Jordan Journal of Civil Engineering, Volume **3**, No. **1**, **2009**

Validity of Feasibility Studies for Infrastructure Construction Projects

***Khalied Hyari* [1)] *and Amr Kandil* [2)]**

[1)] Assistant Professor, Department of Civil Engineering, The Hashemite University, P.O. Box 150459, Zarqa 13115, Jordan, Email: hyari@hu.edu.jo
[2)] Assistant Professor, Department of Civil, Construction and Environmental Engineering, Iowa State University, Ames, Iowa 50011, Email: kandil@iastate.edu

ABSTRACT

Feasibility studies are normally conducted to justify investments in infrastructure projects. Despite the vital importance of feasibility studies in supporting decisions related to public spending on infrastructure projects, there are no attempts to evaluate such studies after construction of facilities. 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. Feasibility study calculations are also repeated using the actual data to examine the impact of forecasting errors on the outcome of the feasibility study. 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, multistage feasibility studies and unified 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: Construction cost, Infrastructure projects, Economic feasibility, Construction, Projects, Construction planning, Feasibility validation.

INTRODUCTION

Examples of infrastructure projects include highways, tunnels, bridges, water mains, dams, sewage systems, water treatment plants, power generation plants and pipeline networks. Infrastructure projects can be classified as large construction projects that utilize vast amount of resources in terms of money, materials, labor, equipment and time (Salman et al., 2007; Kulkarni et al., 2004; Morley, 2002). Massive expenditures on infrastructure projects need to be weighed against the expected benefits resulting from these projects to the public and the national economy. Therefore, economic feasibility studies need to be conducted prior to the construction of infrastructure facilities.

The economic feasibility study of a project is an estimate of the potential profitability of that project, or a study that measures the expected benefits from a certain project relative to its cost (Johnson and McCarthy, 2001; Wong et al., 1999). Owners, decision makers and financial institutions build their decisions to proceed with and/or finance any project based on the results of the feasibility study of that project (Abou-Zeid et al., 2007; Vancas, 2003). Ensuring the validity of economic feasibility studies of infrastructure projects is a vital step

Accepted for Publication on 15/1/2009.

in ascertaining that decisions related to the construction of infrastructure facilities are based on consistent and standard procedures that avoid the use of misleading or inadequate information.

Table (1): Cost of preparing economic feasibility for infrastructure projects.

Project	Year	Contract Amount in JD (2008 $*)
Economic Feasibility Study for Irbid - North Shuna Road	1996	20500 (72,914)
Economic Feasibility Study for Aqaba Coastal Highway	1996	35350 (125,732)
Economic Feasibility for Kufrhoda-Ghor Road	1996	28000 (99,590)
Economic Feasibility for Yajooz-Shafabadran-Sukhna Road	1996	33000 (117,374)
Economic Feasibility for Amman Ring Road	1997	273971 (902,247)
Economic and Technical Feasibility of Sewage Facilities for Yarmook River Basin	1996	741000 (2,635,574)
Economic Feasibility for the Construction of Land Port Near Amman Developmental Corridor	2003	85000 (176,399)

*** Considering a discount rate of 8%, all contract amounts are transformed to current U.S. Dollars.**

Also conducting an economic feasibility study for any infrastructure project entails committing valuable resources in terms of time and cost. Table (1) presents examples of fees paid to engineering consultants in Jordan for the preparation of economic feasibility studies for infrastructure projects. Contract amounts in Table (1) were converted to 2008 U.S. Dollars.

The United States Senate held a hearing about the management practices of feasibility studies by the US Army Corps of Engineers (Army Corps of Engineers: Management of Feasibility Studies, 2002). 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. Baron (1995) presented several cases of manipulating economic feasibility studies for several infrastructure projects in Germany based on prior political decisions. Paron also reported that billions of U.S. dollars were and will be wasted in Germany for prestigious investment projects of which the economic feasibility was never correctly assessed (Paron, 1995). These cases served 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 tackled 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 (Vancas, 2003; Johnson and McCarthy, 2001; Goode et al., 1991). 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.

