) lack in accuracy of topographic surveys for the project site.	8	18	10	4	1	3.68	0.986
6) Delay in approval process of the designs and materials specifications.	11	14	12	4	0	3.78	0.962
7) Stop the work in the project due to causes related to the employer.	17	16	6	2	0	4.17	0.863
8) The employer not have an adequate experience.	17	14	9	1	0	4.15	0.853
9) Choose the design team who does not have efficiency.	20	15	5	1	0	4.32	0.789
10) Inadequate financial allocations	26	14	1	0	0	4.61	0.542



78 Delay Factors	The Engineers' Opinions					M	S.D
	Very High (5)	High (4)	Medium (3)	Low (2)	Very Low (1)		
2- Delay Factors related to Designer							
11) High quality required for the project.	3	14	15	9	0	3.27	0.895
12) Inaccuracy or lack of maps for the networks of service which pass under the project site (such as power lines, water, etc.).	17	15	5	4	0	4.10	0.970
13) Inadequacy of experience of the design team	16	17	5	3	0	4.12	0.900
14) Not to use sophisticated computer programs to prepare designs.	4	14	16	7	0	3.37	0.888
15) There is a difference between the design drawings of all specializations.	18	16	7	0	0	4.27	0.742
16) The complexity of the project designs.	4	12	20	5	0	3.37	0.829
17) Misunderstanding of the employer requirements by the design team	6	7	20	7	1	3.24	0.994
18) Lack of flexibility (hardness) design team with other parties	3	14	13	10	1	3.20	0.980
19) A mismatch between the designs drawings and BOQ	20	12	5	4	0	4.17	0.998
20) The existence of activities cannot be implemented because of the estimated prices in BOQ incorrect	6	13	18	4	0	3.51	0.870
3- Delay Factors related to Contract							
21) The selection is not suitable for the type of construction contracts (turnkey or design, construction only, design, construction, etc).	5	12	17	6	1	3.34	0.965
22) Choose the delivery contract type is not suitable for the assignment of the project (the negotiation, the lowest price, direct invitation etc).	10	16	12	2	1	3.78	0.962
23) The original contract period is too short.	10	19	10	2	0	3.90	0.831
24) Legal disputes between the various parties involved in the project	12	16	12	1	0	3.95	0.835
25) Delay penalties are not calculated properly.	4	9	17	10	1	3.12	0.980
26) The lack of encouraging incentives for the contractor in the event of completion of the project before the deadline in the contract.	3	9	13	15	1	2.95	0.999
27) Contracting with an incompetent contractor.	28	10	2	1	0	4.59	0.706
4- Delay Factors related to Contractor							
28) Lack of financial capacity of the contractor	30	11	0	0	0	4.73	0.449
29) Re-working of some works because of execution errors	9	24	8	0	0	4.02	0.651
30) Poor management and supervision at the site by the contractor	17	19	5	0	0	4.29	0.680
31) Dissatisfaction the contractor for additional periods	2	10	16	10	3	2.95	0.999
32) Poor planning and scheduling of the project by the contractor	16	20	4	1	0	4.24	0.734
33) Use inappropriate the construction methods and not developed	10	21	10	0	0	4.00	0.707
34) Frequent change of the subcontractors because of inefficient their work.	13	21	5	2	0	4.10	0.800

