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Examining the Values and Principles of Agile Construction Management in Iraqi Construction Projects

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ABSTRACT

The avoidance of failure in construction projects is not an easy task, which makes the failure of the construction project to achieve its objectives a major problem experienced by all countries in the world, especially Iraq. Where nearly two-thirds of the construction projects in the world have been suffered by significant problems as an increase in the cost of the project, delay in the specified duration for execution, and stopping the project. Therefore it is required to study and apply new methods for managing the construction project to ensure its success and achieve its objectives. The aim of this study is to study the Agile project management method and its impact on the construction project. In addition, to identify the values and principles of Agile project management, which can be applied in the Iraqi construction industry to be adopted it as a new method to manage the construction projects in Iraq. The researcher reviewed the relevant literature to define the method of Agile project management and its methods and impact on the construction project. Then, the researcher conducted a questionnaire survey of a sample of engineers' experts who work in four main parties in the construction project: (beneficiary, supervising, designer, and contractor). The results of this survey showed that it is possible to apply the four values of Agile project management for managing the Iraqi construction projects, and can apply eleven of the twelve principles of Agile project management for managing the Iraqi construction projects.

Keywords: Agile project management, Agile concept, Agile Values, and Principles.

اختبار قيم ومبادئ إدارة البناء الرشيقة في المشاريع الانشائية العراقية

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الخلاصة

ان تجنب حدوث فشل فى المشاريع الانشائية ليس بمهمة سهلة، مما يجعل فشل المشروع الانشائى فى تحقيق اهدافه مشكلة كبيرة تعانى منها كافة الدول وخصوصاً العراق. حيث ان مايقارب ثلثى المشاريع الانشائية فى العالم خلال الاعوام العشرة الماضية حدثت فيها مشاكل كبيرة كزيادة فى كلفة المشروع، وتجاوز مدة التنفيذ المحددة وتوقف المشروع. لذلك يتطلب دراسة وتطبيق أساليب جديدة لادارة المشروع الانشائي لضمان نجاحه وتحقيق اهدافه. تهدف هذه الدراسة الى دراسة اسلوب ادارة المشاريع الرشيقة وتأثيرها على المشروع لانشائي. بالاضافة الى تحديد قيم ومبادئ ادارة المشاريع الرشيقة التي يمكن تطبيقها في الصناعة الانشائية في العراق ليتم اعتمادها كاسلوب جديد لادارة المشاريع الانشائية العراقية. قام الباحث بمراجعة الادبيات

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ذات العلاقة لتعريف اسلوب ادارة المشاريع الرشيقة والطرق المتبعة فيها وتأثيرها على المشروع الانشائي. بعدها قام الباحث باجراء مسح ميداني لعينة من الخبراء المهندسيين الذين يعملون لدى الاطراف الرئيسية الاربعة في المشروع الانشائي وهم: (جهة مستفيدة، جهة اشراف ومتابعة، جهة مصممة، جهة منفذة). كانت نتائج المسح الميداني انه بالامكان تطبيق القيم الاربعة لادارة المشاريع الرشيقة في ادارة المشاريع الانشائية العراقية، وكذلك يمكن تطبيق احد عشر مبدأ من اصل اثنى عشر مبدأ من مبادئ ادارة المشاريع الرشيقة في ادارة المشاريع الانشائية العراقية.
الكلمات الرئيسية: ادارة المشاريع الرشيقة، مفهوم الرشيق، قيم ومبادئ الرشاقة.

1. INTRUCTION

The measure of the success of any construction project is the integration of its three objectives (time, cost, quality), but the difficulty of reconciling them is one of the major problems faced by the projects. Avoiding project failure is not an easy task and not being able to determine if a project fails or not, makes it even harder, **PMI, 2010**.

In most construction projects, best possible performance is unachievable with poor productivity resulting in time overrun and consequently cost escalation of the projects, because the construction is a risky industry with uncertainties due to many external and internal factors that influence the construction process, **Salunkhe, and Patil, 2014**.

According to the Chaos Report, Chaos results provide a global view of projects statistics in the United State, European countries, and others. These results at 2012 showed that 39% of all projects were successful by delivering on time and within budget estimate, with required features and functions; 43% were challenged by being late, over budget, or with less than the required features and functions; and 18% were considered failures due to cancelations prior to completion or delivered and never used. In addition, project cost overruns were at 59% in 2012, whereas time overruns were at 74%, **Standish Group, 2013**.

Agile has been increasingly adopted and used in projects characterized by uncertainty and unpredictability**, Alleman, 2005 and Cicmil, et al., 2006.** According to**, Mah, 2008,** more than 80% of global firms and large public-sector projects apply APM. In addition, according to a study conducted by**, Rico, et al., 2009,** Agile projects were 20 times more productive compared with traditional projects. **Thomas, 2011,** reported, that 60% of Agile projects are successful, 28% are challenges, and 12% are failures. While 47% of traditional projects are successful, 36% are challenges, and 17% are failures**, Thomas, 2011.**

2. AGILE PROJECT MANAGEMENT

The Agile methods are a reaction to the processes that look good in theory but that do not hold up in practice. The Agile methods are therefore described as empirical – they are based entirely on practical experiences and work methods that are proven to work**, Johansson, 2012.** Agile project management has its roots in the system development industry and has developed and grown through empirical progress. This, however, does not mean that this methodology's uses are limited to that industry. The Agile methodology is a set of values, attitudes, and principles, which can be embraced in other industries as well. Furthermore, the methodology includes different methods and tools to use when conducting a project, which will aid in the mission to follow its values and principles. Two main concepts of the Agile methodology are an adaption to change and collaboration between people**, Agile Sweden, 2012.**

Figs. 1, 2 and 3 shows APM Triangle, APM process, changing process from traditional project management to APM, respectively.

