Available online at www.CivileJournal.org

Civil Engineering Journal

Vol. 5, No. 6, June, 2019

Determination a Reasonable Concession Period for (PPP) Projects

Ali Hasan Hadi [a*], Kadhim Raheim Erzaij [b]

[a] *M.Sc., Department of Civil Engineering, Faculty of Engineering, University of Baghdad, Baghdad, Iraq.*

[b] *Ph.D., Department of Civil Engineering, Faculty of Engineering, University of Baghdad, Baghdad, Iraq.*

Received 25 February 2019; Accepted 26 May 2019

Abstract

Public Private Partnership (PPP) are agreements where public bodies enter into long term contractual with private entities for construction or management the public sector facilities, or provision services to the community. Internal rate of return (IRR), pay back regime or tariff, and the concession period (CP) are essential items to success (PPP) projects. This research presents a systematic approach for a win-win partnership contract determined on a quantitative basis, by informing the partnership parties how long contract period should be made. Essence of the proposed methodology is that project completion time should allow a competent contractor to complete the project on schedule and operation period should be long enough to enable the concessionaire to achieve a reasonable return, but not too long such that concessionaire's return is excessive and public sector's interests are sacrificed. A case study of a PPP project in Mayoralty of Baghdad was conducted to evaluate performance of the developed mathematical models. The determined concession period (CP) has found to be approximately equal to actual concession period (CP) granted to the private sector. Evaluation shows the possibility to adopt the proposed approach to determine the concession period (CP) more effectively. Instead of opportunism policy, the proposed methodology enables local government of Baghdad province to enhance its policies of awarding the partnership projects to increase private sector participation in infrastructure development. Finally, the proposed method can be used by investment practitioners as a decision support tool for contract concession period (CP), and is worth popularizing to design the contracted concession period (CCP) for partnership projects in Iraq, and also can use as a methodology to assess the critical aspects which related to partnership projects in general.

Keywords: Concession Period (CP); Public Private Partnerships; Net Present Value; Operation Time; Investment Capital Cost; Investment Projects; PPP Projects.

1. Introduction

Public Private Partnerships (PPPs) have become a major scheme in delivering public infrastructure at the last decades. This is because of public budget constraints and severe need for new or rehabilitated infrastructure. So, many of governments have fostered private sector involvement in public investment projects [1].

Public Private Partnerships (PPPs) are "agreements where public sector bodies enter into long-term contractual agreements with private entities for construction or management of public sector infrastructure facilities, or provision of services by the private sector to the community on behalf of a public sector entity''. A fair distribution of benefits and risks is one of key factors in deciding concession period and an important prerequisite for cooperation between governments and the private sectors in a (PPP) project [2]. Financing projects of public infrastructure by private firms leads to format entities of partnership between public private sectors [3].

* Corresponding author: ali.hasanalhussainy@yahoo.com

http://dx.doi.org/10.28991/cej-2019-03091328

Worldwide experiences have shown that partnerships can provide variety benefits to governments, in particular, increase "value for money" spent for infrastructure services such as [4]:

- Apply more reliable and efficient services in lower cost;
- Enhance the infrastructure services in term of higher quality and prompt;
- Promote the Gross Domestic Product (GDP) by the increasing of employment opportunities.

In China, (PPP) projects improve living situation for society and keep the public sector budget deficiencies down. This is by transferring the risks that related to construction, finance, and operation of infrastructure projects to the private sector [4]. Public Private Partnership (PPP) were adopted throughout the world for delivering public infrastructure. Despite the worldwide experience was shown that PPP can provide a variety of benefits to the government, to fully gain them several critical aspects related to a PPP project need to be managed, among these the determination of concession period (CP) and risks that associated with it [5].

Therefore, there are several critical aspects related to a PPP project need to be considered. Among of these: evaluate and manage risks that associated with the partnership projects; identification strategies of risk analysis and settle; definition an adequate financial plan; assignment a most suitable concessionaire; and assignment the concession period (CP). To support the decision processes, the researchers were proposed many of models, tools and conceptual techniques which relate to these aspects [6].

Uncertainty that inherent in construction industry always invites us to study and analyze the potential risks of project. It is needed to adopt an effective methodology take into account the uncertainty and risk of the Partnership projects [5].

Each partnership based on concession period (CP), which may be fixed or extendable. The type of concession period specifies according to the risks which act on the key factors of investment such as schedule time, initial capital cost, annual operation and maintenance cost, and the expected revenues.

The period will be a fixed, in which risk factors usually managed through the tariff regime or controlled by other measures. In contrast of that, concession will have an extendable period if risk factors would be worse or better than the expected circumstances. For instance, in order to treat the unsecured project schedule time, the concession period (CP) can be extendable according to the project completion time. Where, If the contractor has delivered the project ahead of the expected schedule time, the concession period (CP) will be more than which contracted. This will allow concessionaire and government earn more return, and vice versa [5].

Therefore, there is an urgent need to adopt a scientific and practical methodology provide an optimal concession period (CP) for the Iraqi construction industry as a best chance that creates a win–win solution for both the government and concessionaire. The optimal concession period (CP) allows a fair risk sharing between the two parties. In other words, the concession period (CP) should protected the rights of the parties by guaranteeing for both a fairly allocate of profit and risks between parties.

The researcher aims to propose a methodology for determination the concession period (CP) based on a public–private win–win principle. That is, the concession period (CP) should be long enough to enable concessionaire to achieve a reasonable return on its investment, but not extravagant of the concessionaire's interests at the expense of public sector.

2. Research Methodology

This research paper concerns with the identification of concession period (CP) in construction industry. To approach a proper solution of this problem, a step by step methodology was adopted. The researchers begin a definition of concession period. Then illustrating the risks related to planning and designing the concession period (CP), into pre construction stage and operation phase of project life cycle.

Terminologies of concession period (CP) were then discussed to match their applicability for designation an optimal concession period (OCP). Based on literature review and fundamentals of engineering economy, the researchers developed mathematical models. To investigate the application ability of proposed methodology a case study was conducted among (PPP) projects. After filed data was collected, analysis was done. Finally, results were discussed in light of Iraqi construction industry. As given the flow chart below. Preceding paragraphs have been summarized in Figure 1. to show steps followed in this research.

