Adoption PPP model as an alternative method of government for funding abandoned construction projects in Iraq

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Abstract. The Iraqi construction sector is facing complex issues and a number of problems. Abandoned construction projects are considered one of the most common and serious problems in the construction industry in Iraq due to a lack of funding, which reflected by exceeding the time limit for completion of the projects. The number and value of the projects involved are usually large. Reconstruction, maintenance, and operation of unfinished projects in Iraq require better coordination between these issues, and the country's other affairs, this goal, cannot be accomplished unless the project is financing in the most successful way. This study aims to use the analytic hierarchy process (AHP) technique to select the appropriate type of the Public-Private Partnership (PPP) contracts to finance abandoned projects in Iraq, using a questionnaire survey to select the most significant criteria for choosing an appropriate financing approach for the abandoned project. The reliability of the questionnaire is achieved, by using the Cronbach Alpha calculated by SPSS software (Version 26). The results obtained illustrate the final weight of the Build, Operate and Transfer (BOT) contract from AHP is 0.261 is the best type of the (PPP) contracts in the alternatives suggested to finance the project.

Keywords. Public-Private Partnership (PPP), Analytical Hierarchy Process (AHP), Abandoned construction projects

1. Introduction

At global level, in the construction industry, the problem of abandoned projects occurs. Abandoned Projects may be defined as When the project is going well, but it's stopped for some reason, hence, it is a waste of land, funds and negatively effect on the environment citizens [1]. The incomplete / abandoned construction projects have a negative impact on the total value of the real estate and reduce the esthetics of the neighborhoods [2]. Abandoning construction projects in Iraq is a serious issue and continues to increase over several years, the government needs to pay more attention to mitigate and address the triggers that could lead to this problem. The financing crisis has had a big impact on the economy of Iraq, with oil prices plummeting, forcing the country to reduce government spending [3]. Project abandonment is considered to be one of the most important obstacles to the construction of Iraq. It represents an unfinished project and negative affects not only customers but also other project participants (for example, contractor, manager, client) and the general public [4]. The most significant factors affecting the performance of the construction sector in Iraq are the financial crisis, lack of contractor expertise, bad working conditions, delays, insufficient technology and equipment, lack of planning, missing and poor materials, price fluctuation, unskilled workers, and inaccurate scheduling.
[5]. In developing countries, the Public Private Partnership (PPP) has been adopted to overcome the lack of financial resources of governments to increase quality and providing better implementations [6]. In the case of Iraq as a developing country, the Iraqi government faced a severe shortage of financing due to financial crisis and security conditions, which caused the Iraqi government to abandoned nearly about 4,000 under-construction projects financed under government capital projects distributed throughout Iraq governorates according to the ministry of planning annual report in 2019 the projects within the period (2010-2018), as shown in Figure 1 the number of projects Abandoned in Iraqi governorates. The Government allowed government agencies to involve the private sector in financing projects that were abandoned as a result of the financial crisis [7]. PPP is used worldwide the private sector is better at conducting complex technological activities, fostering creativity, and responding fast changes compared to the public sector. Such private sector skills will be of great help in making conventional public procurement more competitive and efficient [8].

In recent years, the construction sector in Iraq has been suffering from many problems related to rising the number of unfinished building projects; this is due to the lack of financing, which negatively affected the performance of the building projects environment, as well as Iraq suffering from the optimal selection of financing methods through PPP contracts. The shortage and weakness available in this area cause an unsuitable choice of contract, so the optimal choice of the PPP method is very important due to the current challenges in the financing process in Iraq and the importance of proper selection in the success of projects. Therefore, in this study, the authors attempt to Selection of best PPP model as an alternative method of government to funding projects from the various strategies and tools provided by the multi-criteria decision-making (AHP) method. As a solution to avoid the destruction of projects that had achieved a high percentage of completion as well as to improve the performance of building projects, and to address the shortage of basic services, therefore, research is important to improve the efficiency of financing construction projects abandoned in Iraq in cases of the financial crisis.

Figure 1. Number of projects Abandoned in Iraqi governorates [7].