2.1 Agile Concept

According to the dictionary of foreign words, the word "Agile" means vivid or active. The basic condition of agility in the context of the development of the project is the ability to change an

entry in project development. The client then has the option to modify requirements during the executing project, without a massive re-engineering of work already carried out, and the unnecessary waste of time and resources for all involved. Agile methodology arose in the mid-1990 years of the last century as a response to difficult traditional methodology, which has been criticized for bureaucracy, rigidity, and inability to respond flexibly to changes. Series of publications dealing with the Agile approaches stem from the different theoretical foundations, such as the Lean manufacturing, the theory of constraints, Cooperative Game theory, Six Sigma and Chaos Theory**, Antlova, 2014. Cobb, 2011,** state that Rico & David defined a more general connotation of the word "agility" as follows:

- The ability to create and respond to change in order to profit in a turbulent global business environment.
- The ability to quickly reprioritize use of resources when requirements, technology, and knowledge shift.
- A very fast response to sudden market changes and emerging threats, by intensive client interaction.
- Use of evolutionary, incremental, and iterative delivery to converge on an optimal client solution.
- Maximizing the business value with right-sized, just enough, and just-in-time processes and documentation.

2.2 The Agile Manifesto

Agile project management is characterized by working in short iterative cycles with the delivery of some part of the project result at the end of every cycle. Before February 2001 there was no name under which all these new flexible and adapting methods (Agile methods) could be gathered, they had up until then been called lightweight. However, in the small ski resort Snowbird in Utah, USA, Seventeen method developers who represented different Agile methods gathered because they felt they needed a common name and common values for all their methods. Different names were discussed and one of them was "Adaptable" but since this, more or less means that actions are taken retroactively the name was rejected. The name "Agile" was considered a more accurate description of these methods and was hence chosen. The common issues, which were discussed and agreed upon during the meeting in Snowbird became the "Agile Manifesto". The Agile Manifesto was stated that four values and twelve principles, these results would be explained in following paragraphs**, Beck, et al., 2001.**

2.2.1 Agile Values

The Agile Manifesto states the four main values that Agile methods are built upon. To avoid misunderstandings about these Agile values, many proponents of Agile methods are clarifying that they put value in the statements to the right but that they valued the items to the left even more**, Beck, et al., 2001, Thomas, 2011, Juricek, 2014, Cobb, 2015 and Gustavsson, 2016,** are explained values of Agile project management. Each value of the Agile Manifesto is shortly described according to**, Gustavsson, 2011,** and as presented below:

1. *Individuals and interactions over processes and tools:* The first statement of the Agile manifesto means that the project team and its members are responsible to apply the best working processes and methods for the specific project.
2. *Working software over comprehensive documentation:* The second statement in the Agile manifesto is mainly considering software development projects. To make it more adapted to

other kinds of projects, it could be changed into "Useful project outcome *over* comprehensive documentation".

3. *Customer collaboration over contract negotiation:* At the end of each cycle of an Agile project, the client is involved to bring forward opinions and thoughts about the project. This means that the client collaboration is core to bring the project towards success. The customer gets involved throughout the completely Agile project process by reviewing, discussing and deciding at the end of each cycle.
4. *Responding to change over following a plan*: The Agile Manifesto states that changes are welcomed in agile projects. The reason for this is that Agile projects do not believe in "predicting the future" by planning for every detail in advance. The plans should instead be dynamic and Agile teams should realize that projects are prone to change.

2.2.2 Agile Principles

To further explain; the values of the Manifesto, it was also accompanied by twelve principles, which are presented below:

1. *Our highest priority is to satisfy the customer through the early and continuous delivery of valuable software***, Beck, et al., 2001, Thomas, 2011 and Gustavsson, 2016.** The first principle emphasizes "early and continuous delivery of valuable software." In many traditional plan-driven projects prior to Agile, the end-user customer doesn't see anything until the final user acceptance test phase of the project, and by that time it is very difficult and expensive to make any changes that might be needed**, Cobb, 2015.**
2. *Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive* advantage**, Beck, et al., 2001, Thomas, 2011 and Gustavsson, 2016.** This principle emphasizes creating an environment where change is expected and welcomed rather than rigidly controlled and limited; but, of course, that doesn't mean that the project is totally uncontrolled. There are lots of ways to manage change effectively and collaboratively based on a partnership with the customer. The important thing is that the project team and the customer should have a mutual understanding upfront of how the change will be managed**, Cobb, 2015.**
3. *Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale***, Beck, et al., 2001, Thomas, 2011 and Gustavsson, 2016.** This principle emphasizes using an iterative approach to break up a project into very small increments called *sprints* or *iterations,* which are typically in the range of two to four weeks. There are a couple of reasons why this makes a lot of sense**, Cobb, 2015,** as follow:
    I. All Agile development processes such as Scrum are based on continuous improvement. Instead of having a rigidly defined process that never changes, the team is expected to take an empirical approach to learn what works and what doesn't work as the project progresses, and make adjustments as necessary.
    II. People work more productively given short time-boxes to get things done.
4. *Business people and developers must work together daily throughout the project***, Beck, et al., 2001, Thomas, 2011 and Gustavsson, 2016.** This principle emphasizes a partnership approach between the project team and the business sponsors. This is very consistent with the Agile Manifesto value of "collaboration over contracts." To implement this principle, both the business sponsors and the project team need to feel joint responsibility for the successful completion of the project**, Cobb, 2015.**
5. *Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done***, Beck, et al., 2001, Thomas, 2011 and Gustavsson, 2016.** This principle emphasizes the importance of properly motivated individuals on a

project. Too often in the past, some project managers have used high-pressure, command-and-control tactics to pressure project teams into delivering results faster. Many of us have been involved in "death march" projects in our careers where people are given an absolute deadline for getting something done and have to work nights and weekends if necessary to get it done**, Cobb, 2015.**