3. Concession Period

The partnership between public and private sectors usually addressed to provide public works and services through concession arrangements. One of most important issues to be addressed in public private sectors partnership is the concession period (CP). This is because of concession period (CP), to some extent, demarcates rights and responsibilities between public and private sectors during the project's life cycle. So, the concession period (CP) is critical to project's

sustainable development, where it should be based on a win–win principle for parties involved and exercises simulation techniques in measuring and evaluating the economic uncertainties and risks [7].

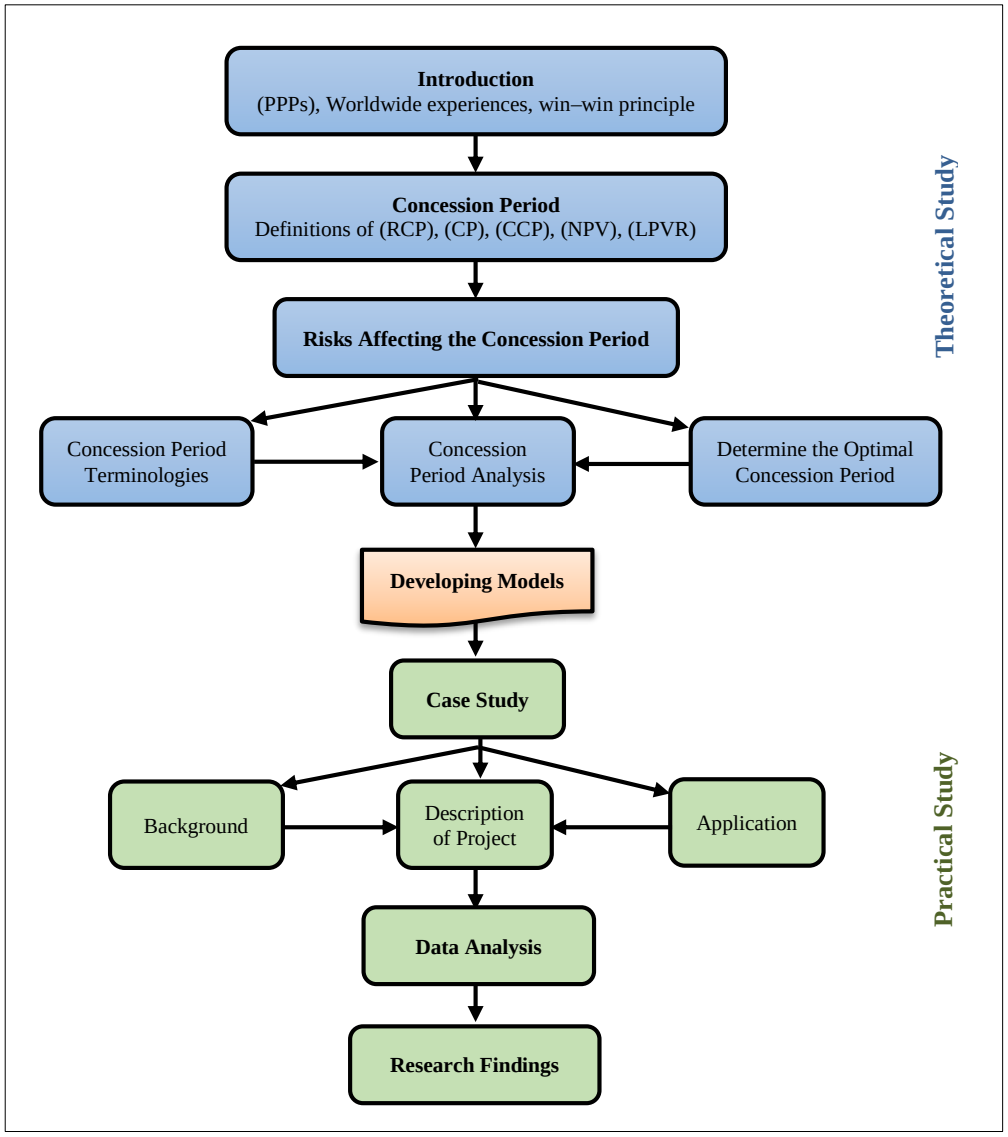

Figure 1. The research methodology

Another form of the concession period (CP), it begins at completion of the construction. And the concessionaire can still operate the project once completed if the project is completed behind schedule. There are also a few examples of concessions whose terms are variable depending on recover period of the investment capital cost and the interest rate at a certain level of interior rate of return [8].

Although, there may be a mechanism for extending it for a limited additional period to compensate the concessionaire for risks it is not prepared to bear. But a long-term fixed concession period (CP) is most common approach. In the former, the concession period (CP) starts when construction begins. For example, some of roads in United Kingdom delivered by the system of (Design–Build–Finance–Operate) have a fixed concession period (CP) of (30) years. Also, there are legislative provisions in some countries limiting duration length of infrastructure concessions such as,

- The concession period assigned to a maximum number of years;
- The concession period expires as soon as investment capital cost of the concessionaire has been repaid at a reasonable level of revenue;
- The concession period expires as soon as achieve a certain level of production or usages without taking into consider the number of years.

For example, the Dartford bridge project has a maximum concession period (CP) of 20 years, within which facilities of the project are required to be handed back to the government once debt charges and other costs have been recovered

[9]. Some studies have been conducted in Canada to settle problems common to traditional government PSA projects, and supposedly absent from PPP arrangements, are still there, only much harder to discern [11].

It is more likely to be used a renegotiable concession period (RCP). The renegotiable concession period (RCP) usually named to deal with many aspects such as; the uncertainty inherent in construction industry, scope of the project has not been clearly defined, the construction activities of infrastructure project usually very complex with substantial risks (e.g., overruns the cost and duration), and also the operation cash flows usually very difficult to be predicted in future [11].

Investment projects may incur many different cash flow profiles during their life cycle. Usually requires an investing a large amount of initial capital cost to construct the partnership infrastructure facilities, so these investment capital cost should be recovered by revenues of project over the contracted concession period (CCP). For public bodies, one of most important issues that considering when using a PPP scheme to develop a particular infrastructure project, is the determination of an appropriate concession period (CP) to the private partner. This concession period (CP) will be named base on a number of key factors, such as type of partnership, number and complexity of construction activities that related with the partnership project, economical life of the project facility, structure of the initial capital investment for the concessionaire, and volatility of revenue when operation in the future. So, all these uncertainties and risks during the construction period and the future operation period have significant effects on the concession period (CP) [12].