2. Literature review
Many researchers focused on the use of PPP in different countries. For example, Cheng et al., (2020) [9] studied the feasibility of PPP as a driver of sustainable development. Zhang, (2005) [10] studied the Critical Success Factors (CSF) for PPP in Infrastructure Development. The results listed 47 CSF from the PPP projects and grouped them into 5 categories: favorable investment climate, acceptable risk distribution, strong financial package, technical quality and economic viability. Anopchenko et al., (2019) [11] studied the Modeling PPP in Innovative Economy, by using multi-criteria decision-making (MCDM) for Selecting a PPP framework for the management of sustainable development projects. Robert et al., (2014) [12] investigated the reasons for adopting PPP for construction projects. Results
illustrate that five key reasons for implementing PPPs are: reduces administrative costs in the public sector, reduces the public sector budget constraint issue, allows for shared risk, the private sector has better mobility and the private sector effective in collect project funds. Noorzai et al., (2016) [13] studied the appropriate type of PPP contracts (DBFO, BOT, BOO, Traditional PRI) in financing highway projects. AHP technology, and Expert Choice software were adopted in this study. Rezouki and Hassan, (2019) [14] studied the obstacles obstructing the Applicability of (PPP) in Infrastructure Development. The results indicated that the weak of the legal framework, Insufficient processes in public administration, delays in land acquisition, and a lack of sovereign guarantee, the most obstacles obstructing the adoption of (PPP) in Infrastructure Development. Onyemaechi and Samy, (2016) [15] investigated the obstacles obstructing the adoption of (PPP) in Infrastructure. The results indicated that the best motivation was to reducing acute housing shortages, making a profit, eliminating budget constraints, and accelerating the completion of projects are the motives and motivating factors for the government in housing projects under the PPP. Naji et al., (2019) [16] studied the effect of financial problems on investment projects in Iraq.

3. Implement PPP contracts to project finances
PPP defined as a long-term contract between a public agency and a private-sector partner or consortium of companies to design, implement, finance, operate, and manage the project. The private partner will be responsible for financing, constructing, managing and maintaining assets and providing services; In return, the private partner will receive payments from the government [17]. PPP advantages such as minimizing budget deficits in the public sector, Improve the living situation of society, delivering high-quality public goods and services, and saving project time. However, the selection of the appropriate PPP model will always depend on several factors, including project objectives, funding requirements, and market realities [18]. Types of PPP contract include:

3.1 Build, Operate and Transfer (BOT)
In this agreement, after the end of the contract period, the investors will transfer the ownership of the project to the government. In addition, the private party undertakes all or part of the financing and, therefore, the contract period should be long enough to ensure a return on investment and to benefit from a private party. These contracts are used in different countries and are referred to as BOT contracts [19].

3.2 Build-Own-Operate-Transfer (BOOT)
BOOT, is a founding model and a form of concession used during a specific period after which the ownership returns to the government, but the sponsor here will acquire the temporary ownership right of the project. This makes the sponsor responsible for the design, finance, construction, operation, and maintenance by taking full control of the process necessary to easily manage facilities [20].

3.3 Build-Own-Operate (BOO)
In these contracts, public assets will be sold to the private sector to implement privatization plans. Transfer of ownership by the public sector to a specific project may involve all or part of the government’s share of the assets of the project. The private sector is responsible for the planning, construction, operation, and financing of investments [21].

3.4 Design-Build-Finance-Operate (DBFO)
The private sector directly funds public sector projects and assumes all obligations from project-related design to service. Instead, the Executive Private Sector would own the project's profits until the negotiated period with the public sector. Such contracts may be used to build new facilities, renovate and update or extend existing [22].
3.5 Traditional Private Contracts
These contracts, assets and ownership of project are allocated to the public sector and the smallest share of responsibility transferred from the public sector to the private sector, which are divided into categories as follows [13].

3.5.1 Service Contracts. Typically, such contracts can be used by the government and the private sector to execute or complete a particular function in a project, such as providing equipment, working with it, or repairing and maintenance.