6. *The most efficient and effective method of conveying information to and within a development team is a face-to-face conversation***, Beck, et al., 2001, Thomas, 2011 and Gustavsson, 2016.** This principle emphasizes face-to-face conversation. This is another statement that you have to not take as an absolute but think of it as relative. It is not always possible with distributed teams to have face-to-face communications, but it is certainly desirable if it is possible. This statement also does not mean that the only form of communication is direct, face-to-face communications**, Cobb, 2015.**
7. *Working software is the primary measure of progress***, Beck, et al., 2001, Thomas, 2011 and Gustavsson, 2016.** Measuring progress on a software development project can be difficult and problematic. The traditional method is to break a project into tasks and track percent completion of those tasks as a way to measure progress; however, that can be very misleading, because often the list of tasks is incomplete and the level of completion often requires some subjective judgment, which is difficult to make and often inaccurate**, Cobb, 2015.**
8. *Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely***, Beck, et al., 2001, Thomas, 2011 and Gustavsson, 2016.** Many of the underpinnings of Agile come from lean manufacturing and total quality management (TQM). In a manufacturing environment, companies learned many years ago that running a manufacturing plant like a sweatshop and forcing workers to work an excessive number of hours under poor conditions do not often result in high-quality products. A similar thing is especially true in an Agile environment because the success of the effort is so critically dependent on the creativity and motivation of the team. In that kind of situation, it is even more important to create an environment where work is sustainable over a long period of time**, Cobb, 2015.**
9. *Continuous attention to technical excellence and good design enhances agility***, Beck, et al., 2001, Thomas, 2011 and Gustavsson, 2016.** This statement is an interesting one. Agile recognizes the need for doing things the right way to avoid unnecessary rework later. However, an Agile approach should not result in overdesigning a product. A comment that is heard often in an Agile environment is the concept of "just barely good enough." In other words, the work should be done to a sufficient level of completeness and quality to fulfill the purpose it was intended to fill, and nothing more. Going beyond that level of "just barely good enough" is considered waste**, Cobb, 2015.**
10. *Simplicity "the art of maximizing the amount of work not done" is essential*, **Beck, et al., 2001, Thomas, 2011 and Gustavsson, 2016.** This statement emphasizes simplicity. How many times have the projects go out of control because the requirements become much too complex and very difficult to implement and the requirements become overdesigned to try to satisfy every possible need you can imagine? This is also related to the concept of "just barely good enough" don't overdesign something; keep it as simple as possible. It is generally much more effective to take an incremental approach to start with something simple and then expand it as necessary, rather than starting with something overly complex that may be overkill for the requirement**, Cobb, 2015.**
11. *The best architectures, requirements, and designs emerge from self-organizing teams*, **Beck, et al., 2001, Thomas, 2011 and Gustavsson, 2016.** Agile is heavily based on the idea of

self-organizing teams but that needs some interpretation. Sometimes, developers have used the idea of "self-organizing" as an excuse for anarchy, but that is not what was intended. The intent is that if you have the right people on a cross-functional team and the team is empowered to collectively use all the skills on the team in a collaborative manner, it will generally deliver a better result than a single individual could deliver acting alone**.**

12. *At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly*, **Beck, et al., 2001, Thomas, 2011 and Gustavsson, 2016.** In Scrum, this is called a retrospective, and it happens at the end of each sprint. The team is expected to continuously improve and adapt the Agile process as needed as the project progresses**, Cobb, 2015.**

3. CLOSE QUESTIONNAIRE TECHNIQUE

Depending on the theoretical study of the agile project management, the researcher examines the applicability of the agile project management values and principles in the construction projects in Iraq. For this purpose, the researcher used the closed questionnaire technique for a group of engineers including the following steps:

1- Designing, distributing and gathering the questionnaire form.
2- Analysis the data of the questionnaire form

3.1 Designing, Distributing and Gathering the Questionnaire Form

The researcher designed the questionnaire form by following a simple method with clear administrative expressions, which enables all respondents to answer the questions easily. The questions of the questionnaire were derived from the values and principles of the Agile project management identified in the theoretical study. Then, the researcher sent the questionnaire to a group of arbitrators for evaluating the questions of the questionnaire, the personal information of the arbitrators had shown in **Table 1**. The researcher made all the amendments and proposals which submitted by the arbitrators. The final form of the questionnaire including the following parts:

- Part One: General information about sample size.
- Part Two: Applying of Agile projects management values in Iraqi construction projects.
- Part Three: Applying of Agile projects management principles in Iraqi construction projects.

The study sample in this survey includes engineers who have at least fifteen years of experience in working with the main parties involved in the construction project: (beneficiary, designer, resident engineer, and contractor) to take all views into the consideration. The questionnaire form was sent to fifty-six of the engineers' participants (ten engineers from each of the above-mentioned parties has been answered all questions of the questionnaire correctly, so that the final sample size is 40 engineers) for examining the values and principles of Agile project management that can be applied in construction projects in Iraq.

3.2 Analysis the Data of the Questionnaire Form

To quantify data analysis and calculate the arithmetic mean it is required to identify a hypothetical weight value (WV), for each answer the five-scale Likert adopted in this questionnaire, and are illustrated in **Table 2**.
The analysis process has been divided into three parts, as follow:

- Part One: General information about sample size.
- Part Two: Applying of Agile projects management values in Iraqi construction projects.
- Part Three: Applying of Agile projects management principles in Iraqi construction projects.

3.2.1 Part One: General information about sample study.
The researcher analyzed the data of the general information of the study sample. **Table 3** shows the general information of the engineers' participants according to the parties that approved in this study.

3.2.2 Part Two: Applying of Agile projects management values in Iraqi construction projects.
The objective of this section is to check the possibility of implementing the Agile project management values in the construction projects of Iraq, by a set of questions related to each value. The researcher used Statistical Package for Social Sciences (SPSS) program for the statistical analysis of data to calculate the arithmetic mean (M) and the standard deviation (S.D) and Cronbach alpha coefficient (α) of the sample responses according to Eq. (1), Eq. (2), and Eq. (3) respectively. **Table 4** shows the answers of the engineers' participants on the questionnaire questions.
Table 5 and **Fig. 4** show the final summary of the possibility of applying Agile project management values in the construction projects in Iraq.

$$M = \frac{\sum_{i=1}^{k}(f_i \times x_i)}{\sum_{i=1}^{k} f_i}$$ **, Ryan, 2007** (1)

$$S.D = \sqrt[2]{\frac{\sum_{i=1}^{k} f_i \times (x_i - M)^2}{\sum_{i=1}^{k} f_i}}$$ **, Ryan, 2007** (2)

$$\alpha = \left[\frac{k}{(k-1)}\right] \times \left[1 - \frac{\left(\sum {S_i}^2\right)}{\left(S_{sum}\right)^2}\right]$$ **, Wong, and Vimonsatit, 2012 and A1, 2009** (3)

Where:

M: The arithmetic mean
S.D: Standard Deviation
α: Cronbach alpha coefficient
x_i: Weight Value for particular.
f_i: Number of frequencies.
S_i: The variance for the current sample of respondents.
k: The total number of class interval = 5.
S_{sum} : The variance of the sum of all respondents.

