The Feasibility Study Report as an Effective Tool to Evaluate Investment Projects: A Solid Waste Treatment Project as a Case Study

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ABSTRACT

Hundreds of infrastructure investment projects are inserted into the Iraqi government budget annually. Many of these projects suffer from suspension, delay in completion, corruption, or other negative issues known in Iraqi construction projects. This may harm the country's economic recovery due to allocating funds to useless projects from one or more feasibility studies' components. Therefore, the best solution is to pay attention to the feasibility study reports. This study highlights the importance of feasibility studies reports for investment projects and their effective role in evaluating project ideas to ensure an equitable distribution of a country's financial resources to the most feasible investment projects. This importance was highlighted through a practical case study for a solid waste treatment project. The results of the case study showed that feasibility studies provide very important information on which investors and governments can rely to make the appropriate decisions for investment projects. The study also addressed the risks that investors can be exposed to in Iraq and how to include them in the economic analysis of feasibility studies.

Keywords-feasibility study; project management; investment; solid waste; energy

I. INTRODUCTION

In Iraq, many investment projects do not achieve the goals and assumptions on which they were based [1-2], not only because these assumptions were based on incorrect facts, but also because decision-makers did not deal efficiently with the uncertainty associated with each stage or every detail of the project. This failure may waste public money and prevent funding investment projects beneficial to the country [3-4]. Feasibility Studies (FSs) effectively reduce uncertainty by answering all the questions of investors and decision-makers by providing a scientific and logical analysis of real data or hypotheses close to reality [5]. An FS is a thorough investigation into the viability of an idea or concept that could affect the country's economic growth and its business potential. It is carried out to the point where the potential project is socially responsible, technically possible, commercially viable, and has a feasible business opportunity exit. The predominant perspective in the construction industry suggests that construction stakeholders prioritize maximizing profits during the execution phase of any project [6-7]. FS is a crucial and consequential aspect in the building industry and other technical domains, as it greatly influences investment decision-making. Valuable feasibility studies are necessary for each construction project to obtain precise decisions from decision-makers or contractual parties, such as clients, consultants, and contractors. FSs conducted in the project initiation phase before significant expenses should deal with correct facts, assumptions, and up-to-date financial data. Every firm wants to succeed and improve its performance [8]. FSs have been identified as a key factor in achieving such a crucial goal. Many projects and business organizations have failed to achieve this goal because they do not begin or understand the implications of conducting FSs. This study investigates the effect of FSs on the evaluation process of investment project ideas and highlights its importance in providing the required answers for investors and decision-makers, converting uncertainty aspects to data close to certainty.

II. FEASIBILITY STUDY CONCEPT

An FS can be interpreted as an assessment of what can or cannot be effective at the conceptual stage of a project [9]. The FS report is an analysis of the viability of an idea. It is used in project management to discover potential positive and negative consequences before investing considerable time and money [10]. Therefore, an FS is an examination and evaluation of a

complicated nature at the level of future investment objectives over a set time frame, considering risks and uncertainties [11]. In [12], FS was defined as a technique for predicting the results of an investigation or evaluation of a proposed project and its potential benefits. An FS report can be considered the most common way to gather comprehensive and transparent data and results to assess the viability of an investment proposal [8, 13]. The purposes of FS are linked through the planning process to the amount of financial resources required for investment projects, which are summarized in a recommendation to the relevant stakeholders (i.e. owner, bank, government) and provide an advantage to facilitate monitoring and control related to the company's objectives [14]. In practice, an FS report is prepared by the investor and submitted to the contracting authority to audit its contents, study the possibility of the investor recovering his disbursements, and achieve a reasonable return, in addition to studying the project's potential to add social, environmental, and economic benefits.

A. *Types of Feasibility Studies*

There are two main FS types:

- A preliminary FS follows the project's first value proposition, providing a general overview using multiple analytical frameworks that allow the expert to recommend its applicability [15]. A legal FS is carried out to examine whether the proposed plan or system complies with national or international legal regulations [16]. Protection acts serve as a means to determine law violations [17].
- A detailed FS includes a set of studies (social, technical, market, financial, environmental, and economic), in which data and information necessary to evaluate investment projects are collected, studied, examined, and evaluated to determine the feasibility of investing in them, and the extent to which they can succeed and grow, and then put them into practice [18-20].