3.5.2 Management Contracts. The responsibility for the operation and management of these contracts is transferred from the public sector to the private sector. Because of the complexity of the associated public projects when used to attract private sector collaboration, the level of technology used in the project is very high, and also the complexity of the project is highly affected by its effectiveness.

3.5.3 Leasing Contracts. These arrangements offer an incentive for units in the private sector to build revenue flows for themselves by paying a fixed rent and also by ensuring that properties in the public sector are properly handled and associated activities are performed correctly. In other terms, the commercial project risk is passed on to the private sector [13].

4. Analytic Hierarchy Process (AHP)
AHP's hierarchical structure consists of three levels: (1) the main goal or objectives are top-level; (2) the criteria and sub-criteria are the middle levels; and (3) the lowest level shows alternatives to the decision. [23]. AHP helps to make decisions based on a pair-wise comparison of criteria and alternatives. Comparisons were made in each part of the hierarchy between elements pairs to define the relative value of one element in relation to the other. The comparison is made using the preferential scale [24], as shown in the Table 1.

In recent years, a lot of research that adopted AHP technology to problem-solving in a wide range of areas, such as Arukala et al., (2019) [25] proposed to use a framework that depends on using AHP for sustainable performance evaluation in the construction industry; Kokangül et al., (2017) [26] using AHP for risk management; Lee and Chan, (2008) [27] Adopts the AHP to develop the most sustainable design for urban renewal proposals assessment; Darko et al., (2019)[28] studied the use of AHP in construction management, as well as this study, provides important tips for researchers and professionals to use AHP technology better in the future to analyze and model construction decisions; Mohammed and Harputlugil,( 2017)[29] proposed to use a framework that depends on the AHP approach to Select the Best Public-Private Partnership (PPP) Model.

| Numerical scale | Definition        |
|-----------------|-------------------|
| 1               | Equally important |
| 3               | Weakly important  |
| 5               | Essentially important |
| 7               | Very important    |
| 9               | Absolutely important |
| 2, 4, 6, 8      | Intermediate values |
5. Methodology and Experimental Work

In this section, the authors will describe the methodology for this study and also illustrate the case study.

5.1 Methodology

The authors in this study will depend on the main tools used to gather information are interviews, questionnaires, statistical analysis of data, and, finally, the use of the AHP decision-making method to Select the best (PPP) model to identify the best strategies to improve the financing performance of construction projects as shown in Figure 2. Methodology mainly includes two parts as following:

1. Part one (theoretical study): A literature review of previous studies relating to this study is conducted in various domains: Public-Private Partnership domain, Abandoned project domain, and domain of using AHP technology.

2. Part two (practical study): The Practical study included:

   1. Meeting with engineers, experts, and professionals working in construction firms to discuss the topic of Public-Private Partnership financing for construction firms to prepare a questionnaire for the study.
   2. Identification important criteria and alternatives in selecting the type of PPP contracts in construction projects based on literature and expert opinion as shown in Table 2.
   3. Structured questionnaire formulation and design in such a way as to measure the significance of each of the identified criteria for the alternatives. The relative weights for and criterion are validated by surveying professionals from all sectors of civil engineering identified as researchers, contractors, consultants, architects, engineers, designers, and others. The statistical analysis was carried out in order to expedite the results by using SPSS software (Version 26) data analyses to observe the accuracy of collected data using Cronbach's alpha.
   4. Data is collected using a field survey by developing a specific questionnaire for this purpose, as mentioned above, and this questionnaire is distributed to professionals employed in both public and private sectors in the Iraqi construction sector, (as a case study in Diyala Governorate). A total of 75 valid responses from 79 respondents were received, with an approximate response rate of 95%.
   5. study of the effect of the criteria obtained on each of the five contract groups (BOOT, BOT, BOO, DBFO, Traditional Private Contracts) and the ranking using the Super Decisions software. Super Decisions software based on the AHP method can make the calculations needed with high precision and accurate results. In AHP and Super Decisions the following steps are the same:
      - Making a Model of hierarchy in the Super Decisions software as shown in Figure 3.
      - Paired comparison of criteria and sub-criteria to assess the significance of them in decision making
      - Check Consistency Ratio and Priorities to identify the best possible alternative
   6. Finally, explain the author's conclusions.
Figure 2. Framework of methodology.
Table 2. Overview of the list of Criteria and alternatives.