3.2.3 Part Three: Applying of Agile projects management principles in Iraqi construction projects.
The objective of this section is to check the possibility of implementing the Agile project management principles in the construction projects of Iraq, by a set of questions related to each principle. The researcher used the statistical program (SPSS) for the statistical analysis of data to calculate the arithmetic mean (M) and the standard deviation (S.D) and alpha coefficient (α) of

the sample responses according to Eq. (1), Eq. (2), and Eq. (3) respectively. **Table 6** shows the answers of the engineers' participants on the questionnaire questions.
Table 7 and **Fig. 5** show the final conclusion of the possibility of applying the principles of Agile project management in the construction projects of Iraq depended on the views of the engineers participating in this study.

4. DISCUSSION OF THE QUESTIONNAIRE RESULTS

1- In accordance with the results shown in **Table 4**, the researcher concluded the following:
   a) The first value of Agile project management values can be applied in the construction projects in Iraq at a high level by the following parties (the beneficiary, the designer, the contractor), and at a very high level by the resident engineer. Emphasizing that the processes and tools have been developed to increase and facilitate the interaction between the employees of the project, to accomplish their work and not to replace them.
   b) The second value of Agile project management values can be applied in the construction projects of Iraq at a very high level by all major parties.
   c) The third value of Agile project management values can be applied in the construction projects in Iraq at a high level by the following parties (the beneficiary, the designer, the contractor), and at a very high level by the resident engineer. Indicating that the beneficiary has agreed to a very high level with the approach is based on the completion of basic requirements only in the contracting phase and the details are worked out as the project progresses, while the following three parties (the resident engineer, the designer, the contractor) are committed to the traditional approach.
   d) The fourth value of Agile project management values can be applied in the construction projects in Iraq at a very high level by the designer and the contractor and at a high level by the beneficiary and the resident engineer.

2- According to the results indicated in **Table 6**, the value of Cronbach alpha (α) of the sample size equal (0.849), this means that the reliability of the questionnaire results, where the value of Cronbach Alpha is supposed not less 0.7, **Varghese, and Varghese, 2015.** Then the researcher concluded the following:
   a) The first principle of Agile project management principles: can be applied in construction projects of Iraq at a high level by all the following main parties (beneficiary, resident engineer, designer, and contractor).
   b) The second principle of Agile project management principles: can be applied in the construction projects of Iraq at a high level by the beneficiary and the resident engineer, but at a very high level by the designer and the contractor.
   c) The third principle: can be applied in the construction projects in Iraq at a high degree by the beneficiary, the resident engineer, and the designer, but at a very high degree by the contractor.
   d) The fourth principle: can be applied in the construction projects in Iraq at a high degree by the beneficiary and the designer, but at a very high degree by the resident engineer and the contractor.
   e) The fifth principle: can be applied in the construction projects in Iraq at a high degree by all the main parties involved in the project.
   f) The sixth principle: can be applied in the construction projects in Iraq at a high degree by the beneficiary, the resident engineer, and the designer, but at a very high degree by the contractor.

g) The seventh principle: can be applied in the construction projects in Iraq at a high degree by the beneficiary, the resident engineer, and the designer, but at a very high degree by the contractor.
h) The eighth principle: can be applied in the construction projects in Iraq at a high degree by all the main parties involved in the project.
i) The ninth principle: can be applied in the construction projects in Iraq at a high degree by all the main parties involved in the project.
j) The tenth principle: can be applied in the construction projects in Iraq at a high degree by the beneficiary only, while it can be applied at a medium degree by the resident engineer, the designer, and the contractor.
k) The eleventh principle: can be applied in construction projects in Iraq at a high degree by both the resident engineer and the designer, but at a very high degree by the beneficiary and the contractor.
l) The twelfth principle: can be applied in the construction projects in Iraq at a high degree by both the beneficiary and the resident engineer, but at a very high degree by both the designer and the contractor.

5. CONCLUSIONS

According to the results that are mentioned in **Tables 5** and **Table 7**, it is possible to apply the four values of Agile project management for managing the Iraqi construction projects by all parties, because all values have a high level of application in the Iraqi construction projects at least. While the eleven of the twelve principles of Agile project management can be applied for managing the Iraqi construction projects by the main parties because the tenth principle has a medium level of application in the Iraqi construction projects. Finally, Agile project management term became Agile construction management (ACM) because of its possibility of application in the construction projects in Iraq.

6. RECOMMENDATIONS

This study recommends the adoption of the values and principles of Agile construction management in the Iraqi construction industry by providing the necessary governmental support for the enactment of relevant laws and regulations. In addition, holding the seminars and training courses to raise awareness among the decision-makers and the engineers in Iraq to adopt these values and principles in the construction projects.

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NOMENCLATURE

ACM= Agile construction management
APM= Agile project management
f_i = number of frequencies.
K= the total number of class interval.
M= the arithmetic mean
S.D= standard deviation
S_i = the variance for the current sample of respondents.
SPSS= statistical package for social sciences program
S_{sum} = the variance of the sum of all respondents.
TQM= total quality management
WV= weight value
x_i= weight value for particular.
α = Cronbach alpha coefficient