B. *Necessities and Non-Necessities of Feasibility Studies*

An FS is necessary for all projects [21]. However, certain projects are implemented without the need for an FS. Table I illustrates the types of projects that require the execution of an FS, as well as the types where FS is typically not executed.

C. *Who Prepares the Feasibility Study?*

Contracting authorities prepare themselves the FSs or hire external consultants [22-23]. If external consultants are hired, the authority staff is involved in the complete study development process and provides most of the information and data required to assess the situation, including costs, staffing, etc. Hiring a consultant to prepare the FS is an important decision for contracting authorities and line ministries. Contracting authorities must take care and select a technically proficient consultant to undertake it, considering the following selection criteria:

- Experience in conducting feasibility studies
- Strong background in both financial and technical aspects of different types of projects
- Experience in the industry being studied
- Working independently and objectively
- Fair and neutral decision making
- Experience in data collection and manipulation
- Working closely with the designated MOP and line ministries team
- Working with the assigned budget
- Strong presentation and communication skills

TABLE I. TYPES OF PROJECTS THAT NEED FS

Category	Example	Remarks
An FS is necessary	Infrastructure project involving an extensive development plan	Economic zones, power plants, ports, toll roads, large bridge
	Improvement project with extension or broadening plan and possible social influences	Example: expansion of an existing hospital from 50 to 250 beds
	Commercial project: e.g. toll road, touristic project	Financial analysis will be prioritized
FS is usually not necessary	Immediate measures to mitigate the impact of natural disasters	The countermeasure project aims to mitigate the impact of disasters by adopting a long-term view. It is a focal point for FS
	Symbolic/religious project	e.g. Parliament Halls, National Universities, public parks, sports stadiums, national cemeteries, National Mosques, etc.
	Expansion/maintenance project with normal demand	FS may be needed for peculiar situations, e.g. when there will be a lot of traffic during a road project
	Small project	Internally evaluated based on the project concept
	A project devoiding of any potential for feasibility	As a consequence of the evaluation conducted by the project concept
	Study/survey project on how to find solutions to current issues	It will be looked at by a project concept or a basic study, for example, to see if it will have any environmental effects

D. *Feasibility Study Process*

Every detailed FS has a rigorous process to follow [24]. If a large project needs a detailed FS, then a pre-FS should indicate a Go/No-Go signal. Figure 1 shows the process that is maintained for project development.

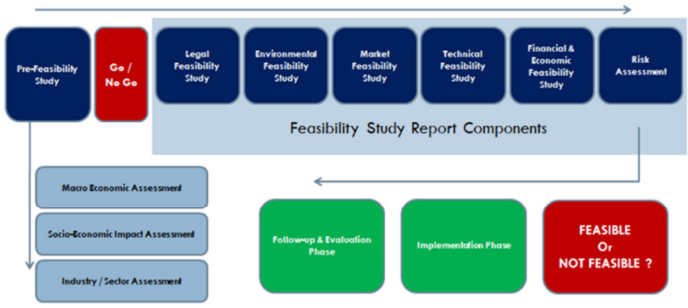

Fig. 1. Feasibility study process.

III. CASE STUDY

Landfilling is the only method used in Iraq to treat solid waste. Several studies have shown that treating solid waste using the landfilling method can have many negative impacts, including high financial costs, soil and groundwater pollution, and the emission of toxic substances and gases such as methane. One of the best solutions for treating solid waste is to use it for energy production (Waste to Energy, W2E). This process requires the establishment of a Feed-In-Tariff (FIT).

A. FIT to W2E

In deciding the FIT for W2E, one needs to consider the following cost and financing elements. The example here is a project that would take care of 2,250 tons/day of Municipal Solid Waste (MSW) and turn it into electrical energy.

