FEASIBILITY STUDIES FOR INFRASTRUCTURE CONSTRUCTION PROJECTS: HOW GOOD ARE THEY?

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Abstract

This paper presents an evaluation of feasibility studies conducted to justify investments in infrastructure projects. An analysis of a previous feasibility study for a highway construction project is presented in this paper with an emphasis on the estimates and forecasts presented in that study in order to weigh expected benefits from the project against expected costs. The forecasted numbers are compared with actual data collected during the operation phase about the usage of the facility. The comparison reveals a huge difference between estimated numbers and actual numbers. Based on the lessons learned from the analyzed case study, recommendations are presented to improve feasibility studies for infrastructure projects including: peer review of feasibility studies; before-and-after feasibility studies; and defined scope and methodology for feasibility studies. Decision makers are advised to take outcomes of feasibility studies for infrastructure projects with extreme caution as some studies may provide erroneous and misleading input to their decisions regarding investment in infrastructure projects.

Keywords: Infrastructure Projects, Economic Feasibility, Construction Projects, Construction Planning, Feasibility Validation.

1. Introduction

The feasibility study is a formal technical report that is used to determine whether the proposed project is capable of being developed to generate a sufficient return to justify the capital and other resources that need to be committed to the project [1]. Virtually every new project goes through the "Feasibility Study" phase before actually being built [2]. This phase is particularly important while considering large scale construction projects such as infrastructure projects. Thus, feasibility studies are a vital step in the construction of infrastructure projects. These studies are conducted to evaluate the economical feasibility of projects in order to support decisions regarding the construction of infrastructure projects and to justify the large investments needed for this type of projects.

The United States Senate held a hearing about the management practices of feasibility studies by the US Army Corps of Engineers [3]. The committee on environment and public works in the U.S. Senate wanted to investigate whether the Army Corps of Engineers has a "pro-

construction mentality" which presumably means, the bigger the construction project, the better, even though better alternative may be available. Also, the Senate committee examined the possibility of manipulation of the studies by the Corps Officials to produce results favorable to large scale construction. This serves as the real impetus for this research and a starting point to question the validity of feasibility studies conducted to justify the construction of infrastructure projects. If feasibility studies are based on estimates or forecasts that can be inaccurate or in some cases manipulated, how valid are the feasibility studies of infrastructure projects?

A relatively extensive review of literature to investigate previous research efforts that tackle the validity of feasibility studies in different disciplines revealed the existence of such studies only in the mining industry. Several research studies have addressed the validity and technical soundness of feasibility studies in the mining industry [1, 2, and 4]. Feasibility studies for mining industry share similar characteristics with infrastructure projects including: (1) both types of projects require large initial investment in capital; and (2) both types are usually developed to be operated over a relatively long duration. Despite these similarities, there has been no serious attempt to evaluate the predictive accuracy of feasibility studies conducted prior to the construction of infrastructure projects.

The objectives of this paper are to 1) investigate and examine the predictive accuracy of feasibility studies for infrastructure projects by comparing predicted conditions with actual/current ones for a selected infrastructure project; 2) initiate the practice of measuring the accuracy of feasibility studies of infrastructure projects, and the forecasts presented in such studies; and 3) to identify the main weaknesses and potential sources of errors in feasibility studies. The following section presents the basic structure of an economic feasibility study, while the rest of paper presents a case study of a highway project in Jordan with a comparative analysis between the predicted conditions in the feasibility study and actual conditions on site. Conclusions and recommendations to improve the reliability of feasibility studies are presented based on the findings of this research at the end of the paper.

2 Structure of Infrastructure Feasibility Studies

After a relatively comprehensive review of literature and previous feasibility studies for infrastructure projects, the structure of a feasibility study can be divided into the following five major stages as shown in Figure 1.

1. Identifying alternatives for the project under consideration. This involves considering all possible alternatives to the project under consideration in addition to the current situation which is normally called "do nothing" alternative.

2. Collecting all possible data about practical alternatives. This includes estimates of the construction costs of the considered alternatives in addition to the socioeconomic activity and development in the region affected by those alternatives.