| Criteria                                      | Alternatives                                      |
|-----------------------------------------------|---------------------------------------------------|
| 1. Risk Allocation and Sharing                | 1. Build, Operate and Transfer (BOT)              |
| 2. Efficiency in cost and time management     | 2. Build-Own-Operate-Transfer (BOOT)              |
| 3. Available Financial Market                 | 3. Build-Own-Operate (BOO)                        |
| 4. Political support                          | 4. Design-Build-Finance-Operate (DBFO)            |
| 5. Quality Improvement                        | 5. Traditional Private Contracts                  |
| 6. The Economic Framework Developed           |                                                  |
| 7. Strong Private Consortium                  |                                                  |
| 8. Financial Return                           |                                                  |
| 9. Transparent process of procurement         |                                                  |
| 10. Integrated Delivery of projects           |                                                  |
| 11. Efficiency of safety management at work   |                                                  |
| 12. Transfer Sustainable Technologies and Methods |                              |

Figure 3. Shows structure of the AHP in the Super Decisions software.

5.2 Experimental Work (case study)
The research will apply the model proposed on the projects, for this study Project in Diyala Province was adopted as a case study and collect data related to the construction project from the specialist Engineers at Diyala Government. Al- Razi Complex project this project consists of different buildings. Each building differs from another in dimensions and type. Work started in the September 2010 project and in 2013 the construction work in the project was stopped due to the economic crisis in the country and due to the security conditions at the time, these challenges can have a major impact on construction projects, especially in some countries such as Iraq.
6. Results and Discussion

6.1 Specific information for the respondent
Demographics of the target respondents shows in Table 3.

| information about | categories    | Percentage |
|-------------------|---------------|------------|
| Gender            | Males         | 76%        |
|                   | females       | 24%        |
| Academic qualification | diploma    | 9%         |
|                   | bachelor      | 49%        |
|                   | Master        | 30%        |
|                   | Ph.D.         | 7%         |
|                   | Other         | 5%         |
| Group (Job)       | Architect     | 20%        |
|                   | Civil Engineer| 50%        |
|                   | Electrical Engineer | 14% |
|                   | mechanical engineer | 10% |
|                   | other         | 6%         |
| Specialization    | consultants   | 15%        |
|                   | designer      | 12%        |
|                   | site engineers| 60%        |
|                   | project managers | 13%   |
| Practical experience (years) | less than 5 years | 39% |
|                   | 5-10 years    | 25%        |
|                   | 11-15 years   | 20%        |
|                   | 16-20 years   | 16%        |

6.2 Measuring the Reliability of Research Tool Using SPSS
In this study, questionnaire reliability was measured by SPSS using the Alpha Cronbach method was determined from the information given by 75 respondents, the results are 0.85 and this result is within the good Limit confirms the questionnaire's reliability. Table 4 illustrates the classification of the degree of reliability by the alpha Cronbach coefficient.

| Cronbach’s alpha | Degree of Reliability |
|------------------|-----------------------|
| \( \alpha \geq 0.9 \) | Excellent |
| \( 0.9 > \alpha \geq 0.8 \) | Good |
| \( 0.8 > \alpha \geq 0.7 \) | Acceptable |
| \( 0.7 > \alpha \geq 0.6 \) | Questionable |
| \( 0.6 > \alpha \geq 0.5 \) | Poor |
| \( 0.5 > \alpha \) | Unacceptable |
6.3 AHP results

In this study, the Super Decisions software was used to analyze the AHP results.

6.3.1 Pairwise Comparisons

Paired comparison of decision between criteria for the optimal selection of PPP contracts in construction projects. Use Super Decisions v.3.2 software dedicated to AHP analysis as shown in Figure 4.

Figure 4. Implementation of the pairwise comparison method by Super Decisions software for weighing the criteria.