Public private partnership (PPP) as an alternative financing mechanism has been widely applied in the construction of public infrastructure projects and may provide new funding sources for building new infrastructure. Governments should take detailed information into consideration at the initial project stage when determining the concession period. In Iraq public bodies usually preset the concession period (CP) to a fixed length because of it is subject to bureaucratic procedures. This will prompt the concessionaire to bid the project on a high ceiling of guarantees to achieve a certain level of internal rate of return. This practice, however, induces the frequent failure or renegotiation of concession contracts. This because it does not lead to select the concessionaires an efficiently. To overcome these problems, governments need to use a methodology that appropriately calculates the concession period (CP) [13].

Concession period (CP) begins at the moment of signed the contract or agreement between the government and the private sector, indicating period within which the concessionaire is responsible for construction and operation the project. Concession period (CP) is a key decision in the arrangement of partnership contract. The length of concession period (CP) is mainly related to recovery of investment capital cost and required profit by the concessionaires. The determining concession period (CP) should base on win-win principle. For that concession period (CP) should be long enough to allow concessionaire to recover investment capital costs and then earn reasonable profits within that [5].

Generally, a long concession period (CP) is beneficial to the private investor, but a prolonged concession period (CP) may induce loss to concerned government. Alternatively, the short concession period (CP) leads to either reject the contract or be forced to increase the service fees in the operation phase. Consequently, risk burden due to a short concession period (CP) will be shifted to the party who uses and pays for the facilities. Therefore, named a reasonable concession period (CP) is a key factor for success the PPP projects [14].

Many developed models had defined the concession period (CP) as interval of time which been agreed by the governments. Also, some of methodologies calculated the concession period (CP) as a specific period of time within which the concession must be end [5].

Most of the developed models in the literature review were used the present value of cash flow (NPV) as a parameter to designation concession period (CP) of the partnership. Some of these adopted the least method of present value for revenue (LPVR) to determine the concession period (CP). This mean the method would consider the maximization of the concessionaire's benefits only. Also, some of models developed the concession period (CP) by maximize benefits of both government and concessionaire through the win-win approach [15].

Other researchers adopted a Fuzzy Delphi technique to calculate the uncertainty parameters of the concession period (CP). In particular, determine the values of different uncertain factors that effect on the partnership projects by considering the opinions of experts, and then calculate the NPV value by taking into account the resulted aggregated values of uncertain input parameters, finally determination the concession period (CP) using the fuzzy approach. The proposed methodology offers a fuzzy number for the concession period (CP). Also, a fuzzy of multi objective decision model was developed to assess the most satisfactory of concession options for the PPP projects [16].

Through the literature review, the researcher identified two main aspects to designation the concession period (CP) are: the first one concern for determination the concession period (CP), which classified for two main categories:

- Models allow determining the concession as instant of time;
- Models calculate the concession period (CP) as a range period within which the concession contract must end.

The second aspect involves the uncertainties and risk factors affecting PPP projects. By study the literature, it was found models which do not take into account the risks and uncertainties that affect over a long of period many input the variables to calculate the concession period (CP) as a deterministic time. While, the models in which uncertainties are accounted modeled by a statistical distribution and the concession period (CP) is determined by using simulation methods.

Finally, the third aspect concerns the perspective adopted in calculating concession period (CP), in terms of safeguard and party to satisfy. In this respect, from the point of private partner view, the models should provide a long enough concession period in order to allow the concessionaire to obtain an abundant level of revenues.

In contrast, some researchers proposed a win-win approach in order to satisfy the multiple interests of public sector and the profitability benefits of the private sector. It was determining the concession period (CP) by takes into account both the government and investor interest perspective.

Many of these studies applied the win–win approach in different ways. For example, the win-win approach was implemented by posing the following two constraints; concessionaire acts in the interest of the government, and the concession should be long enough to allow the concessionaire to obtain a reasonable interior rate of retain. The responsibilities of concessionaire may act on improve efficiency, cost effectiveness, and service quality, sustain a stable and continuously public affordable price regime, and transfer excessive profits to the government [17].

Hanaoka and Palapus (2012), employed the bargaining theory to design a reasonable concession period (CP). Thus, the concession period (CP) had been considered as a negotiation process wherein; public bodies and private sectors entities act as parties to adopt a partnerships deal, benefit to be generated within the concession period (CP) interval within which the end of concession period (CP) could occur, is the conflict of interest, and the negotiation will not end until an agreement of both partnership parties are reached [18].

4. Risks Affecting the Concession Period

It is obvious that determination of an appropriate concession period (Tcp) requires a good estimation for construction period (Tc) and operation period (To). Construction period (Tc) dependents upon; the duration of various construction activities, their relationships, planning, and scheduling of project.

The construction projects are uniquely and uncertainties usually inherent in it. Complexity of the infrastructure projects typically requires a huge amount of investment cost. So, many of parties participate for many aspects of these types of projects. These because of the infrastructure projects are involving more risks than other types of projects regarding either external risks or internal risks [19].

According to (American Consulting Engineers Council and Associated General Contractors of America 1998), "various risks may occur in the construction project site, relationships of contractual parties, contractual arrangements, technical specifications, and other areas. These include archaeological discoveries; the time of resolve the problems in construction sites, unpredicted environmental conditions during the construction process, get of licenses, approved the permits, and the subsurface conditions (e.g., difficult soils, rock, groundwater, and underground utilities); design changes; extreme weather or natural disasters; insufficiency of plans and specifications; construction cost escalation; inadequacy of resources (e.g., labor force, material, funding); changes in legal requirements; delays in delivery of critical equipment and supplies; labor strife and (or) jurisdictional disputes; political involvement and interference; subcontractor capability; protracted disputes; and third-party litigation" [10]. So, the project completion time or (Tc) affected by these risks.

Operation period (To) depend on the development cost of project as well as net present value (NPV) of the annual revenues for all long of the operation period. (NPV) is defined as presently equivalent value for construction activities costs (Construction Capital Cost CCC). The various construction risks mentioned above may also greatly increase the project development cost. (NPV) depends on the construction period (Tc) and many risks that may be encountered in future operation of the project, particularly, economic risks such as service and (or) product demand (quantity and price), project operation and maintenance costs, exchange rate (if foreign currency is involved), interest rate, and inflation rate [20].

As explained earlier, any Partnership infrastructure project subjects to the uncertainties in planning and execution. Hence, it is necessary to model the project development by specified the adventure risks in order to support the decision makers. So, the analysis and modeling of risk leads to informed decisions for procurement the public works and services. Major risk variables of determination the optimal concession period are construction period (Tc), project development cost (NPV), market demand, sale price, project operation and maintenance costs, and discount rate (interest rate of retune and inflation rate) [21].