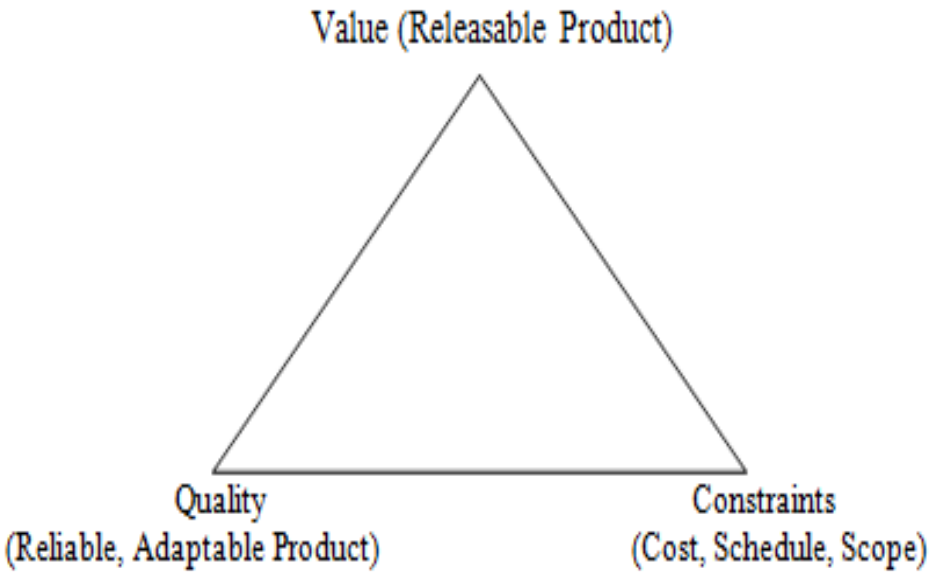

Figure 1. Agile Project Management Triangle, **Cobb, 2011.**

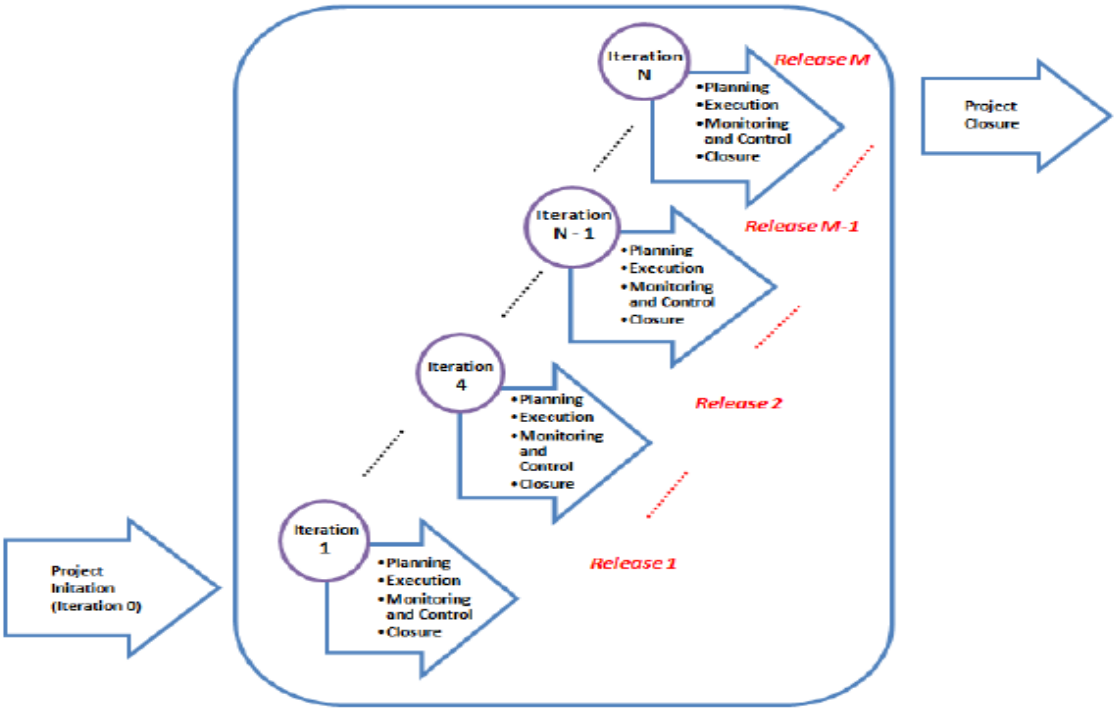

Figure 2. Agile Project Management Method (APM) Process**, Salameh, 2014.**

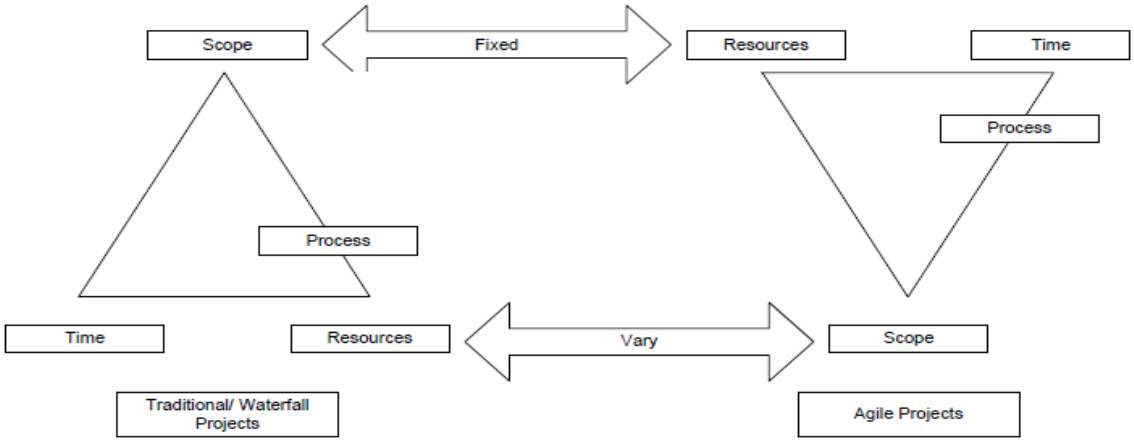

Figure 3. Changing from Traditional to Agile Project Management**, Owen, and Koskela, 2006.**

Table 1. Arbitrators' personal information **(Researcher)**

Arbitrators	Experience (Years)	Work Sector	Scientific degree	Engineering Specialization
1) I. A.	25	Public	Ph.D	Civil
2) A. M.	36	Private	M.Sc	Civil
3) H. K	22	Public	Ph.D	Civil
4) D. A.	26	Public	Ph.D	Architectural
5) A. A.	20	Public	B.Sc	Architectural

Table 2. The weight value of descriptive frequencies, **Abdulridha, and Mohammed, 2016; Al Hammadi, and Nawab, 2016; Rao, and Culas, 2014; Kazaz, et al., 2012**.