78 Delay Factors	The Engineers' Opinions					M	S.D
	Very High (5)	High (4)	Medium (3)	Low (2)	Very Low (1)		
35) Lack of qualification & training for the contractor team.	9	14	16	2	0	3.73	0.867
36) Frequent disputes between the subcontractors during the project execution.	6	16	11	8	0	3.49	0.978
37) Not develop a plan for risk management in the project.	8	16	16	1	0	3.76	0.799
38) Frequent changes in the project schedule by the contractor.	6	26	8	0	1	3.88	0.748
39) Poor relationship between staff and senior management for the contractor.	7	15	15	4	0	3.61	0.891
40) Failing to secure working environment due to the ignorance of the contractor or not to apply the system of occupational safety in the project	4	12	18	7	0	3.32	0.879
5- Delay Factors related to Materials							
41) Lack of materials at the site or the market.	13	14	13	1	0	3.95	0.865
42) The changes in the types and specifications of the materials during the execution.	8	13	14	6	0	3.56	0.976
43) Damages caused by poor storage of construction materials.	4	17	13	7	0	3.44	0.896
44) Late payment of the amount of suppliers to import materials.	3	16	16	5	1	3.37	0.888
45) Delays in the manufacturing process of special building materials.	5	14	17	5	0	3.46	0.869
46) The large number of paragraphs of import materials.	6	13	13	9	0	3.39	0.997
47) There is no schedule to supply the construction materials.	14	16	10	1	0	4.05	0.835
48) Supplying of construction materials non-conform to the specifications.	13	19	6	2	1	4.00	0.949
49) There is not enough space to store construction materials within the project site.	1	13	20	6	1	3.17	0.803
50) Fluctuations in prices / inflation in prices of materials in the markets.	2	7	22	8	2	2.98	0.880
51) Not develop a plan for the management of construction waste.	2	9	17	12	1	2.98	0.908
52) Not conduct the necessary laboratory tests for construction materials before use.	6	23	10	2	0	3.80	0.749
6- Delay Factors related to Equipment							
53) Obsolescence of equipment life.	6	15	17	3	0	3.59	0.836
54) Use equipment operators with a low level of skill.	3	13	19	6	0	3.32	0.820
55) Non-availability of equipment on the market when it's needed.	5	12	17	6	1	3.34	0.965
56) The wrong choice for the type of Equipment	5	11	15	10	0	3.27	0.975
57) Lack of advanced technology and advanced equipment in the implementation of the paragraphs of the project (specialized equipment).	6	11	19	3	2	3.39	0.997
7- Delay Factors related to Manpower							
58) Non-use of labor in sufficient numbers.	8	22	7	4	0	3.83	0.863

78 Delay Factors	The Engineers' Opinions					M	S.D
	Very High (5)	High (4)	Medium (3)	Low (2)	Very Low (1)		
59) Use labor who are not qualified or unskilled.	10	22	7	2	0	3.98	0.790
60) The difficulty of using skilled labor in some projects because of the poor security conditions.	7	15	17	1	1	3.63	0.888
61) High labor salaries lead to the employment of a small amount of workers.	4	11	19	7	0	3.29	0.873
62) Occurrence of the workers injured as a result of working in hazardous conditions.	3	8	22	8	0	3.15	0.823
63) Not taking social factors into consideration for the workers before hiring them in the project.	3	6	18	12	2	2.90	0.970
64) Lack of moral and financial incentives for workers in the project.	2	8	21	8	2	3.00	0.894
8- Others (External) Delay Factors							
65) High water table during the execution of the project.	4	12	21	3	1	3.37	0.859
66) The impact of bad weather conditions on the operative paragraphs in the project.	4	13	15	9	0	3.29	0.929
67) Delays in approvals related to the official bodies to work on the project.	8	20	8	4	1	3.73	0.975
68) Lack of service facilities on the site (such as water, electricity, telephone, etc).	5	10	15	11	0	3.22	0.988
69) Bad the security situation lead to a closure of roads leading to the project during the execution.	10	12	16	3	0	3.71	0.929
70) The multitude of official holidays and public events.	11	15	12	2	1	3.80	0.980
71) Weak commitment to occupational safety requirements in the workplace.	4	16	12	8	1	3.34	0.990
72) Changes in government regulations and laws during the execution of the project.	1	9	18	10	3	2.88	0.927
73) Civil unrest / general strikes.	1	11	16	10	3	2.93	0.959
74) An occurrence of economic crises in the country during the execution of the project.	16	12	12	1	0	4.05	0.893
75) Delay in issuing the results of the project laboratory tests by the competent authorities.	3	16	17	5	0	3.41	0.805
76) Lack of communication and coordination between the parties involved in the project (the employer, contractors and sub-contractors, designers and consultants, employees and suppliers).	8	16	12	5	0	3.66	0.938
77) The existence of disputes in the land of the project.	11	18	8	3	1	3.85	0.989
78) The inaccuracy of the reports of soil investigations test in terms of the number of test points and the depth of the point.	12	13	14	1	1	3.83	0.972