Multi-Party contracting and risk sharing are relatively innovative at the construction industry. Conventional approach of risk management, in the project delivery systems, cannot adopted in multi-Party contracting environment.

Furthermore, this needs better understanding for the project potential risks and potential areas for reducing to earn more settled methods with considerations of all contracting party interests and priorities.

5. Concession Period Analysis

Determination of concession period (CP) lies in critical position for the successful PPP projects. The private sector may prefer an extended concession period in order to reap more revenue. On the contrary, the public sector would limit the length of concession period (LCP) to protect user's interest. Thus, determination of a resend able concession period becomes a complicated decision making activity among participants, and subject to influence of many economic factors, such as total initial investment capital cost (IICC), toll system, and inflation rate [22].

There are two main time variables need to identified when designation a concession period; construction period and operation period (Tc and To, respectively). Construction period schedules, (Tc), are always estimates because a great number of factors affect construction activities. Concessionaire operation period (To) is the period of recovery investment capital and its cost with a certain level of return based on projected revenues, which are subject to market risks. A short concession period (CP) means a high price for service or increase of excise during the operation period. High price for service or increases often faces opposition from the masses.

Based on whether the construction period and the private operation period are defined together or separately, there are two concession period structures: single-period concession structure (SPCS) and two-period concession structure (TPCS). Therefore, designation of an appropriate concession period (CP) lies in two main axes are; an informed estimation for the project completion time within which an experienced contractor can complete the project on schedule, and an accurate prediction for operation period that allows the concessionaire to obtain a reasonable but not excessive level of return [23].

For the private concessionaire, opportunity costs in current and future markets are taken into consideration in addition to scope and severity of the risks which involved in the particular project thus, concession period (CP) should be long enough to allow the concessionaire recover its investment capital costs (ICC) and then obtain a reasonable return within that period. For the public client, concessionaire's return should not be excessive compared to its commitments and efforts in addition to compare his revenues with available information of costs and rates of return for current and future markets [24].

In addition, a PPP scheme should achieve a better result than a traditional public procurement approach. This is the strategy that should be behind selection of partnership by the client. United Kingdom Treasury Task Force (1999) "*defines the Public Sector Comparator (PSC) as a technique used by the client to assign a proper service provider for a public sector project*". It determines by estimating cost of service when delivered by the public sector itself. The public sector comparator is expressed in net present value terms based on the required output specifications and taking into full account the risks that would be encountered by that style of procurement". The public sector comparator is used many purposes such as determine if the project is affordable to government by ensuring full life-cycle costing at an early stage, test whether a public-privately partnered (PPP) project is viable and demonstrates value for money, communicate with partners on such key aspects as output specifications and risk allocation, and encourage broader competition by creating greater confidence in the bidding process. Hence, the Public Sector Comparator helps the private partnership to be more cost effective [25].

5.1. Concession Period Terminologies

Some terms related to the analysis of concession period (CP) are defined as these words are frequently mentioned all throughout this study [18].

- Concession period (CP): is counts from the time when project owner and investor start signing the agreement.
- Operation period: starts when the project is opened to the public and starts to generate revenues.
- Breakeven point: it is the point where in it, the net present value equals zero.
- Payback period: "the period that required for recovering the cost initial of investment". It ends as soon as project reaches the breakeven point [26].
- Repayment period: is the time in which the debt obligations or loans must be repaid. Repayment period may be longer than or equal the payback period of project and must be finished before the transfer point.
- Transfer point (TC): any time/ year (T) between the breakeven point and the end of economic life where at which the ownership of project will be transferred back the client.
- Concession period (CP) interval: it is the interval or period starting from the project's breakeven point until the end of economic life; period where transfer point (TC) decided based on the result of negotiation between the government and the private sector could occur.

- Economic life: the period of project life that during it the project able to generate net gains.

Figure 2 illustrates relationship among the defined terminologies. Net present value of investment capital cost decreases during the construction period. But, as soon as the project enters service and makes revenues, capital cost would be covered and achieve profits. So, this requires a long enough operational period to achieve that investment objective.

6. Determine the Optimal Concession Period

The design of contracted concession period (CCP) is calculating the instant of time within which the concession must end. This requires three major issues; financing flow diagram, net annual returns, and profit margin of investment capital cost (ICC). Also, designate the concession period (CP) should take into consider uncertainty in construct and operate the partnership project. In other words, concession period (CP) should be able to protect both interests of private investor and the client simultaneously in addition to ensure that interests of the parties are satisfied in a balanced way by win–win principle.

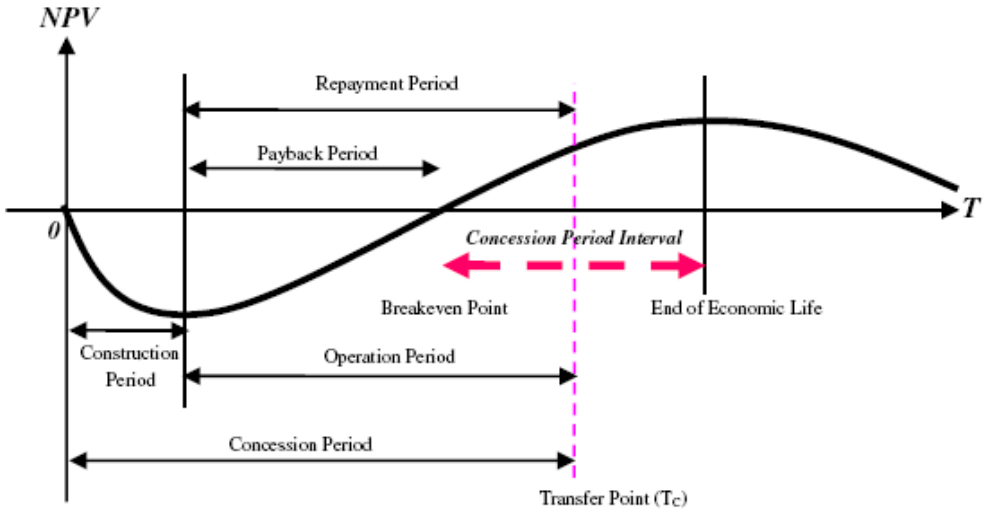

Figure 2. The relationship between concession period terminologies [18]

There are two period structures when design of a concession period (CP). One is the integrated concession period (CP) that combines the construction period and operation period, and the other is the separated concession period (CP) that distinguishes the (CP) as a construction period and operation period.