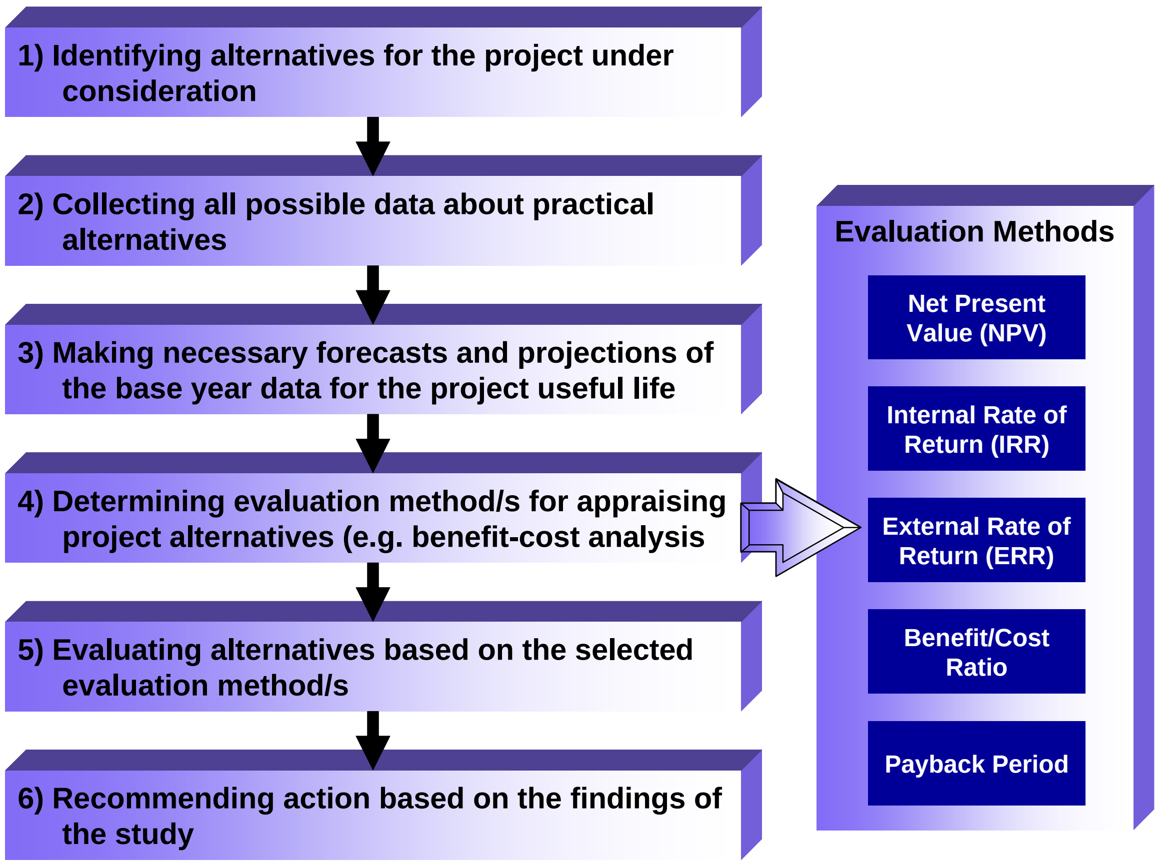

Figure (1): Basic structure of feasibility studies.

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 the 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.

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 six 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.

Table (2): Percentage of actual to the projected traffic on Tafileh Ghor fifa road.

	Average Daily Traffic					
	Section 1			Section 2		
Year	**Projected**	**Actual***	**Percentage****	**Projected**	**Actual***	**Percentage****
1999	2927	378	12.9%	1202		
2000	3068	365	11.9%	1292		
2001	3188	268	8.4%	1357		
2002	3310	374	11.3%	1425		
2003	3437	628	18.3%	1496		
2004	3570	444	12.4%	1571		
2005	3708	482	13.0%	1649	251	15.2%
2006	3852	497	12.9%	1731		

* Actual counts performed yearly by the Traffic Safety Department- Ministry of Public Works and Housing.

** Percentage of actual to the projected daily traffic.

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.
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 (e.g. geotechnical problems) or unexpected weather conditions; and (b) benefit risks where forecasted demand for the project appear to be overestimated in the feasibility study.