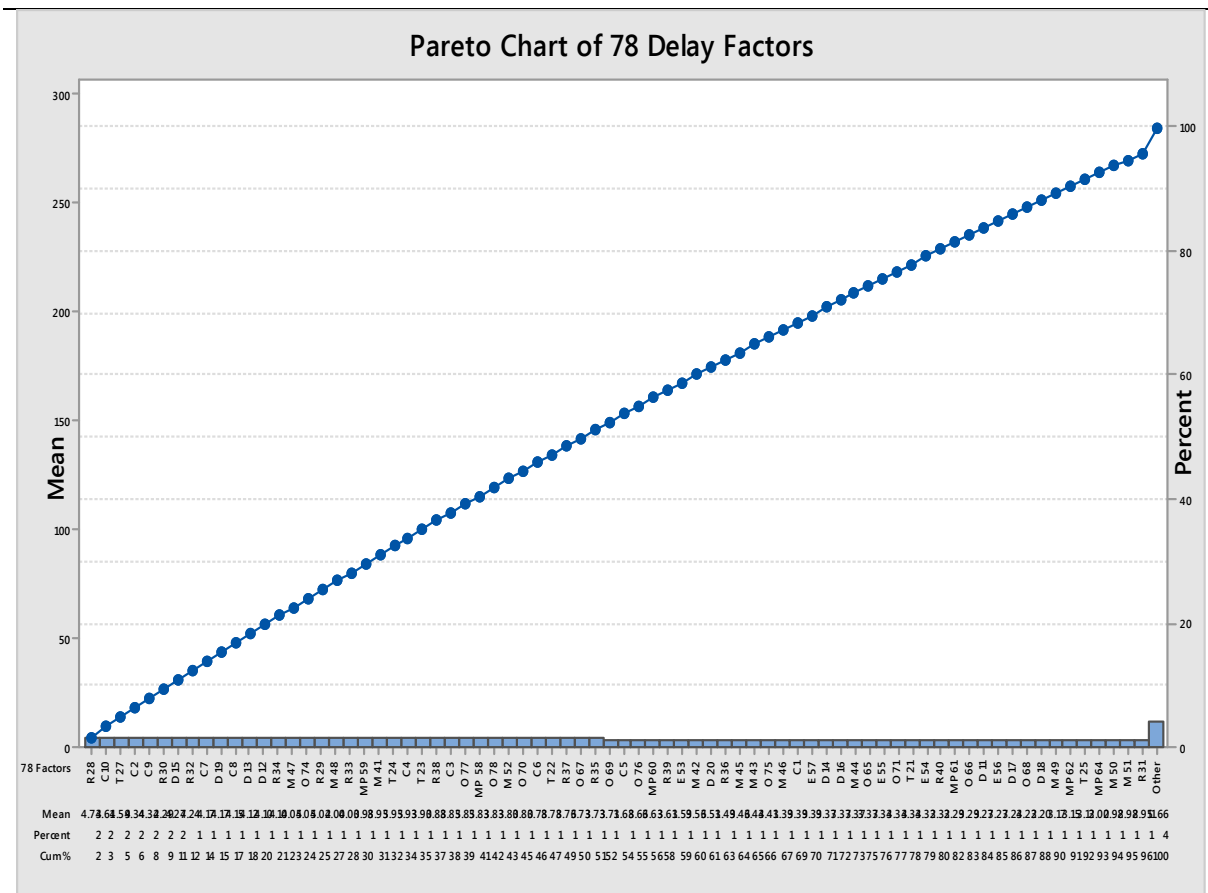


Fig. 1. Pareto chart of the seventy-eight causative factors of delay.