In the integrated concession period (CP), the concession period starts from the moment of signing the contract which fixes the length of the concession. Thus, transfers the risk of construction time overrun to the concessionaire. This means, the operation period is shorter if the construction period is longer, and vice versa. Hence, the concessionaire will be achieved profits from revenues generated by the project run when it completed ahead of schedule or otherwise severe the loss of revenues resulting from delayed of handover and reduced operation time.

In the separated concession period (CP), the concessionaire has a fixed operation period regardless of actual completion time of construction. Possible incentive schemes include an early completion bonus (the government benefits a share or a percentage from the generated profit during the period ahead schedule of completion time) or delay completion penalty (the concessionaire bears a percentage of the losses resulting from delay of completion). Regardless the period structure type of contract, Figure 3 shows the two periods as a specific point of time should not be skipped.

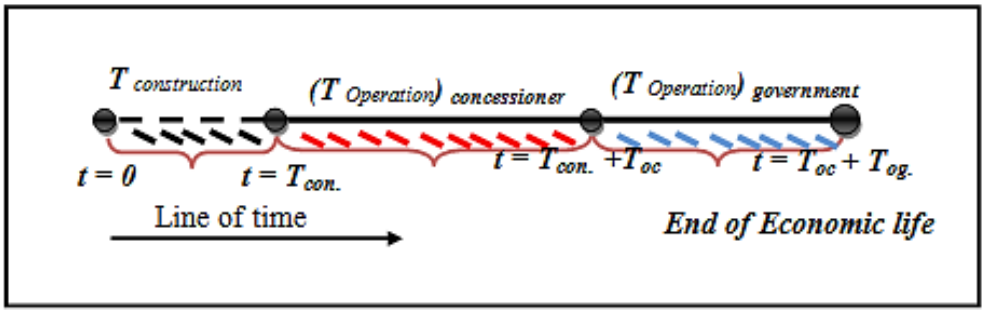

Figure 3. Life intervals of investment project

According to a reasonable but not excessive principle, the concession period (Tcp) can be defined as in Equation 1. But, concession period (Tcp) should to meet the hypotheses' limits in Equations 2 and 3;

$$Tcp = Tc + To \quad (1)$$

Where: Tc, is the project construction time; To, is the operation period of project.

$$Tc \leq Tc\ max. \quad (2)$$

$$To \leq To\ ecomomic\ life \quad (3)$$

Where: $Tc\ max$, is the maximum allowable project completion time; $To\ Economic$, is the designed economic operation life of the project.

At the same time, net present value (NPV) of total project capital cost should be satisfied the hypothesis in Equation 4:

$$\text{NPV}|(1+\text{R private sector}) \leq \text{NPV}|\text{To} = t \leq \text{NPV}|(1+\text{R public sector}) \quad (4)$$

Where: NPV, is the net present value of the total project development cost; $R\ private\ sector$, is the minimum rate of return required by the private sector in the development of a certain type of projects; $R\ public\ sector$, it is the return rate of total project development cost, which should be limited by the public sector as a maximum percentage to be acceptable. $NPV|T = t$, is the net present value of net revenues generated from an operation period $To = t$.

As mention in the Figure 1, concession period (Tcp), is any point within the interval after completion time until end of economic life of the project. The optimal concession period (CP) should to adopt an appropriate time for both the client and private sector as below:

To satisfy the concessionaire profits (earn reasonable return), net present value (NPV) for gross project development cost should achieve (at least) the minimum rate of return required by the concessionaire to develop a certain type of projects as illustrates in Equations 5 and 6; i.e.

$$(\text{NPV})\ \text{private sector} = \text{NPV} \times (1+\ \text{R private sector}) \quad (5)$$

As it is known, the fundamental concept of engineering economy is based on the equivalence value of money over time. The economic equivalence of the investor revenue after the construction finished should be:

$$(\text{NFV})\ \text{private sector} = (\text{NPV})\ \text{private sector} \times (1+\ \text{i})\text{^Tc} \quad (6)$$

Where: NFV, is the value of money in the future for the total project development cost, *i*, annual rate of discount, is the interest rate that charged by financial institutions for use of their money. Usually, the interest rate reflects the value of money over time, and the inflation as well as the risks of cash flows [26].

Inflation is decreasing value of money over the time. It is calculated to increase the money over time to get the same amount of goods or services [26].

The discount rate (*i*) can be rectified in Equation 7 as the following:

$$i_f = i + f + i \times f \quad (7)$$

Where: *i*, is real interest rate; *f*, is inflation rate.

$$(\text{NFV})\ \text{private sector} = (\text{NCFt})\ [(1+\ \text{i})\text{^t -1 / i}\times(1+\ \text{i})\text{^t}] \quad (8)$$

Where: $NCFt$, is the annual net cash flow of operation for each year (t); $NCFt$ = (Revenue or income - operation & maintenance cost) t.

Then after, the Equation 9 solves for time (T), the concession period can be calculated by summation the operation time (T) and the completion time of project:

$$\text{Minimum Concession Period (Tcp) private sector} = \text{Tc} + (\text{To})\ \text{private sector} \quad (9)$$

Now satisfying the government instructions, the net present value of total project development cost should not to exceed value of Equations 10, 11, and 13 respectively the maximum level of profits; i.e.

$$(\text{NPV})\ \text{public sector} = \text{NPV} \times (1+\ \text{R public sector}) \quad (10)$$

$$(\text{NFV})\ \text{public sector} = (\text{NPV})\ \text{public sector} \times (1+\ \text{i})\ \text{Tc} \quad (11)$$

$$(NFV)\ \text{public sector} = (NCFt)\ [(1+ i)\ t\ -1\ /\ i\times(1+ i)\ t] \quad (12)$$

After Equation 13 solves for time (To), the concession period can be calculated by summation the operation time (To) max and the completion time of project:

$$Maximum\ \text{Concession Period (Tcp) public sector} = Tc + (To)\ \text{public sector} \quad (13)$$

7. Case Studies

The developed mathematical models have been applied to partnership projects to valid its ability to determine the concession period (CP). The developed mathematical models have used to calculate the optimal concession period (CP) of the partnership projects. The developed models allow to public sector to negotiate with the private sector on the principle of win-win. The principle allows to the investors a period of time to recover their capitals cost (construction and operating costs) and then achieve a reasonable profit margin for their investments. Taking into consideration, concession period (CP) of the investment should be less than the economic life of the assets after return the ownership to the public sector (i.e. the project should to be valid for the functional feasibility).