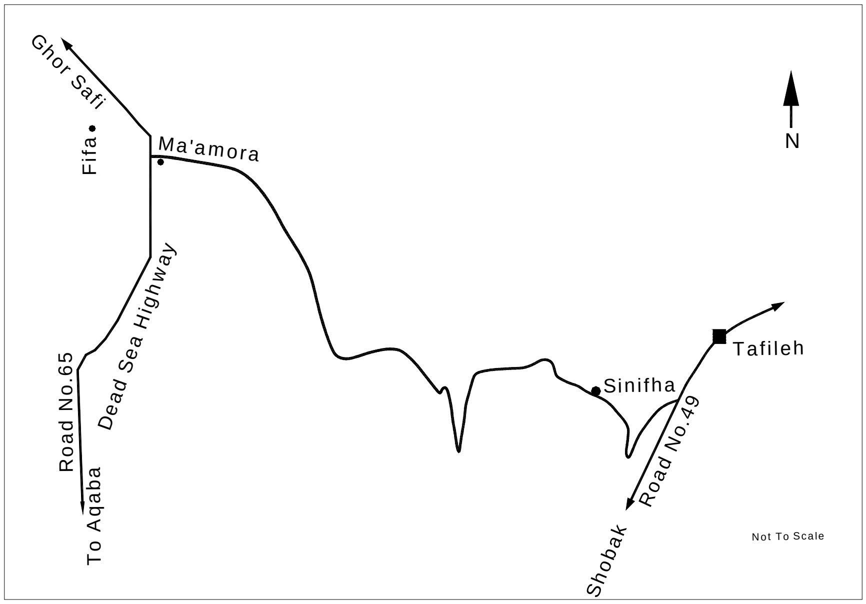

Figure (2): Tafileh-Ghor Fifa road.

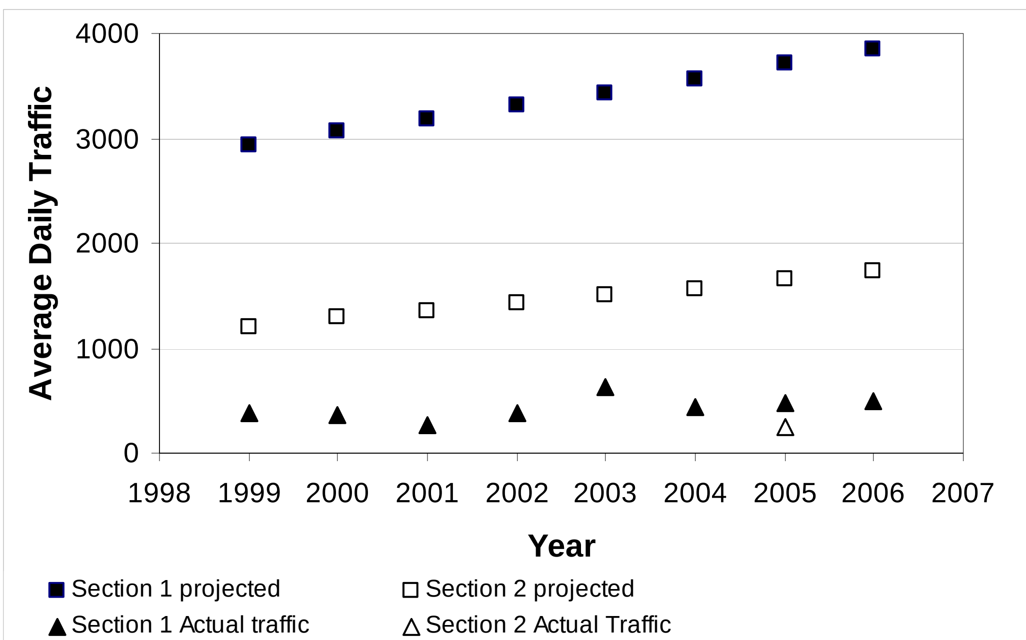

Figure (3): Projected versus actual traffic volumes.

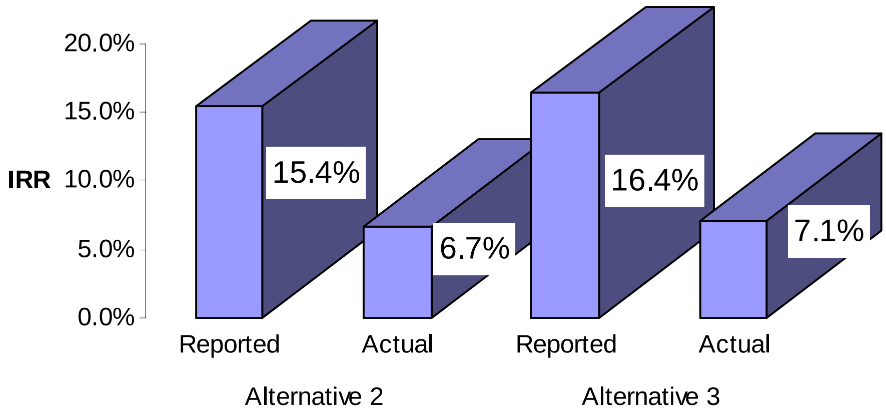

Figure (4): Reported versus actual internal rate of return.