Table 2. The key causative factors of delay in Iraq construction projects

No.	Key Causative Factors of delay	M	Origin
F1-	Lack of financial capacity of the contractor	4.73	Contractor
F2-	Inadequate financial allocations	4.61	Client
F3-	Contracting with an incompetent contractor	4.59	Contract
F4-	Delay the contractor's payments by the client	4.34	Client
F5-	Choose the design team who does not have efficiency.	4.32	Client
F6-	Poor management and supervision at the site	4.29	Contractor
F7-	There is a difference between the design drawings of all specializations.	4.27	Designer
F8-	Poor planning and scheduling of the project by the contractor	4.24	Contractor
F9-	Stop the work in the project due to causes related to the employer.	4.17	Client
F10-	A mismatch between the designs drawings and BOQ	4.17	Designer
F11-	The employer does not have an adequate experience	4.15	Client
F12-	Inadequacy of experience of the design team	4.12	Designer
F13-	Inaccuracy or lack of maps for the networks of service, that passes under the project site (such as power lines, water, etc.)	4.10	Designer

4. Experts' Interviews Technique

For the purpose of identifying the principles of Agile Construction Management (ACM) related to reducing delay and proposing the appropriate procedures to address the delay problem, the researcher used the experts' interview technique for a group of experts, and included the following steps:

- 1- Conducting interviews with experts to identify Agile construction management (ACM) principles related to reducing delay in Iraqi construction projects.
- 2- Conducting interviews with experts for proposed the appropriate procedures to address the delay problem.

4.1. Identify Agile construction management principles related to reducing delay in Iraqi construction projects.

The researcher has created interview form according to the principles of agile construction management, and the thirteen key causative factors of the delay in Iraqi construction projects (identified by Pareto chart as shown in **Table 2**). The researcher interviewed with a group of experts who were selected based on the following:

- 1- Have extensive working experience in the construction industry in Iraq for at least fifteen years.

2- Participate in the management of construction projects in Iraq.

3- The desire to participate in this process.

To choose the suitable sample size in this study, the number of experts' interviews must not less than twelve [14]. [6] State that the enough sample size of experts' interview for master thesis and researches is twenty. While the study [10] found that saturation answers occurred within the first twelve interviews). So, in this study Twenty-five experts were invited to participate in this process. Twenty experts responded and agreed to participate in this study.

The work sector for the participated experts, academic degrees, the field of specialization, and the experience years for experts are given in (**Figs. 2, 3, 4, and 5**) respectively. The interviews with experts have been conducted face to face.