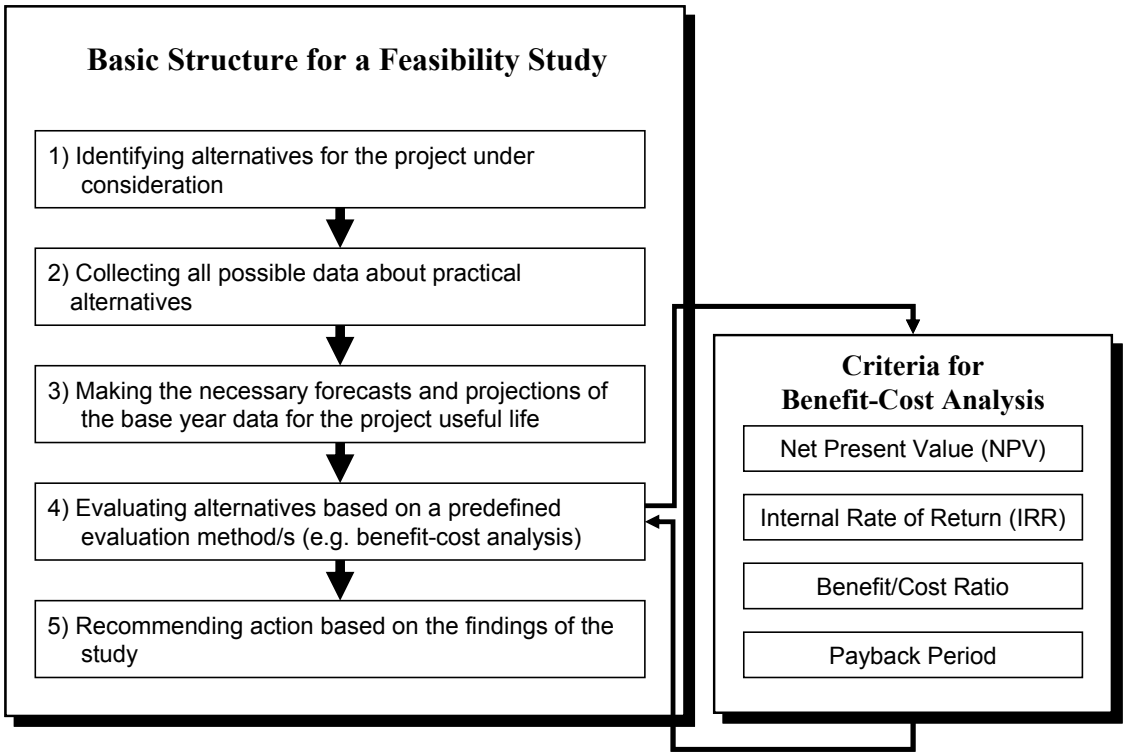

FIGURE 1. Basic Structure for a Feasibility Study

3. Making the necessary forecasts and projections of the base year data for the project useful life. This stage involves estimates of future costs that are expected to be incurred during the life cycle of the proposed project, and forecasts of benefits that are expected to be generated from the considered project during the operating phase of the project. As, forecasting the future is at best a risky business, risks associated with these estimates need to be identified and evaluated. Risks associated with the feasibility of infrastructure projects can be divided into two categories: (a) project risks where the actual cost of developing the project exceeds the estimated costs due to unforeseen conditions geotechnical problems or unexpected weather conditions; and (b) benefits risks where forecasted demand for the project appear to be overestimated in the feasibility study.

4. Evaluating alternatives based on a predefined evaluation method/s. The most widely used evaluation method to determine the feasibility of infrastructure projects is the benefit-cost analysis [5, 6, 7, 8, 9, and 10]. After estimating the costs and benefits of each project alternative, a discounted cash flow analysis is usually performed for the developed cash flow that represents the stream of both benefits and costs over the lifetime of the facility. The main criteria used in the cost benefit analysis to verify the financial viability are: 1) net present value (NPV); 2) internal rate of return (IRR); 3) benefit/cost ratio; and 4) payback period [5, 8, and 9]. Further methods for supporting decision-making in the construction of infrastructure projects include: multicriteria

analysis and risk based analysis [6, 8, and 11]. However, these methods are regarded as complementary rather than competitive analytical tools to benefit cost analysis [11].

5. Recommending action based on the findings of the study. The project is considered economically feasible and recommended when a) the benefit is greater than the cost, and b) the profitability of that project is greater than those of other alternatives [8].