Descriptive Frequency	Class Interval	Weight Value (WV)
Strongly Disagree	1 – 1.8	1
Disagree	1.81 – 2.6	2
Neutral	2.61 – 3.4	3
Agree	3.41 – 4.2	4
Strongly Agree	4.21 – 5	5

Table 3. General information of the study sample **(Researcher)**

General Information		Beneficiary	Resident Engineer	Designer	Contractor
Number of Experts		10	10	10	10
Work sector	Public %	100	100	80	50
	Private %	0	0	20	50
Scientific Degree	B.Sc %	70	80	70	60
	M.Sc %	20	20	20	30
	Ph.D %	10	0	10	10
Specialty	Architectural %	20	10	80	30
	Civil %	50	50	10	40
	Mechanical %	30	10	10	10
	Electricity %	0	30	0	20
Experience Years	15 – 20 (%)	40	30	30	50
	20 – 25 (%)	30	40	30	30
	More than 25 (%)	30	30	40	20

Table 4. The Engineers' answers to the questions related to Agile project management values. **(Researcher)**

The questions related to APM values	Beneficiary		Resident Engineer		Designer		Contractor	
	M	S.D	M	S.D	M	S.D	M	S.D
Value No.1: Individuals and interactions over processes and tools								
Q.1-Do you agree with that focusing on the importance of the engineering staff and staff working on the construction project and their interactions and enable them to perform their work and encourage them to work collectively, will lead to help to succeed the tasks of project management and reduce delay more than focusing on items of work and tools only?	4	0.943	4.3	0.483	4	0.943	4.1	0.738
Q.1-1 Do you agree that processes and tools are developed to increase and facilitate interaction between project workers to accomplish their work, not to replace them?	4.3	0.483	4.1	0.316	3.9	0.568	4	0.816
Value No.2: Working Software over Comprehensive Documentation								

The questions related to APM values	Beneficiary		Resident Engineer		Designer		Contractor	
	M	S.D	M	S.D	M	S.D	M	S.D
Q.2-Do you agree that the use of modern software in project management, electronic documentation, build a database, etc. will lead to help for making the smart and correct decisions at fast by the construction project manager?	4.3	0.483	4.5	0.707	4.7	0.483	4.4	0.516
Q.2-1 Do you agree that electronic documentation of the data of construction project is better than the manual documentation (traditional)?	4	0.471	4.7	0.483	4.2	0.632	4.6	0.516
Value No.3: Customer Collaboration over Contract Negotiation								
Q.3-Do you agree that follow an administrative approach depends on the completion of the basic requirements only in the contracting stage and developing the required details with the project progress, will lead to help for completing the project within specified time and cost when compared with the traditional approach.	3.8	0.919	3.4	0.843	2.6	0.699	3.1	0.738
Q.3-1 Do you agree that the use of an administrative approach based on the spirit of trust and partnership between the project team and its beneficiaries, will lead to ensuring the success of the construction project?	4	0.667	4.3	0.675	3.9	0.994	4.2	0.422
Value No.4: Responding to Change over Following a Plan								
Q.4-Do you agree that follow an approach responds to changes during the construction project execution by making flexible alternative plans, which are pre-agreed to deal with these changes, for ensuring the project's success?	4.2	0.789	3.9	0.876	4.4	0.516	4.3	0.675

Table 5. The final summary of the possibility of applying the values of Agile project management in the construction projects of Iraq**. (Researcher)**

APM values	Beneficiary	Resident Engineer	Designer	Contractor	Total
	M	M	M	M	
Value No.1: Individuals and interactions over processes and tools					
Mean according to Q.1	4	4.3	4	4.1	4.1
Effect Level	High	Very High	High	High	High
Value No.2: Working Software over Comprehensive Documentation					

APM values	Beneficiary	Resident Engineer	Designer	Contractor	Total
	M	M	M	M	
Mean according to Q.2	4.3	4.5	4.7	4.4	4.475
Effect Level	Very High	Very High	Very High	Very High	Very High
Value No.3: Customer Collaboration over Contract Negotiation					
Mean according to Q.3	4	4.3	3.9	4.2	4.1
Effect Level	High	Very High	High	High	High
Value No.4: Responding to Change over Following a Plan					
Mean according to Q.4	4.2	3.9	4.4	4.3	4.2
Effect Level	High	High	Very High	Very High	High

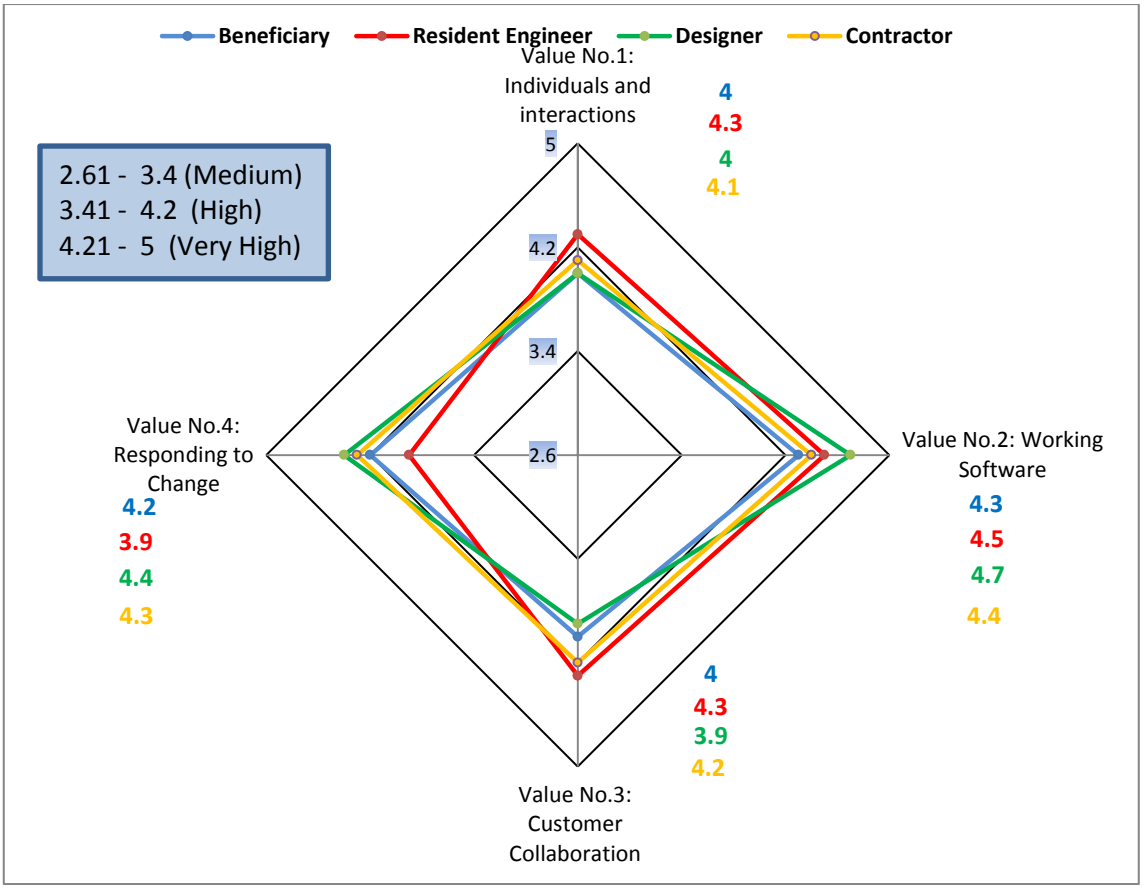

Figure 4. The final summary of the possibility of applying the values of Agile project management in the construction projects of Iraq. **(Researcher)**