The researcher applied the developed mathematical models on two partnership projects for two different sectors, one of it is an investment project in the tourism sector (built and operate a super deluxe hotel). The other project is a shopping mall (shopping center), to the commercial sector. Subsequent paragraphs show description of a case study.

7.1. Background

Mayoralty of Baghdad, one of the administrative authorities of the Baghdad local government, has announced its desire to establish a luxury tourist hotel at the central of Baghdad to support the tourism sector. The Mayoralty launched the initiative for investors to submit their proposals and suggestions to design and construction the project. Also, it is asked the investor to operate the project for a specific concession period (CP) to recover their capital cost and profits. Then, return the ownership of the project to the public sector.

The Mayoralty received several offers by various investors, the most prominent of which was design and constructs a luxury tourist hotel then operates it by the investor. The contract covers delivery the hotel by Turnkey delivery system during (24) months for a (10) years concession period. The technical feasibility study for specification of buildings illustrates the economic life of project is (20) years. The analysis of time period data was summarized in Figure 4. to illustrate the life intervals of hotel.

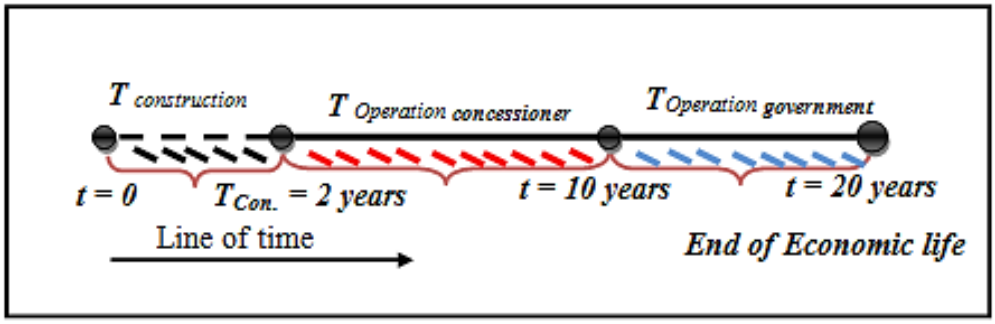

Figure 4. Life intervals of hotel

7.2. Description of Project

The project is constructing a multi-storey building on an area of (571 m2) at central of capital. The project consists of (7) floors contain (4 suites, 5 VIP rooms, 29 luxury rooms, 14 double rooms, and 11 single rooms). The building also contains a fine dining restaurant, a swimming pool, offices, services, multifunctional and other leisure facilities.

On the other hand, the project will be awarded by the investor to a specialized construction company to deliver the work by Turnkey system during (24) months for the cost of square meter unit. The investor also contracted with a specialized consultant to study and approve the drawings, plans, schedules, and statement methods that will submit by the contractor. Also, the consultant is responsible to supervise on the work process in site to ensure the compliance with the approved specifications.

7.3. Analysis of Feasibility Study Records

A retrospective study was conducted to extract data from feasibility study records of project. The feasibility study records are prepared by the investor. Table 1 lists the hypotheses of the proposed hotel feasibility study. The estimations of the operating revenues and costs had been based on historical data, data collected from similar investment projects, and experts' opinions. Data were analyzed to verify the investor point of view to determine the concession period (CP).

Table 1. Hypotheses of feasibility study

Item	Percentage
Workdays (per year)	330 days
Insurance of lobar	30%
Maintenance of civil works	5%
Maintenance of equipment	5%
Maintenance of furniture and office supplies	5%
Maintenance of transportation means	5%
Insurance of buildings	0.5%
Insurance of equipment	0.5%
Insurance of furniture and office supplies	0.5%
Insurance of transportation means	0.5%
Depletion of Buildings	5%
Depletion of equipment	10%
Depletion of furniture and office supplies	10%
Depletion of transportation means	10%
Sensitivity of initial capital cost	10%
Sensitivity of operating cost	10%
Sensitivity of annual revenue	10%

The hypotheses which developed by the investor were also analyzed to estimate the capitals cost of construction and investment. Also, it had been analysis the estimation of operation and maintenance costs for the next (20 years). Table 2 summarizes the data of feasibility study which analyzing the proposed hotel.

The annually operation costs mainly consist of administrative expenses, operations and maintenance costs, marketing, insurance, and depletion fee. As well as the annual returns that expected for each operations year had been guessed. The revenues mainly consist of rents, long-term leases, and annual leases (such as suites, Restaurant Lounge, and pool). The data of analysis are summarized in the Table 3.

Table 2. Analysis data of the feasibility study

Item	Value
Economic life of project	20 years
Concession period (CP)	10 years
Capital cost (ID)	3,336,000,000
Loan (ID)	1,452,000,000
Construction time	2 years
Investor margin of profit	50%
Rate of return	8%
Inflation rate	2%
Recovery period	5.8 years
Breakeven point	58%

Table 3. Estimated the annual operations cost of project and revenues

Item	Value
Initial Cost:	
Cost of Civil works (ID)	2,025,000,000
Cost of Architectural works (ID)	1,473,000,000
Cost of Electrical works (ID)	450,000,000
Cost of Mechanical Works (ID)	250,000,000
Cost of Furniture & Equipments (ID)	590,000,000
Annual operating cost:	
Electrical (ID/year)	50,000,000
Water (ID/year)	25,000,000
Labor (ID/year)	85,000,000

Insurance of lobar (30%)	25,000,000
Transportation & Communication (ID/year)	25,000,000
Fuel (ID/year)	50,000,000
Emergency services	100,000,000
Annual insurance cost:	
Annual insurance of buildings (ID/year)	23,000,000
Annual insurance of equipment (ID/year)	5,000,000
Annual insurance of furniture (ID/year)	2,000,000
Annual insurance of transportation means (ID/year)	1,000,000
Annual maintenance cost:	
Annual depletion (ID/year)	390,000,000
Service of maintenance accessories (ID/year)	117,000,000
Emergency services	250,000,000
Expected revenue:	
Total annual revenue (ID/year)	2,500,000,000
Net annual returns (ID/year)	**1,352,000,000**