6.3.2 Totally weight of every criterion and weight of every item

The weights of the different criteria were extracted from a pairwise comparison of the relative importance of all evaluation criteria using the Super Decisions software. The Table 5 illustrates the weight totally of each criterion and the weight of each object. The results are consistent with the Consistency Ratio (CR) 8.7%. According to Saaty (2008) [23], the internal consistency ratio (CR) in AHP should be less than 10%; thus the data collected are consistent and reliable.

| PPP options       | Number of criteria |
|-------------------|--------------------|
|                   | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 |
| BOT               | 0.262 | 0.244 | 0.257 | 0.259 | 0.230 | 0.281 | 0.258 | 0.297 | 0.257 | 0.271 | 0.268 | 0.264 |
| BOOT              | 0.198 | 0.180 | 0.172 | 0.181 | 0.126 | 0.164 | 0.165 | 0.134 | 0.145 | 0.164 | 0.107 | 0.135 |
| BOO               | 0.128 | 0.209 | 0.178 | 0.232 | 0.189 | 0.224 | 0.216 | 0.201 | 0.233 | 0.258 | 0.259 | 0.214 |
| DBFO              | 0.220 | 0.141 | 0.224 | 0.102 | 0.224 | 0.204 | 0.233 | 0.084 | 0.170 | 0.192 | 0.136 | 0.130 |
| Traditional Private Contracts | 0.189 | 0.224 | 0.167 | 0.224 | 0.229 | 0.125 | 0.126 | 0.282 | 0.192 | 0.113 | 0.228 | 0.254 |
6.3.3 Priorities of criteria and alternative

AHP a useful tool to determine the priority of the effective criteria for the selection of PPP contracts in construction projects as shown in Figure 5, where funding has a direct effect on the length and completion of the project. It is now apparent in Iraq that several projects have been abandoned due to a lack of funding, which reflected in exceeding the time limit for completion of projects; the result shows that the top priorities of criteria is efficiency in cost and time management, with a normalized cluster of 12.4% and a limiting value of 6.2%, is the most important criteria for the selection of PPP contracts in construction projects, followed by risk allocation and sharing and Integrated Delivery of project with a normalized cluster 11.4% and 11.1%, respectively.

Figure 5. The results of the Priorities of criteria.

Figure 6 illustrates the result of the priority of alternatives; the result shows that the BOT contract, with normalized clusters of 26% and a limiting value of 13%, is most important for achieving the appropriate financing methods, with lack of funding building followed by BOO contracts and Traditional Private Contracts, with normalized clusters of 21%, 19% respectively. BOOT contracts were the least important with a normalized cluster of 15% and a limiting value of 9.6%.

Figure 6. The results of the Priorities of alternative
7. Conclusions
One of the major challenges facing the construction sector developing countries such as Iraq is to focus on financial crises that have occurred in recent years, reflecting their effect by stopping or abandoning projects due to lack of funds, resulting in a substantial delay in completing projects in Iraq. Therefore, the authors are trying to identify the best strategies to choose the best financing model for public-private partnerships by using AHP technology in order to achieve the project completion and avoids cost overflow, the authors conclude the following.

- The construction firm's financial funding plays a significant role in all facets of the development process, it has been noted that the construction movement is directly affected by financial crises, locally or globally. The need to provide a financial source not affected by the financial crisis, therefore, adopting the Public-Private Partnerships very useful to construction and implementation of projects to improve the efficiency of financing of the projects abandoned in Iraq in cases of the financial crisis, supported the use of investment as an alternative option, and supported the renovation of a project.

- The criteria Efficiency in cost and time management, Risk Allocation and Sharing aspect has attained a weight of 12.4% and 11.4% respectively, they are very important in developing and improving existing and future projects

- using AHP is very suitable for identifying Best the Public-Private Partnership Contract this improves the funding performance of the building during its lifecycle. The result illustrates that the BOT contract has received a higher score equal to 0.261 and is considered best for this project.

- The limitations of this study are the application of the Public-Private Partnerships strategies at the construction stage of the project. For future studies, use different tools and different case study in order to choose the best financing model of the Public-Private Partnerships in the construction projects.

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