Table 6. The engineers' answers to the questions related to Agile project management principles**. (Researcher)**

The questions related to APM principles	Beneficiary		Resident Engineer		Designer		Contractor	
	M	S.D	M	S.D	M	S.D	M	S.D
Principle No.1: Our highest priority is to satisfy the customer through the early and continuous delivery of valuable software.								
Q.1- Is the conducting the necessary modifications and changes required, by the contractor prior to the delivery phase are possible and less damage than doing it after the delivery stage?	4.3	0.483	3.6	0.966	4.2	0.632	4.1	0.876
Q.1-1 Is the employer's satisfaction has the priority at the main parties of the construction project and impact on the success of the construction project?	3.7	0.675	3.8	0.632	3.7	0.823	3.9	0.738
Q.1-2 Is the delivery of the construction project in the form of stages, gives the beneficiary and the contractor the opportunity to test the success of the project before the final delivery stage?	3.8	0.919	3.5	0.972	3.3	0.949	4.3	0.675
Principle No.2: Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.								
Q.2- Is the existence of a flexible design so that changes can be made during the execution phase of the construction projects, affects the success of the construction project?	3.1	0.994	3.7	0.823	4.3	0.675	4.3	0.675
Q.2-1 Is develop a pre-agreed plan (between the contractor and the employer) on how to make the necessary changes required during the execution phase, affects the success of the construction project?	4.1	0.994	4.1	0.568	4.3	0.483	4.5	0.527
Principle No.3: Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.								
Q.3- Do you agree that 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?	4.2	0.632	3.9	0.876	3.8	0.422	4.3	0.823
Principle No.4: Business people and developers must work together daily throughout the project								
Q.4- Do you agree that the cooperation between the employees and senior management, affects the success of the project management tasks in the	4.3	0.675	4.3	0.675	4.2	0.789	4.6	0.516

The questions related to APM principles	Beneficiary		Resident Engineer		Designer		Contractor	
	M	S.D	M	S.D	M	S.D	M	S.D
construction project?								
Q.4-1 Do you agree that to give both the employee and the employer a sense of joint responsibility for the completion of the project affect the success of the construction project?	3.9	0.568	4.3	0.483	3.8	0.632	4.7	0.483
Principle No.5: Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.								
Q.5- Do you agree that the approval of the project manager on the management policy depends on the motives of individuals and encourage them and give them confidence and not subject to pressure to complete the work assigned to them on the dates specified, leads to accomplishing these works quickly and without delay?	4	0.816	4.2	0.632	3.7	0.823	4	0.943
Principle No.6: The most efficient and effective method of conveying information to and within a project team is a face-to-face conversation.								
Q.6- Do you agree that the direct communication between the parties of the construction project to communicate the information and discuss the problems, affect the success of the construction project?	4.2	0.422	4	0.471	4.1	0.568	4.6	0.516
Principle No.7: Working software is the primary measure of progress.								
Q.7- Do you agree that 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 and thus lead to the success of the construction project?	3.7	0.823	4	0.471	3.6	0.699	4.3	0.675
Principle No.8: Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.								
Q.8- Do you agree that applying the principles of sustainability in the project and creating a sustainable working environment for workers in terms of environmental, social and economic aspects helps reduce the changes and accidents in the project and thus lead to the success of the construction project?	3.9	0.316	4	0.667	4.2	0.789	3.9	0.876
Principle No.9: Continuous attention to technical excellence and good design enhances agility.								
Q.9- Do you agree that the continued attention to technical excellence and the good design, leads to avoid the rework	4.4	0.516	4.4	0.516	4.3	0.483	4.5	0.527

The questions related to APM principles	Beneficiary		Resident Engineer		Designer		Contractor	
	M	S.D	M	S.D	M	S.D	M	S.D
or over-design? (I.e. work at an adequate level of completeness and quality to achieve its intended purpose)?								
Principle No.10: Simplicity—the art of maximizing the amount of work not done—is essential.								
Q.10- Do you agree that starting a construction project is somewhat simplistic (in terms of requirements) and then expanded if necessary, achieves the success of the project within the specified period instead of starting a construction project that is too complex (excessive requirements)?	3.5	0.850	3.1	0.876	3.1	0.738	3	0.943
Principle No.11: The best architectures, requirements, and designs emerge from self-organizing teams.								
Q.11- Do you agree that 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, helps to complete the construction project within the specified period and prevents the delay when compared to work individually?	4.5	0.527	4.2	0.422	4.2	0.789	4.6	0.516
Principle No.12: At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.								
Q.12- Do you agree that the development of training plans to improve the performance of staff working in the construction project, helps to succeed the construction project?	4.1	0.316	4.1	0.876	4.5	0.527	4.6	0.516
Q.12-1 Do you agree that having an integrated risk management plan that is expected to occur in the construction project will help to success the construction project?	4.1	0.568	4.2	0.422	4.4	0.699	4.5	0.527
Q.12-2 Do you agree that setting time periods in the construction project during each period can conduct a review of project operations and take prompt corrective actions when necessary, helps the success of the construction project within the required time, cost and quality?	4.2	0.632	4.2	0.632	4.6	0.516	4.7	0.483

Table 7. The final summary of the possibility of applying the principles of Agile project management in the construction projects of Iraq. **(Researcher)**