According to win-win principal the optimal concession period (CP) should to be less than the economic life of project (E.L.).

$$C.P. \leq E.l.$$

According to technical feasibility study the construction schedule of project will be (24 months).

$$T \text{ construction} = 2 \text{ years}$$

As summarized in the Table 3 above, the initial capital cost is summation of (Civil works, Electrical works, Mechanical Works, Construction management, Architectural, and Furniture) costs.

$$\text{Capital cost} = 4788{,}000{,}000 \text{ ID}$$

Also, the Table 2 above illustrates, the margin of profit requires by investor is (50%). So, the net present value of the investor will be,

$$(\text{NPV}) \text{ private sector} = 4788{,}000{,}000 \times (1.5) = 7182{,}000{,}000 \text{ ID}$$

Economic equivalence of the net present value after the construction finished will be calculated on the base of interest rate for the inflation (10.16%) will be:

$$(\text{NFV}) \text{ private sector} = 7182{,}000{,}000 \times (1.1016)\text{^}2 = 8{,}715{,}519{,}000 \text{ ID}$$

From the Table 3, the annual cost will be operation & maintenance cost (Electrical & Water & Labor & Communication & Fuel & Transportation & Annual depletion & Service accessories).

The net income of project estimated to be (1,352,000,000 ID) for each year of economic life period, $NCFt$ = (Revenue or income - operation & maintenance cost) t.

$$8.715{,}519{,}000 = 1{,}352{,}000{,}000[(1.1016\text{^}t - 1) \div (1.1016\text{^}t \times 0.1016)]$$

Solve for (t), the concession period about (12 years) after the project will have been delivered. That mean the recovery period will be about (5.8 years).

To satisfy the government instructions, the investor capital profit should not to exceed (35%) for these types of partnership in tourism sector; i.e.

$$(\text{NPV}) \text{ public sector} = 4{,}788{,}000{,}000 \times (1.35) = 6{,}463{,}800{,}000 \text{ ID}$$

$$(\text{NFV}) \text{ private sector} = 6{,}463{,}800{,}000 \times (1.1016)\text{^}2 = 7{,}843{,}967{,}000 \text{ ID}$$

$$7{,}843{,}967{,}000 = 1{,}352{,}000{,}000[(1.1016\text{^}t - 1) \div (1.1016\text{^}t \times 0.1016)]$$

The concession period (CP) according to the maximum approved profit margin in public sector (to such type's partnership projects) is (9 years) after the project will have been delivered.

The calculations illustrate that the breakeven analysis for the project (i.e. payback analysis period for the investor's capital) will be at (5.8 years) from the start time of generate revenue, according to the reasonable margin of profit from

the investor's point of view. On the other hand, the maximum allowed percentage of profit is (35%) which by the government awarded such investment project to the private sector. The maximum concession period (CP) to operate the project is (9 years). This because, exceed of maximum percentage will not to be consistent with the social profitability objectives settled by administrative authorities of the government.

It should to be noted that, the concession period (CP) calculations for both of parties of partnership must to be less than the economic life of the investment project. For our case, it is (20 years) according to the technical feasibility study of the project which prepared by the investor. According to win-win principle, the government committee entrusted with the concession contract must negotiate with the investor to grant the contract with not less than (5.3 years) and not more than (9 years). But, it should to be (12 years) from the investor commercial point of view. It should be noted here that the project was granted a concession period of (10 years) for the investor by the local government of Baghdad then the ownership will be returned to the public sector.

8. Conclusion

The main element of (PPP) projects is the agreement upon the concession period (CP). The concession period (CP) names the obligations for both public and private sectors through all life cycle of the project. Since the concession period is mostly determined by empirical estimation, rather than quantitative analysis, leads to personal judgments that may not protect the rights of the parties that arise in partnership practices. A prolonged concession period will lead to a social profitability's loss that governments often seek to achieve them.

On the other hand, a short concession period (CP) usually lead to two scenarios; either the concessionaire will be obliged to increase prices the service charges or fees that provide to the public. Or the investor would reject the partnership. So, the concession period is an important decision to arrange a successful partnership contract because its value decides when the ownership of project should be transferred from the private sector to the public one, thereby demarcating the influence, and responsibility, between the private party and the government.

This research presents a systematic approach for a win-win partnership contract determination on a quantitative basis, attempting to inform the partnership parties how long the contract period should be made. The developed mathematical models target the concession period (CP) as a period creates a fair benefit sharing between the project promoter and the public bodies. In other words, the developed models try to satisfy the private and the government by guaranteeing the rights for both parties.

The proposed methodology tries to enable the evaluating agency to analytically determine a concession period to be granted by the government to the private sector. Through, assign the concession period (CP) as a variable to the financial cash flow equation. Hence, the net present value (NPV) uses as a financial viability indicator (the financial viability of partnership projects).

Core of the proposed methodology is that the concession period (CP) should integrate construction and operation to promote innovations, effectively, capital savings, and early project completion. The project completion schedule should be estimated properly which allow to handle the project effectively. Also, the named operation period should be relevance to allow the concessionaire to achieve a reasonable profit.

9. Conflicts of Interest

Authors declare no conflict of interest.

10. Funding

This research supported by College of Engineering, University of Baghdad, Iraq.

11. References

[1] Carbonara, Nunzia, Nicola Costantino, and Roberta Pellegrino. "Risk Analysis Methods." Advances in Public-Private Partnerships (July 11, 2017). doi:10.1061/9780784480267.037.

[2] Yan, Xue, Heap-Yih Chong, Jing Zhou, and Qian Li. "Concession Model for Fair Distribution of Benefits and Risks in Build-Operate-Transfer Road Projects." Journal of Civil Engineering and Management 25, no. 3 (March 13, 2019): 265–275. doi:10.3846/jcem.2019.8649.

[3] Tang, LiYaning, Qiping Shen, and Eddie W.L. Cheng. "A Review of Studies on Public–Private Partnership Projects in the Construction Industry." International Journal of Project Management 28, no. 7 (October 2010): 683–694. doi:10.1016/j.ijproman.2009.11.009.

[4] Kwak, Young Hoon, YingYi Chih, and C. William Ibbs. "Towards a Comprehensive Understanding of Public Private Partnerships for Infrastructure Development." California Management Review 51, no. 2 (January 2009): 51–78. doi:10.2307/41166480.