3 Case Study: Tafileh- Ghor Fifa Road

3.1 Background

On July 1988, the ministry of public works and housing (MPWH) in Jordan awarded a contract to a local consultant to develop an economic analysis of the costs and benefits of constructing a proposed 2-lane road linking the city of Tafileh with Ghor Fifa (i.e. linking "Road No. 49" with "Road No. 65"), with a total length of 24.4 kilometers as shown in Figure 2 [12]. The consultant investigated the feasibility of three alternatives namely: 1) do nothing alternative with an estimated cost of 0 Jordan Dinars (JD); 2) full construction of the proposed road with an estimated cost of JD5,188,806; and 3) stage construction of the project with an estimated cost of JD4,740,592 for stage 1 and JD483,214 for stage 2. All estimated costs were in 1988 JDs. The Consultant divided the road into two sections; the first one is the existing route from Tafileh-Shobak Road (i.e. Road No. 49) to the village of Sinifha with a length of 4.5 km, while the second one is the rest of the road from Sinifha to Ghor Fifa (i.e. Road No. 65). Afterward, the consultant submitted the final feasibility report in march1989, and concluded that it is economically feasible and reasonably profitable to construct the proposed road. The feasibility study report revealed that alternative 3 project (i.e. stage construction of the proposed road) ranked first with an internal rate of return (IRR) of 16.4%, while alternative 2 project (full construction of the proposed road) ranked second with an IRR of 15.4%.

3.2 Comparative Analysis

The consultant developed the economic feasibility report of the project alternatives by weighing the expected net benefits to road users over the analysis period against the construction and maintenance costs of each alternative. The considered benefits to road users were: savings in vehicle operating costs and savings in travel time. Savings in vehicle operating costs were calculated by comparing vehicle operating costs for the “Project” and “No Project” alternatives. The benefits are estimated for a single vehicle, and then multiplied by the projected traffic volumes that are expected to use the proposed road throughout the analysis period. Thus, the principal factor in determining the economic feasibility of the project was the anticipated traffic volumes over the analysis period.

To examine the validity of estimates and projections used in the feasibility study report, actual traffic counts on the road for six successive years (i.e. 1999 to 2005) were obtained from the traffic safety department at the MPWH. By comparing estimated traffic volumes and actual

traffic counts as shown in Table 1 and Figure 3, it is obvious that estimated traffic did not materialize and actual traffic is much less than anticipated traffic. On average, actual traffic volumes are only 12.5% of the estimated traffic volumes used to develop the economic feasibility of the road. Furthermore, it is noteworthy that actual counts performed by the MPWH represent unclassified count and the counting unit is number of axles divided by two, while the projected traffic by the consultant represents classified average daily traffic which means that actual number of vehicles is less than the numbers obtained from the MPWH. This means that the deviation between projected and actual numbers is even larger.