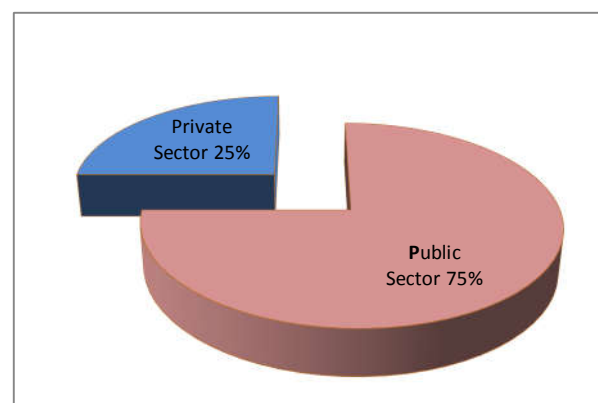


Fig. 2. The work sector of experts

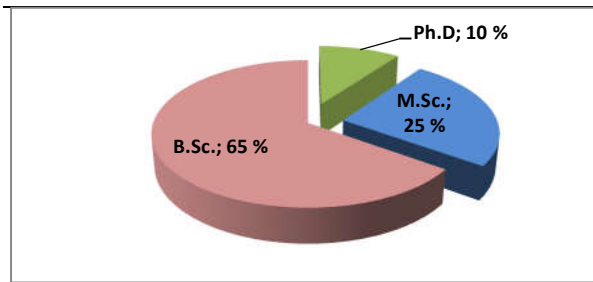


Fig. 3. Academics Degree

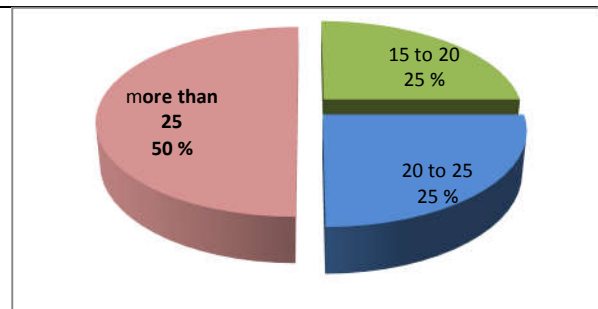


Fig. 5. Experience years

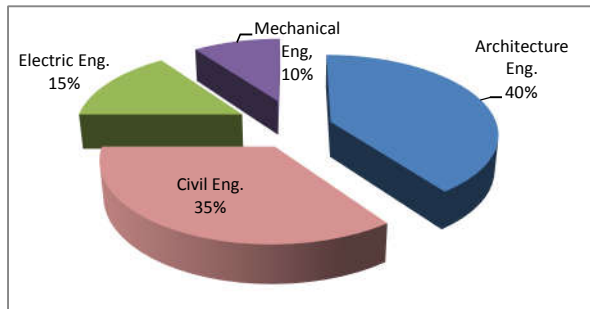


Fig. 4. Field of specialization

The views of experts on the identification of the Agile construction management principles which can be reduced the key causative delays factors in the construction projects of Iraq were carefully analyzed. The results of the analysis were shown in **Table 3**.

Table 3. The experts' answers

ACM Principles	Key causative factors of delay												
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13
Principles No.1	15	14	7	6	3	7	5	6	12	4	4	9	7
Principles No.2	1	5	0	2	12	5	14	5	3	13	7	9	14
Principles No.3	7	5	5	3	7	6	14	6	5	15	4	13	3
Principles No.4	1	3	10	14	5	15	7	3	4	4	15	7	4
Principles No.5	2	0	13	5	5	13	13	0	4	12	15	5	3
Principles No.6	0	2	5	12	5	12	12	13	3	14	7	5	12
Principles No.7	0	6	4	3	2	11	5	14	5	4	5	8	3
ACM Principles	Key causative factors of delay												
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13
Principles No.8	5	13	12	4	7	6	3	4	5	4	12	15	7
Principles No.9	3	5	4	3	16	7	13	8	0	12	5	11	10
Principles No.10	11	10	3	2	9	6	8	6	0	9	7	10	3
Principles No.11	2	6	16	5	7	12	9	14	3	6	12	13	13
Principles No.12	5	5	11	5	13	13	10	16	5	8	14	14	12

The researcher identified the principles that agreed by 60% of the size of participates experts (are located within the range a medium at least [4]) as

principles which can be reduced the delay in Iraqi construction projects, as shown in **Table 4**.



Table 4. ACM principles related to reducing the delay in Iraqi construction projects.

ACM Principles	Key causative factors of delay												
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13
Principle No.1	√	√							√				
Principle No.2					√		√			√			√
Principle No.3							√			√		√	
Principle No.4				√		√					√		
Principle No.5			√			√	√			√	√		
Principle No.6				√		√	√	√		√			√
Principle No.7								√					
Principle No.8		√	√								√	√	
Principle No.9					√		√			√			
Principle No.10													
Principle No.11			√			√		√			√	√	√
Principle No.12					√	√		√			√	√	√

4.2. Propose appropriate procedures to address the delay problem

The researcher interviewed with a group of experts (the same group of experts adopted in Paragraph No. 4.1) for the purpose of distributing the key causative factors of delay over the project phases and proposing the procedures for each phase to address these factors according to ACM principles. This study adopted the following three phases of the construction project: (Planning and Design Phase, Contracting Phase, and Construction Phase). The proposed procedures for each phase will be explained in the next paragraph.

4.2.1. The Proposed Procedures for Planning and Design Phase

The proposed procedures for addressing the delay problem in the planning and design phase according to Agile construction management principles are divided into two groups, as follow:

- 1- Procedures related to Client.
- 2- Procedures related to Design team.

Table 5 shows the proposed procedures to address the delay problem in the Planning and Design phase.