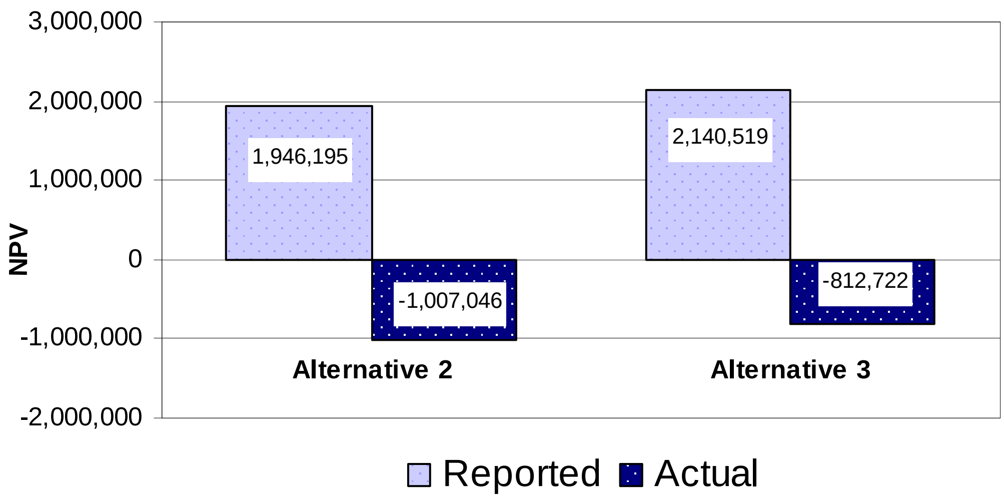

Figure (5): Reported versus actual net present value.

4. Determining evaluating method/s for appraising project alternatives. The most widely used evaluation method to determine the feasibility of infrastructure projects is the benefit-cost analysis (Brzozowska, 2007; Kulkarni et al., 2004; Fosgerau and Jensen, 2003; Leleur, 2002; Vries, 2002; Tanczos and Kong, 2001; Ye and Tiong, 2000; FHWA, 1998). For example, in the case of highway projects, the considered costs include project costs, users as well as non-users as well as department of transportation costs. The benefits include reduction in vehicle operating costs, the monetary equivalent value of time savings to road users and possibly the monetary equivalent value of the expected reduction in accidents, injuries and fatalities that would result from use of a new facility (Vries, 2002; FHWA, 1998). Those estimated benefits per vehicle are then multiplied by the expected amount of traffic in the future over the analysis period of the study (Vries, 2002). Further methods for supporting decision-

making in the construction of infrastructure projects include multicriteria analysis and risk based analysis (Leleur, 2002; Tanczos and Kong, 2001; Tsamboulas et al., 1999). However, these methods are regarded as complementary rather than competitive analytical tools to benefit cost analysis (Tsamboulas et al., 1999).