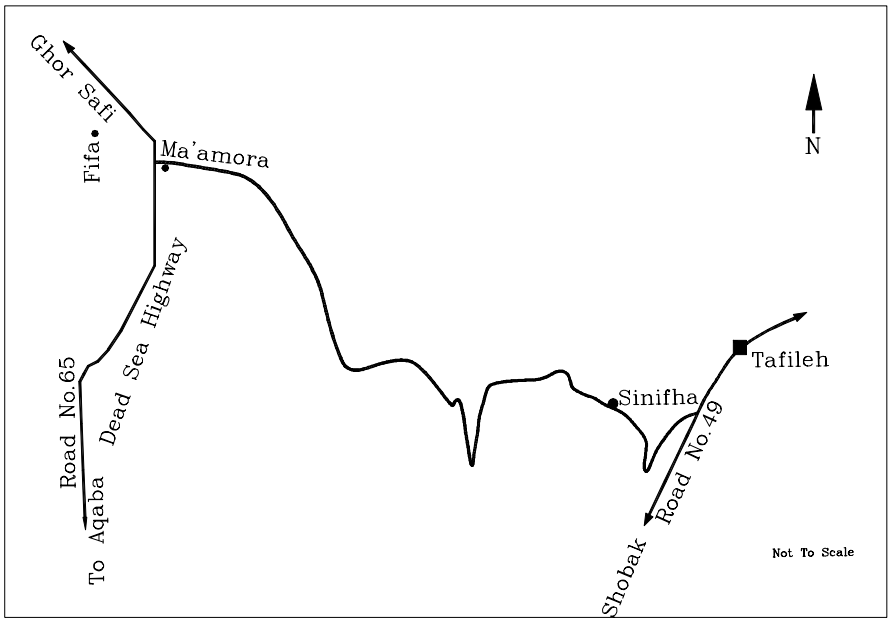

FIGURE 2. Tafileh- Ghor Fifa Road

3.3 Discussion

Based on the above comparison, the legitimate question to ask: what would be the results of the economic feasibility study if actual numbers were used to prepare the feasibility study instead of the projected numbers? Although this seems to be a theoretical question that has no impact on the considered project since investment was already been made on this project, it clearly brings to light the issue of the credibility of the economic feasibility study. Also, the main lesson that can be extracted from the above comparison is that outcomes of feasibility studies should not be taken for granted and the difference between numbers projected in such studies and actual numbers could be tremendously huge. If actual traffic volumes is only 12.5% of the estimated traffic counts as shown in Table 1, this represent an error percentage of 700% in traffic estimates and projections. Therefore, traffic estimates and projections represent the weakest point in the economic feasibility study for transportation projects that may jeopardize the validity of such study. Errors in traffic volumes can be attributed to two sources: (1) errors in estimated base year traffic that consists of local traffic, diverted traffic who currently use other alternative routes, and generated traffic due to the construction of the

road; and (2) errors in the projected traffic growth rates adopted by the consultant after considering the population, economic and development trends in the region

TABLE 1. Projected Versus Actual Average Daily Traffic on Tafileh Ghor Fifa Road

Year	Average Daily Traffic			
	Projected		Actual*	
	Section 1	Section 2	Section 1	Section 2
1991	1977	615		
1992	2079	677		
1993	2188	744		
1994	2307	819		
1995	2432	900		
1996	2546	968		
1997	2666	1040		
1998	2855	1180		
1999	2927	1202	378	
2000	3068	1292	365	
2001	3188	1357	268	
2002	3310	1425	374	
2003	3437	1496	628	
2004	3570	1571	444	
2005	3708	1649		251
2006	3852	1731		
2007	4003	1818		
2008	4159	1909		
2009	4322	2004		
2010	4492	2105		

* Actual counts performed yearly by the traffic safety department- Ministry of Public Works and housing

4 Conclusions

A comparative analysis between estimates and projections used to develop a feasibility study for an infrastructure project and actual numbers obtained after constructing the facility was performed. The analysis indicates a substantial discrepancy between estimated and actual numbers. Therefore, the outcomes of feasibility studies should not be taken for granted. Decision makers should exert every possible effort to ascertain that analyses presented in a feasibility study report are based on reasonable forecasts and reliable information. For transportation projects, estimated traffic conditions represent the most vulnerable element that affects the validity of such studies.

There is a pressing need for improving the validity of feasibility studies for infrastructure projects in order to: (1) ascertain that allocation and expenditure of public money follows standard, systematic and transparent procedures; (2) minimize the effect of political pressure on decisions taken regarding the construction of infrastructure projects; and (3) promote public/private partnership, and introduce capital investments in infrastructure projects as the soundness of economic feasibility is the sole factor in attracting private investments in infrastructure projects.