Table 5. The Proposed procedures to address the delay problem in Planning and Design phase

The proposed procedures related to client
1- Preparing the technical and economic feasibility study to ensure the adequacy of the financial allocations for the project
2- Securing fixed sources of project financing such as borrowing from banks, for example.
3- Ensuring that the project designs and specifications are within the specified financial allocations and achieve the principle of sustainability



- 4- Secure the land of the project or purchase it.
- 5- Employing a specialized staff to avoid problems of lack of employer's experience
- 6- Provide the material and moral motivation of employees to cooperate among themselves and encourage them to work collectively.
- 7- Create a database of designers to use it for choosing the designer who has the experience and qualifications to complete the designs within the specifications and specified duration.
- 8- Commitment to do flexible designs (responsive to changes and meet the employer's requirements within the budget and according to specifications) and finishing it within the contracted period and develop a program for work progress.
- 9- Adopting differentiation between design agencies based on experience and technical excellence using the modern software in addition to cost.
- 10- Conduct periodic meetings between the employer and the design team to ensure the efficiency, the seriousness of the designer team, and to overcome any obstacles that may occur in the design of the project.

The proposed procedures related to Design team

- 11- The use of advanced programs and modern methods in the preparation of designs such as the use of engineering programs those operate according to the building information modeling methodology (BIM).
- 12- Preparing the program of progress work to complete the designs according to the specified duration by the client
- 13- The motivation of the material and morale for the staff who work within the designer team to cooperate among themselves and encourage them to work collectively and give them confidence and their status and not subjected them to pressure to complete the designs.
- 14- Hold frequent meetings between the designer's team to discuss and address any obstacles that may occur in the designs.
- 15- Preparation of design drawings and project documents accordance with the client's requirements (previously identified and studied) and reviewing it for more than one time to ensure that all plans and drawings conform to specifications and bills of quantity.
- 16- The accuracy in the calculation of the quantities of construction work and the use of sophisticated programs for this purpose, such as programs, which operates according to the methodology of BIM
- 17- Conduct frequent interviews with the client to understand all project requirements to avoid future changes in design as much as possible.
- 18- Identify the most prominent obstacles and possible problems occurring during implementation by holding periodic meetings to develop alternative and flexible plans.
- 19- Cooperation between the design team and the others concerned parties to achieve the desired objectives of design.
- 20- Take advantage of historical information on previous projects to avoid repeated mistakes in designs.
- 21- Training the design team on the use of software and modern tools to prepare designs
- 22- Adopt the sustainability principle in the project with respect to project resources and designs.
- 23- Estimating the approximate cost and the time required to complete the project for depending upon at the contracting phase.



- 24- Review the maps and drawings for the underground networks (infrastructure) around the project site to ensure that there are no conflicts with the designs of the project by using advanced programs such as ArcGIS and other advanced programs.
- 25- Conducting visits and holding meetings with the concerned offices of services for obtaining accurate information.

4.2.2. The Propose Procedures for Contracting Phase

The proposed procedures for addressing the delay problem in the contracting phase according to Agile construction management principles are divided into two groups, as follow:

1- Procedures related to Client.

2- Procedures related to Contractor.

Table 6 shows the proposed procedures to address the delay problem in the Contracting phase.

Table 6. The Proposed procedures to address the delay problem in contracting phase

The proposed procedures related to Client
1- Put an item in the contract document obliging the employer not to delay the contractor's payments.
2- Determining of interest financial of the contractor as a result of the delay of the employer to pay the contractor's amounts for the period specified in the contract.
3- Compensation of the contractor for lost profits due to the suspension the project by the employer.
4- The employer shall bear the cost of depreciation in the work performed in the project, the materials supplied, the inflation in the price of construction materials, labor and equipment.
5- Designation of specialized and qualified staff to avoid the contractual problems
6- The material and moral motivation of the employer's staff to cooperate with them and give them confidence and their position to choose the good contractor and prepare the contract document accurately.
7- Accuracy in the preparation of contracting documents by taking advantage from the contracting documents of previous projects
8- The accuracy in the preparation of the general and specific conditions of the contract and its formulation clearly for avoiding any disputes between the parties
9- The imposition of significant delay penalties will force the contractor to complete the project within the specified period.
10- Reviewing the previous and current works status of the contractors, to choose the contractor who has the experience and qualifications sufficient to complete the work within the prescribed period
11- Forming a technical committee composed of experienced and efficient people to study and analyze tenders submitted by the contractors.
12- Evaluation of the methodology and work plan prepared by the Contractor for the implementation of the project
13- Adopt the time required for the implementation of the project submitted in contractors' tenders as a basis for the differentiation between the contractors in addition to the cost.