1) Investment Cost

The investment for a plant that would handle 2,250 tons/day of MSW, which could have a generation capacity of 50 MW at minimum, would cost the order of $350,000,000. This would be financed through banks, private financers, or financial institutions at a rate that reflects the risk appetite of those who would like to lend their money to Iraq for this project. The perceived risk and the related ranking of that country mostly shape the risk appetite. At this risk level, borrowing funds from Iraq would be costly. The only upside is that this is an environmentally friendly project that would eliminate the emission of hazardous gases into the environment, where given the global environment, the Paris Agenda, and the 2050 targets, locating funds at somewhat lower rates might still be possible. The level of risk in Iraq and the size of the project would require government support, either in the form of a Treasury Guarantee or a Bank Letter of Guarantee (BLG) from the Trade Bank of Iraq (TBI) and endorsed by a first-class international bank. The interest rate to finance this project could be 7.5% per year.

2) Political Risk Insurance (PRI)

PRI covers non-commercial risks, political events, and direct or indirect government actions that could affect investment returns [25]. Although there are various forms of PRI, not all PRI providers would provide or offer cover for all the risks, but depending on the risk rating of the country, they would offer cover for some of the following risks: expropriation, transfer restrictions, currency inconvertibility, political violence, contract default, war, and civil unrest, etc. Although this is rather a very costly insurance, on the other hand, it becomes an enabler for establishing the required financing. PRI could be obtained from international private insurance companies or bilateral agencies, depending on the supply of equipment from these countries, or multilateral agencies such as MIGA, World Bank, or Asian Development Bank (ADB). The rates change over the years, depending on the changes in the country and the availability of PRI in the market. Therefore, the PRI cost is estimated to be more than 2% per year.

3) Operation and Maintenance (O&M) Costs

Yearly O&M costs, including staff, were projected at $15 million.

4) Renewal Costs

O&M cost does not cover the long-term maintenance and replacement cost for equipment. The equipment would require a major overhaul in certain periods, depending on the equipment and its working condition, which could range from 3 to 10 years. Some equipment would even require total replacement. Renewal costs were proposed to be 1% per year.

5) Cost of Fuel and Water

MSW is the fuel for the plant. Both MSW and water should be supplied free of charge to the plant.

6) Land

The land should be available for free during the project terms for 25 years, under a lease contract. This should be on the order of 200,000 m^2.

B. Amount of MSW and Calorific Value

The depletion of fossil fuel reserves has tempted research and development programs to compensate for the deficit by switching to alternative energy sources [26]. MSW is the fuel for this W2E plant, and the calculations are based on the waste composition provided by the Baghdad Municipalities, as given in Table II. This composition is expected to have a Calorific Value (CV) of 7.5 MJ/Kg. Table III shows the average ratios of secretion components per person for the Baghdad province. The values in Table II represent the most important parameters in the project calculations. A higher portion of plastics, cardboard, etc., has a higher CV [27]. Therefore, it will produce more heat, which in turn will generate more electricity. However, more watery or organic content will have less CV, resulting in less electricity. The general rule of recommendation is that if the CV is less than 6.0 MJ/kg, then incineration should not be used to eliminate MSW. The MSW should be supplied free of charge by the municipality, and daily average quantities should be guaranteed. The calorific value is most important for the amount of power to be produced. A mechanism should be established to ensure CV. The CV of the MSW must be studied, and the municipality has to guarantee not only the amount but also its CV value. Otherwise, it would be like giving less fuel to a car and expecting the car to travel the same mileage with much less fuel.

TABLE II. SOLID WASTE COMPONENTS AND CV

Components	Organic	Plastics	Paper	Glass	Metal	Other	Total
Tons per Year	363814	127294	121545	66521	63236	78840	821250
%	44.3	15.5	14.8	8.1	7.7	9.6	100
MJ/kg	5.2	22.5	11.7	0.0	0.0	0.0	Avg. 7.5
Energy (MJ)	1.89×10^9	2.88×10^9	1.42×10^9	0	0	0	6.19×10^9

TABLE III. AVERAGE RATIO OF SECRETION COMPONENTS PER PERSON FOR BAGHDAD PROVINCE

Year	Organic	Plastics	Paper	Metal	Glass	Other	Total
2017	46.4	15.5	14.6	8.2	7.8	7.5	100
2018	45.18	16.1	14.81	7.27	8.01	8.63	100
2019	43.19	20.93	17.68	6.8	6.25	5.15	100
2020	43.4	19.6	21.7	5.7	4.5	5.1	100
2021	42.25	20.5	21.75	5.5	5.5	4.5	100
Avg. (%)	44.08	18.53	18.11	6.69	6.41	6.18	100