APM principles	Beneficiary	Resident Engineer	Designer	Contractor	Total
	M	M	M	M	
Principle No.1: Our highest priority is to satisfy the customer through the early and continuous delivery of valuable software.					
Q.1	4.3	3.6	4.2	4.1	
Q.1-1	3.7	3.8	3.7	3.9	
Q.1-2	3.8	3.5	3.3	4.3	
Average M	3.93	3.63	3.73	4.1	3.8475
Effect Level	High	High	High	High	High
Principle No.2: Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.					
Q.2	3.1	3.7	4.3	4.3	
Q.2-1	4.1	4.1	4.3	4.5	
Average M	3.6	3.9	4.3	4.4	4.05
Effect Level	High	High	Very High	Very High	High
Principle No.3: Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.					
Q.3	4.2	3.9	3.8	4.3	
Average M	4.2	3.9	3.8	4.3	4.05
Effect Level	High	High	High	Very High	High
Principle No.4: Business people and developers must work together daily throughout the project					
Q.4	4.3	4.3	4.2	4.6	
Q.4-1	3.9	4.3	3.8	4.7	
Average M	4.1	4.3	4	4.65	4.2625
Effect Level	High	Very High	High	Very High	Very High
Principle No.5: Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.					
Q.5	4	4.2	3.7	4	
Average M	4	4.2	3.7	4	3.975
Effect Level	High	High	High	High	High
Principle No.6: The most efficient and effective method of conveying information to and within a project team is a face-to-face conversation.					
Q.6	4.2	4	4.1	4.6	
Average M	4.2	4	4.1	4.6	4.225
Effect Level	High	High	High	Very High	Very High
Principle No.7: Working software is the primary measure of progress.					
Q.7	3.7	4	3.6	4.3	
Average M	3.7	4	3.6	4.3	3.9
Effect Level	High	High	High	Very High	High
Principle No.8: Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.					
Q.8	3.9	4	4.2	3.9	
Average M	3.9	4	4.2	3.9	4
Effect Level	High	High	High	High	High

APM principles	Beneficiary	Resident Engineer	Designer	Contractor	Total
	M	M	M	M	
Principle No.9: Continuous attention to technical excellence and good design enhances agility.					
Q.9	4.4	4.4	4.3	4.5	
Average M	4.4	4.4	4.3	4.5	4.4
Effect Level	Very High	Very High	Very High	Very High	Very High
Principle No.10: Simplicity—the art of maximizing the amount of work not done—is essential.					
Q.10	3.5	3.1	3.1	3	
Average M	3.5	3.1	3.1	3	3.175
Effect Level	High	Medium	Medium	Medium	Medium
Principle No.11: The best architectures, requirements, and designs emerge from self-organizing teams.					
Q.11	4.5	4.2	4.2	4.6	
Average M	4.5	4.2	4.2	4.6	4.375
Effect Level	Very High	High	High	Very High	Very High
Principle No.12: At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.					
Q.12	4.1	4.1	4.5	4.6	
Q.12-1	4.1	4.2	4.4	4.5	
Q.12-2	4.2	4.2	4.6	4.7	
Average M	4.13	4.17	4.5	4.6	4.35
Effect Level	High	High	Very High	Very High	Very High

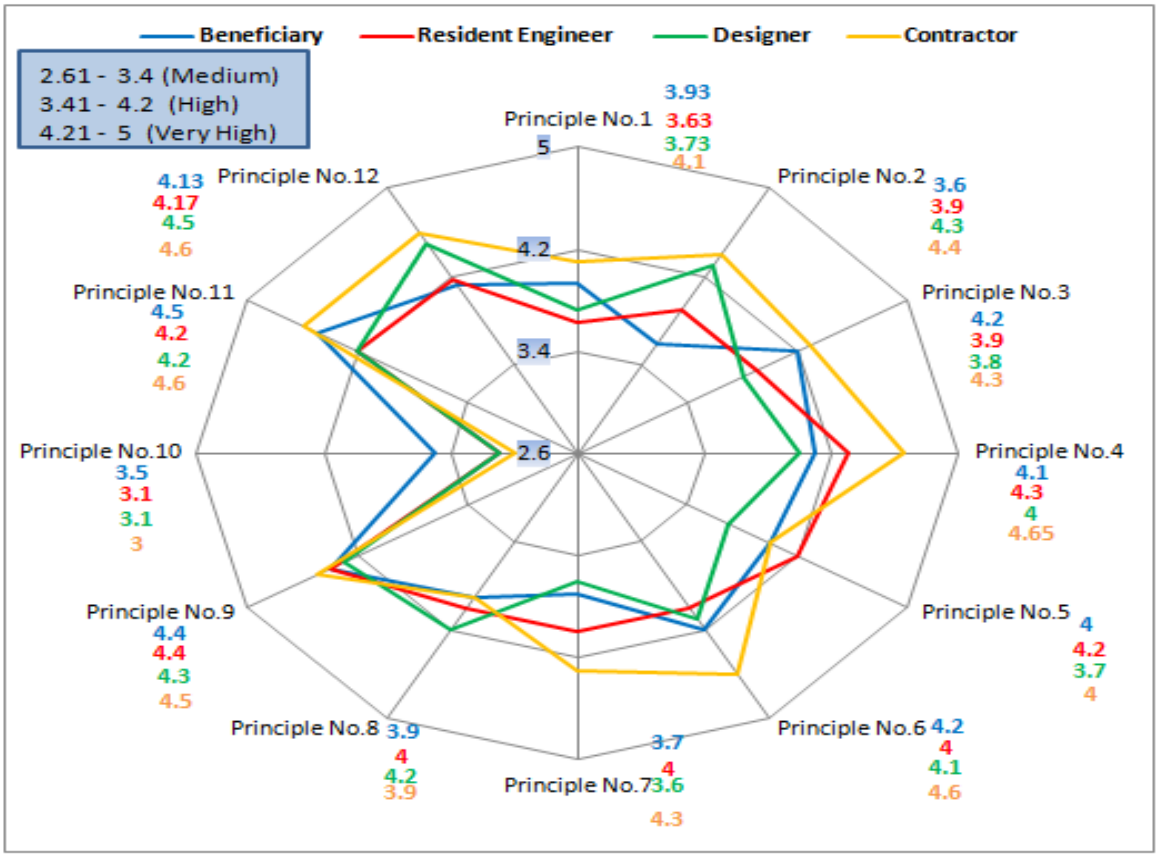

Figure 5. The final summary of the possibility of applying the principles of Agile project management in the construction projects of Iraq. **(Researcher)**