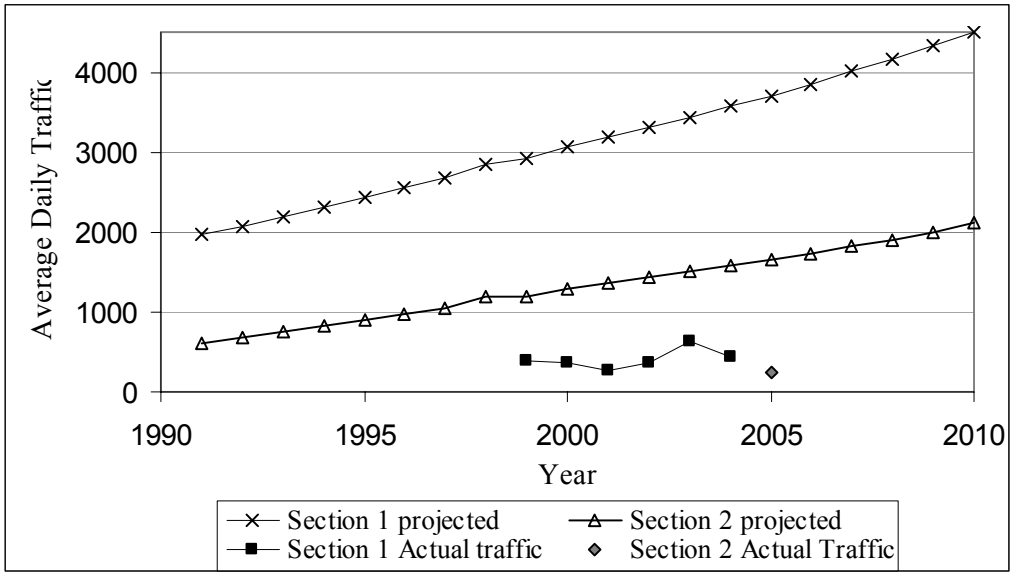

FIGURE 3. Projected Versus Actual Traffic Counts

5. Recommendations for Improvement

Based on the previous review of the problem and lessons learned from it, specific recommendations were drawn to improve this vital step in the construction of infrastructure projects including: (1) peer reviews of feasibility studies; (2) before-and-after feasibility studies; and (3) defined scope and methodology for feasibility studies. The following paragraphs provide a brief description of these recommended practices.

5.1 Peer reviews of feasibility studies

Feasibility study reports should be reviewed and analyzed by experts in order to enhance the quality of this important document. This process can be done in the following sequence:

1. Asking the award wining consultant who is preparing the feasibility study to submit a draft of the study to the owner (e.g. department of transportation) before submitting the final feasibility study report for approval.

2. After getting the draft study, the owner needs to ask experts in this area (i.e. peer reviewers) to review the document. Peer reviewers can be selected from local and/or international consultant offices, economic experts, and academic people.
3. Peer reviewers are required to answer the primary question: is the study appropriately prepared? and submit a report that includes: (a) critical review of the draft feasibility study; (b) identification of major deficiencies and/or areas of weakness in the draft if any; and (c) specific recommendations to improve the study.
4. Award wining consultant should include this review as an appendix in the final submitted study, and should respond and address all comments in theses reviews to the satisfaction of the owner of the project (e.g. department of transportation).

The expected advantages from following this approach includes: (1) providing another layer that can help in ensuring the objectivity of these studies; (2) motivating consultants team to excel in their work knowing that such studies will be subjected to analytical and critical reviews by experts in this area; (3) providing a broader evaluation of the assumptions and analyses of the draft feasibility study; (4) assuring financing agencies that feasibility studies are prepared to the best possible knowledge of experts in a transparent way; and (5) providing owners with additional confidence in the statements and conclusions of the feasibility study.

5.2 Before-and-After Feasibility Studies

Owners should have a procedure for the assessment of the validity and accuracy of previous feasibility studies that were conducted to justify existing facilities (i.e. projects that are in the operation phase). This approach is intended to put in test a selected set of previous feasibility studies performed in the past. For each feasibility study, all the factors and assumptions used to arrive at a decision regarding the project under consideration should be reexamined and compared to actual data, and check how actual data deviates from data projections and estimates used in the original feasibility study. This will determine what the project actual rate of return is, and if other alternatives would be more feasible if actual data were known while preparing the original feasibility study. Although this recommended practice has no effect on the examined project since decisions are all been made, but this will provide valuable information for studying new projects, and will demonstrate areas of strength and weakness in models used to project base year date to future years. Any deficiencies in used models can be identified, and lessons can be extracted and made available to all researchers, consultants in charge of preparing feasibility studies, and other infrastructure departments who utilize similar information in their feasibility studies. This will provide indirect validation to the feasibility studies, and extend the use of feasibility studies from only the pre-construction phase to all project life cycle.

5.3 Defined Scope and Methodology for Feasibility Studies

Feasibility studies for different projects are usually performed by different consultants. As such, preparing feasibility studies without a unified guidelines and evaluation criteria for all projects makes the development of such projects highly subject to the bias of the consultant and/or the owner of these projects (e.g. department of transportation). Therefore, standardization to what constitutes an acceptable feasibility study, and even more to what

constitute an acceptable measure of economic viability, should be developed. The scope and methodology of such studies should be well defined in order to establish a basis for comparing economic feasibility of different projects. This is particularly important when owners have to prioritize these projects due to financial constraints. This is often the case in infrastructure projects, where government officials need to allocate a limited budget to a selected number of projects out of the whole set of considered projects for construction. If the scope in these projects is not well defined and if different methodologies were adopted for studies of different projects, there is no basis for comparing the outputs of these feasibility studies in order to prioritize them.

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