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- 14- Adopt the contracting and referral method which is suitable for the type of project.
 - 15- The contractor shall submit a table with similar previous works showing how to complete these projects within the prescribed period.
 - 16- Requiring the contractor to ensure his staff at a recognized insurance company.
 - 17- Requiring the contractor to use modern construction methods and advanced equipment in the implementation of the project.
 - 18- Requiring the Contractor to develop a system for the treatment and recycling of waste in the project.
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The proposed procedures related to Contractor

- 19- Provide a letter of guarantee and a letter of good execution to ensure that the Contractor is able to complete the work according to the required specifications and not to evade the project.
 - 20- The Contractor shall prepare the project implementation plan and schedule all the materials, equipment and labor accurately and in detail for all work activities.
 - 21- Commitment to the schedule submitted by the contractor, by using the modern programs in preparing, following up and updating it to avoid any deviation in implementation.
 - 22- Put an item in the contract document obliges the contractor to submit a plan for the risk management that is expected to occur in the project.
 - 23- The imposition of items on the contractor to use skilled labor and sufficient to complete the work as soon as possible with the continuation of the training courses to improve and rehabilitate them.
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4.2.3. Propose Procedures for Construction Phase

The proposed procedures for addressing the delay problem in the construction phase according to Agile construction management principles are divided into three groups, as follow:

- 1- Procedures related to Client.
- 2- Procedures related to Design team.
- 3- Procedures related to Contractor.

Table 7 shows the proposed procedures to address the delay problem in the construction phase.

Table 7. Proposed procedures to address the delay problem in Construction Phase

The proposed procedures related to Client

- 1- The possibility of taking advantage of the assets belonging to the employer for providing the required funds or borrowing from banks.
 - 2- The employer's compliance with the laws and instructions related to the construction contracts issued by the Iraqi government.
 - 3- The material and moral motivation of staff of the employer to cooperate among themselves and encourage them to work collectively and give them confidence and their place to carry out the tasks.
 - 4- Follow a logical plan of action complies with the contractor's payment instructions.
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- 5- Designation of a specialized and efficient staff with multi-functional skills and competencies and have the authority to work collectively and in a cooperative manner to approve the contractor's payments and supervise the work.
- 6- Raising the awareness of the employer about the consequences of stopping the project and reminding him of his obligations in the contracting phase.
- 7- Hold frequent meetings with the project's parties to discuss the problems, prevent the suspension of work and take prompt corrective action when necessary.
- 8- Contracting with a consultant to supervise the implementation of work activities and ensure compliance with the required specifications.
- 9- Develop training plans to improve the performance of working staff with the employer.
- 10- The existence of an integrated plan to manage all risks expected to occur in the construction project.

The proposed procedures related to Design team

- 11- Forming a technical committee of qualified engineers to study the design drawings and bills of quantities before implementing the work activities in sufficient time to make the amendments, if any, without affecting the project schedule
- 12- Increasing of work hours in the projects in case of occurring delay due to design errors.
- 13- Continuous coordination with the infrastructure offices to obtain accurate information and the possibility of using it easily when an obstacle has occurred

The proposed procedures related to Contractor

- 14- Entering of a partner to contribute to finance or borrow from banks to cover work expenses in case of lack of financial capacity.
- 15- The possibility of benefiting from the contractor's private assets in obtaining a second funding source for the project
- 16- Delivery of the construction project in the form of stages
- 17- Forming a special technical committee on quality control of the project and supervise the construction process and resources to ensure its quality and committed to the required specifications before using to avoid re-work.
- 18- The use of skilled labor with the number required to carry out the work in the project.
- 19- Develop a waste treatment and recycling system.
- 20- Adopt sustainability principles in the project.
- 21- Continuous training of employees and engineers within the contractor's staff
- 22- The use of modern construction methods and specialized equipment suitable for the work execution of the project
- 23- Commitment to occupational safety requirements at the workplace and provide the fire-fighting tools, etc.
- 24- Evaluate the productivity and skills of the labors with the proper planning of required materials to execute the project.
- 25- Provide financial incentives to encourage labors for carrying out work according to the schedule.
- 26- Supplying of the construction materials in a manner that does not affect the workflow and the possibility of conducting the necessary laboratory tests before use
- 27- Conduct the regular maintenance of equipment to avoid sudden malfunctions.
- 28- Use labors from the nearest area of the project as much as possible.
- 29- Commitment to the work progress program of the project and continuously updating it