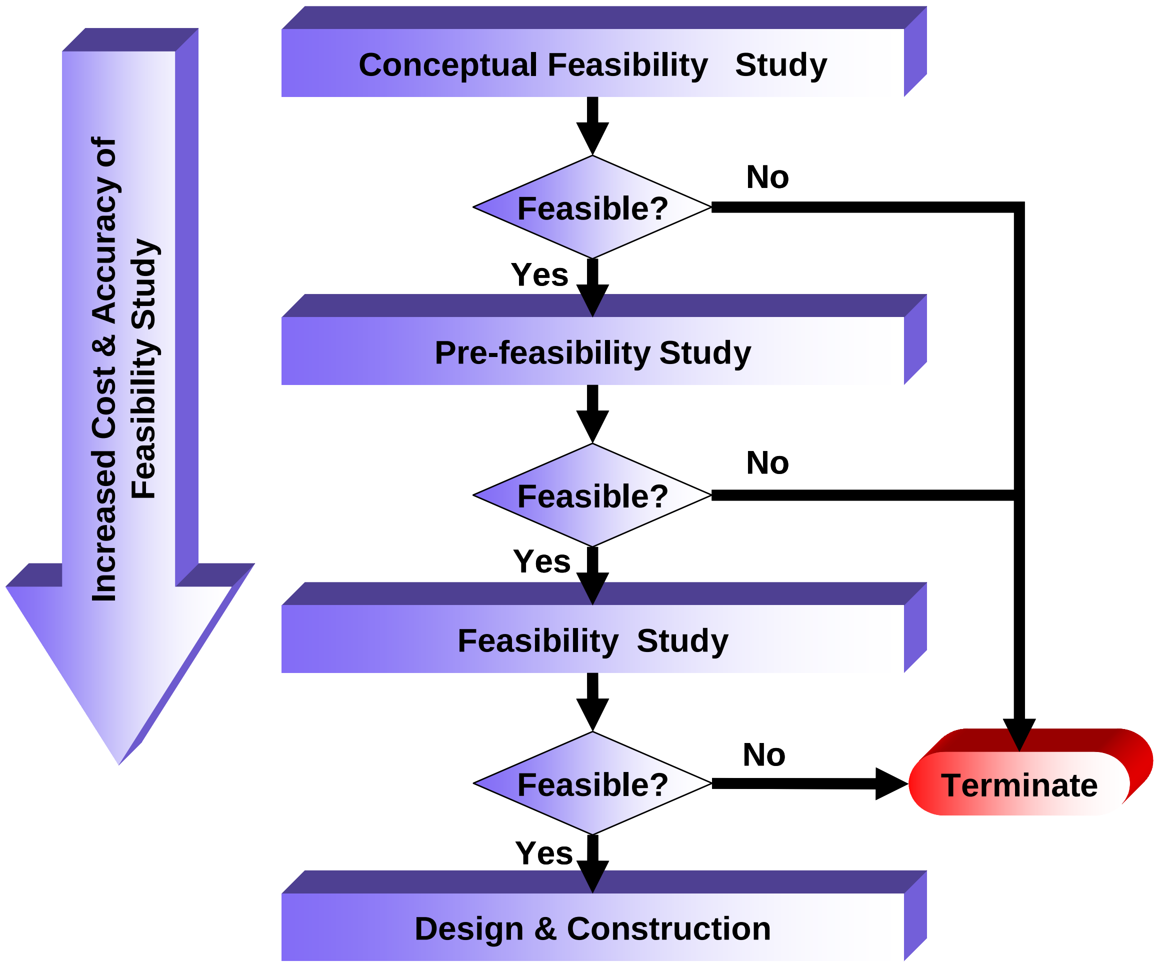

Figure (6): Multistage feasibility study.

5. Evaluating alternatives based on the selected evaluation method/s. This stage involves performing discounted analysis for the developed cash flow that represents the stream of both benefits and costs over the lifetime of the facility. This analysis needs to be performed for each project alternative. The main criteria used in the analysis to verify the financial viability of each of the developed alternatives are: 1) Net Present Value (NPV); 2) Internal Rate of Return (IRR); 3) External Rate of Return (ERR); 4) benefit/cost ratio; and 5) payback period (Sullivan et al., 2006; Fosgerau and Jensen, 2003; Tanczos and Kong, 2001; Ye and Tiong, 2000).
6. 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 (Brzozowska, 2007; Tanczos and Kong, 2001).

CASE STUDY: TAFILEH-GHOR FIFA ROAD

Background

In 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 km as shown in Figure 2 (Habib Associates, 1989). 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 4.4 km, while the second one is the rest of the road from Sinifha to Ghor Fifa (i.e. road no. 65) with a length of 20.0 km. 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. Stage 1 involves the new construction of section 2 of the road from Sinifha to Ghor Fifa with a length of 20.0 km with some improvements to section 1. Stage 2 involves the reconstruction of section 1 from the beginning of the road to the village of Sinifha with a length of 4.4 km. All estimated costs were in 1988 JDs. Afterwards, the consultant submitted the final feasibility report in march 1989 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%.

Comparative Analysis and Discussion

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 (VOC) 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 data regarding the usage of the road during the operation phase was obtained from the MPWH. The obtained data includes average daily traffic counts on the road performed by the traffic safety department over consecutive years (i.e. 1999 to 2006). By comparing estimated traffic volumes and actual traffic counts as shown in Table (2) 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 12.6% of the estimated traffic volumes used to develop the economic feasibility of the road as shown in Table (2). Furthermore, it is noteworthy that actual counts performed by the MPWH represent unclassified counts and the counting unit is the number of axles divided by two, while the projected traffic by the consultant represents classified average daily traffic which means that the actual number of vehicles is less than the number obtained from the MPWH. This means that the deviation between projected and actual numbers is even larger.