[5] Carbonara, Nunzia, Nicola Costantino, and Roberta Pellegrino. "Concession Period for PPPs: A Win–win Model for a Fair Risk Sharing." International Journal of Project Management 32, no. 7 (October 2014): 1223–1232. doi:10.1016/j.ijproman.2014.01.007.

[6] Garvin, Michael J., and David N. Ford. "Real Options in Infrastructure Projects: Theory, Practice and Prospects." Engineering Project Organization Journal 2, no. 1–2 (June 2012): 97–108. doi:10.1080/21573727.2011.632096.

[7] WANG, Xianjia, and Shiwei WU. "Mechanism Design of Reverse Auction on Concession Period and Generalized Quality for PPP Projects." Frontiers of Engineering Management 4, no. 2 (2017): 156. doi:10.15302/j-fem-2017016.

[8] Bagui, Swapan Kumar, and Ambarish Ghosh. "Traffic and Revenue Forecast at Risk for a BOT Road Project." KSCE Journal of Civil Engineering 16, no. 6 (September 2012): 905–912. doi:10.1007/s12205-012-1533-5.

[9] Ullah, Fahim, Muhammad Jamaluddin Thaheem, Samad M. E. Sepasgozar, and Nuria Forcada. "System Dynamics Model to Determine Concession Period of PPP Infrastructure Projects: Overarching Effects of Critical Success Factors." Journal of Legal Affairs and Dispute Resolution in Engineering and Construction 10, no. 4 (November 2018): 04518022. doi:10.1061/(asce)la.1943-4170.0000280.

[10] Bayat, Morteza, Mostafa Khanzadi, and Farnad Nasirzadeh. "Determining Optimal Capital Structure and Concession Period Length in BOT Scheme Using Trilateral Bargaining Game Model." Journal of Infrastructure Systems 25, no. 1 (March 2019): 04018036. doi:10.1061/(asce)is.1943-555x.0000456.

[11] Ho, S. Ping. "Model for Financial Renegotiation in Public-Private Partnership Projects and Its Policy Implications: Game Theoretic View." Journal of Construction Engineering and Management 132, no. 7 (July 2016): 678–688. doi:10.1061/(asce)0733-9364(2006)132:7(678).

[12] Zhang, Yiwen, Zhuo Feng, and Shuibo Zhang. "The Effects of Concession Period Structures on BOT Road Contracts." Transportation Research Part A: Policy and Practice 107 (January 2018): 106–125. doi:10.1016/j.tra.2017.11.018.

[13] Liu, Shijing, Hongyu Jin, Benzheng Xie, Chunlu Liu, and Anthony Mills. "CONCESSION PERIOD DETERMINATION FOR PPP RETIREMENT VILLAGE." International Journal of Strategic Property Management 22, no. 5 (September 24, 2018): 424–435. doi:10.3846/ijspm.2018.5476.

[14] Ruizheng, Fan, and Wan Li. "The Optimal Concession Period in the Built-Operate-Transfer Project." 2010 International Conference on Management of e-Commerce and e-Government (October 2010). doi:10.1109/icmecg.2010.53.

[15] Chan, Albert P. C., John F. Y. Yeung, Calvin C. P. Yu, Shou Qing Wang, and Yongjian Ke. "Empirical Study of Risk Assessment and Allocation of Public-Private Partnership Projects in China." Journal of Management in Engineering 27, no. 3 (July 2011): 136–148. doi:10.1061/(asce)me.1943-5479.0000049.

[16] Mostafa, Khanzadi, Nasirzadeh Farnad, and Alipour Majid. "Using Fuzzy-Delphi Technique to Determine the Concession Period in BOT Projects." 2010 2nd IEEE International Conference on Information and Financial Engineering (September 2010). doi:10.1109/icife.2010.5609396.

[17] Zhang, Xueqing. "Win–Win Concession Period Determination Methodology." Journal of Construction Engineering and Management 135, no. 6 (June 2009): 550–558. doi:10.1061/(asce)co.1943-7862.0000012.

[18] Hanaoka, Shinya, and Hazel Perez Palapus. "Reasonable Concession Period for Build-Operate-Transfer Road Projects in the Philippines." International Journal of Project Management 30, no. 8 (November 2012): 938–949. doi:10.1016/j.ijproman.2012.02.001.

[19] Pipattanapiwong, Jirapong, Stephen Ogunlana, and Tsunemi Watanabe. "Multi-Party Risk Management Process for a Public-Private Partnership Construction Project in Asia." Public-Private Partnerships. 351–368. doi:10.1002/9780470690703.ch16.

[20] Deng, Qianli, Limao Zhang, Qingbin Cui, and Xianglin Jiang. "A Simulation-Based Decision Model for Designing Contract Period in Building Energy Performance Contracting." Building and Environment 71 (January 2014): 71–80. doi:10.1016/j.buildenv.2013.09.010.

[21] Pivatto, Douglas, Rodrigo Nobre Fernandez, Helton Saulo, and Andre Carraro. "Estimating the Optimal Time for a Road Concession Contract in Brazil." International Journal of Economics and Finance 9, no. 12 (November 2, 2017): 44. doi:10.5539/ijef.v9n12p44.

[22] Feng, Ke, Shouqing Wang, Chunlin Wu, Guangtao Xia, and Wangyin Hu. "Optimization of Concession Period for Public Private Partnership Toll Roads." Engineering Economics 30, no. 1 (February 25, 2019). doi:10.5755/j01.ee.30.1.19215.

[23] Zhang, Yiwen, Zhuo Feng, and Shuibo Zhang. "The Effects of Concession Period Structures on BOT Road Contracts." Transportation Research Part A: Policy and Practice 107 (January 2018): 106–125. doi:10.1016/j.tra.2017.11.018.

[24] Rouhani, Omid M., and Debbie Niemeier. "Resolving the Property Right of Transportation Emissions through Public–private Partnerships." Transportation Research Part D: Transport and Environment 31 (August 2014): 48–60. doi:10.1016/j.trd.2014.05.018.

[25] Yan, Xue, Heap-Yih Chong, Jing Zhou, Zhaohan Sheng, and Feng Xu. "Fairness Preference Based Decision-Making Model for Concession Period in PPP Projects." Journal of Industrial & Management Optimization 13, no. 5 (2017): 1–13. doi:10.3934/jimo.2018137.

[26] Blank, Leland T., and Anthony J. Tarquin. Basics of engineering economy/Leland Blank, Anthony Tarquin. Boston: McGraw-Hill Higher-Education, 2008.