C. Remuneration of the Investment (Take or Pay)

With the above investment, the investor can handle 2,250 tons/day of MSW. The investor should ensure that the facility performs at its optimal performance throughout the project. The buyer should ensure that the facility is properly fed daily with the required fuel. According to the contract, the investor would require the buyer to provide the MSW at a CV of not less than 7.5 MJ/Kg. Higher content of plastics and paper, etc., would provide more heat and therefore more electricity, whereas providing more organic would mean less CV and therefore less power. The investor would design the plant capacity at the pre-agreed level of CV and tonnage of MSW. When the plant is commissioned, tests will be run to confirm its electricity production capacity. This capacity would then be adjusted for the CV of the MSW supplied, setting the reliable capacity for the plant. With the contract, the buyer would commit to buying all the power produced from the plant and paying for it at FIT prices. However, if the plant cannot produce, for example, if not enough MSW is supplied or any other similar reason that is beyond the investor's control, the buyer then also commits to pay the full dependable capacity, whether it is produced or not. In other words, it is a Take-or-Pay for capacity.

D. Production Capacity and Return

This plant is estimated to produce 430 TWh of electricity per year with 91% availability. A higher CV of MSW could result in a higher level of electricity generation. Initially, all the income from payments would be given back to the lenders. There would be a significant interest cost during this period until the borrowed sums are returned. Therefore, there must be a higher level of FIT during this period to ensure that financial institutions receive their returns. Subsequently, the rates could be significantly reduced. In this case, the investor should state that the rates should not be less than \$0.19/kWh for the first seven years and then \$0.10/kWh for the remaining 18 years to provide an acceptable Internal Rate of Return (IRR) and Return on Investment (ROI).

E. Benefits of the Project

The benefits of this project can be identified as:

- A better and healthier environment through the elimination of waste: This plant eliminates the total organic content of the MSW. Without building this plant, the municipality must eliminate MSW using landfills with appropriate impermeable membrane ground cover, etc. Although the plant would generate electricity, it requires some investment. However, what is more important is that landfills need careful handling of both gaseous emissions and groundwater contamination issues. The odors of decaying matter become a concern for the public living nearby.
- Reduction in Green House Gases (GHG): As mentioned above, dealing with MSW will reduce hazardous gases that are of great concern globally and contribute to global warming. This would be achieved in two ways: elimination of methane gas emissions from landfills and electricity generated would replace electricity that would otherwise be generated from fossil-based fuels. The project would significantly contribute to Iraq's commitment to the Paris Agenda of eliminating hazardous gases and limiting global warming by 2050.
- Job creation: The plant is expected to employ 74 people, electrical or mechanical technicians, various plant personnel, security, etc. The cost of salaries and benefits would be \$1.5 million. Job creation is one of the key elements for investment worldwide, in developed or developing countries. The high unemployment rate is always a social concern and will remain so, and employment provides value to the economy.

IV. CONCLUSIONS

FSs are considered the basis for the rest of investment project studies. These studies provide the investor and the project owner with information related to the technical, environmental, social, financial, and economic aspects of the project. Consequently, government institutions sponsoring investment projects must emphasize that investors should pay special attention to this type of study due to its importance in uncovering feasible projects. FSs are required for all types of projects, but in some cases, they are not necessary, such as in projects related to urgent countermeasures after natural disasters.

FSs must be prepared by experts who have sufficient experience in all technical, financial, and economic aspects, and the environmental aspect of the study should be prepared separately by an expert on environmental issues. For the W2E project shown above, although difficult to quantify in monetary terms, the W2E plant delivers an alternative to landfills without concern for odors, land, and air pollution. Such projects have greater social revenues than the economic revenues sought by most investors. Therefore, the government must support investment in such projects and provide all requirements and privileges to investors. Waste energy has been proven to be a clean, environmentally friendly, and effective source of electricity throughout the world. The safest and most economically viable way to deal with MSW is to convert it into energy.

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