5. Conclusion

According to the results above, the researcher concluded that there are eleven principles out of twelve principles of Agile construction management can be reducing delays in construction projects in Iraq. In addition, can be reducing the delay in the planning and design phase of a construction project to a minimum by applying the twenty-five of the proposed procedures related to Client, and Design's Team, and can be reducing the delay in the contracting phase to a minimum by applying the twenty-three of the proposed procedures related to Client and Contractor. Moreover, it can be reducing the delay to a minimum in the construction phase by applying the twenty-nine of the proposed procedures related to Client, Design's Team, and Contractor.

6. Recommendations

Based on the results achieved from this study, the following points were suggested as recommendations to research:

- 1- Training and qualifying of engineering staff to adopt the principles of ACM in Iraqi construction projects, in addition to, hold scientific conferences by the government.
- 2- Government encouragement for the contractors in Iraqi construction industry to complete their construction projects in the specified duration.
- 3- Using the latest information communication technology in the construction projects of Iraq will contribute to the reduction of the chances of getting delayed.
- 4- It is recommended that choosing a project manager, whose qualified enough since the beginning of the construction project life-cycle to the end, will contribute to reducing delay and achieving the project objectives.
- 5- The data gathered from this study can be used as a good base for new construction projects.

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إستخدام مبادئ الادارة الانشائية الرشيقة لتقليل التأخير في الصناعة الانشائية العراقية

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الخلاصة :-

ان عدم التوفيق بين اهداف عملية البناء هي واحدة من المشاكل الرئيسية التي تواجهها المشاريع، حيث يعتبر التأخير في اتمام اي مرحلة من المشروع او في اتمام المشروع ككل من اهم المشاكل. وهذه المشكلة تعاني منها جميع دول العالم، وخاصة العراق، بسبب التأثير السلبي للتأخير على أهداف المشروع الانشائي. تهدف هذه الدراسة الى اقتراح اجراءات مناسبة لمعالجة مشكلة التأخير في المشاريع الانشائية العراقية بالاعتماد على مبادئ ادارة البناء الرشيقة الخاصة بتقليل التأخير. لذلك قام الباحث بمراجعة الادبيات ذات العلاقة لتحديد العوامل الرئيسية المسببة للتأخير. بعدها قام الباحث باجراء تقنية المقابلة مع الخبراء لتحقيق هدف الدراسة. كانت نتائج هذه الدراسة تحديد أحد عشر مبدأ من مبادئ إدارة البناء الرشيقة يمكن عن طريقها الحد من التأخير في المشاريع الانشائية العراقية بالإضافة الى اقتراح خمسة وعشرين إجراء للحد من التأخير في مرحلة التخطيط والتصميم وأهمها "استخدام البرامج المتقدمة والأساليب الحديثة في إعداد التصاميم مثل استخدام البرامج الهندسية التي تعمل وفقاً لمنهجية معلومات بناء المبنى (BIM)", كما تم اقتراح ثلاثة وعشرين إجراء للحد من التأخير في مرحلة التعاقد، وأهمها "وضع بند في وثيقة العقد يلزم صاحب العمل بعدم تأخير مستحقات المقاول". بالإضافة إلى ذلك، تم اقتراح تسعة وعشرين إجراء للحد من التأخير في مرحلة التشييد، وأهمها "دخول شريك للمساهمة في التمويل أو الاقتراض من البنوك لتغطية نفقات العمل في حالة الافتقار إلى القدرة المالية".

الكلمات المفتاحية: المشروع الانشائي، التأخير، المبادئ الرشيقة، الادارة الانشائية الرشيقة.