Based on the above comparison, the legitimate question is: What would be the results of the economic feasibility study if the actual numbers were used to prepare the feasibility study instead of the projected numbers? To answer this question, the feasibility study calculations were repeated using the same parameters (i.e. VOC benefits, travel time benefits, growth rates and traffic composition) utilized in the original study with the exception of using actual traffic numbers rather than the projected ones. The results of redoing the feasibility study reveals that the IRR values of alternatives 2 and 3 are 6.7% and 7.1% rather than 15.4% and 16.4% as shown in Figure (4). Recalculating the net present value for the two alternatives, utilizing the same discount rate adopted in the original study, also reveals a considerable difference as shown in Figure (5). The reported net present values for alternatives 2 and 3 in the original study are 1,946,195 and 2,140,519, respectively, while the calculated ones for alternatives 2 and 3 are -1,007,046 and -812,722, respectively. Although this seems to be a theoretical comparison that has no impact on the considered project since investment was already been made in 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 the actual traffic volume is only 12.5% of the estimated traffic counts as shown in Table (2), this represents 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 that currently uses 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.

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; (3) multistage feasibility studies; and (4) unified scope and methodology for feasibility studies. The following paragraphs provide a brief description of these recommended practices.

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:

- 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.
- 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.
- 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.
- The award winning 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 include: (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 analysis 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.

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 it should be checked 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 have all been made, this will provide valuable information for studying new projects and will demonstrate areas of strength and weakness in models used to project base year data 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 that 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.

Multistage Feasibility Study

The result of an economic feasibility study, by definition, will be either the project is feasible and should be advanced to the design and construction phases or it is not feasible. However, current practices in infrastructure projects show that the second possibility is often forgotten. This can be attributed in many cases to the procedures adopted by awarding studies of economic feasibility to engineering consultants. When the owner awards a contract to an engineering consultant to perform a detailed economic feasibility study for a certain infrastructure project, this phase entails a considerable commitment of time and financial resources to perform the study. Unfortunately, once a project is advanced to this stage (i.e. detailed feasibility study), the implied assumption will be that the project is feasible.

Staging the economic feasibility study to three phases as shown in Figure (6) will help reducing this problem. The suggested stages are: (1) conceptual feasibility study; (2) pre-feasibility study; and (3) feasibility study. The first study (i.e. conceptual study) is a scoping study that should be completed on a project to provide initial evaluation. Estimates for costs and benefits will be based on limited data and engineering work (design and testing), and as a result rely more on previous experiences and an order of magnitude estimates. A study of this level is valid to determine whether a project is worth pursuing further or not.

The second study (i.e. pre-feasibility study) is the intermediate step in the project evaluation. At this stage, there is sufficient data and preliminary engineering design data to improve the estimates performed in the previous stage. The goal of this stage is to determine preliminary estimates for costs and benefits based on further data and analysis. As part of this process, areas of concern that need further research during the feasibility stage should be identified.

The third study (i.e. feasibility study) is simply a refinement of the pre-feasibility study, which evolved from the conceptual study. Key components in the feasibility study are the detailed design, detailed cost and benefit estimates, consideration of environmental and socioeconomic issues and an economic model of the project. The final study provides the basis for the decision on whether to advance the project to design and construction phases. The increasingly stringent steps provide the possibility of terminating the study at the end of each stage if the findings reveal the infeasibility of the project.

Unified Scope and Methodology for Feasibility Studies

Feasibility studies for different projects are usually performed by different consultants. As such, preparing feasibility studies without 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 constitutes 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.

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.

REFERENCES

Abou-Zeid, A., Bushraa, A. and Ezzat, M. 2007. Overview of Feasibility Study Procedures for Public Construction Projects in Arab Countries, *The Journal of King Abdulaziz University: Engineering Sciences*, 18 (1): 19-34.

Army Corps of Engineers: Management of Feasibility Studies. 2002. Hearing before the Subcommittee on Transportation and Infrastructure of the Committee on Environmental and Public Works, United States Senate, *One Hundred Seventh Congress*, First Session on Management Practices of the Corps in Conducting Studies of New Projects, Especially the Upper Mississippi River-Illinois River Waterway Feasibility Study, March. 15, 2001, Washington.

Baron, P. 1995. Transportation in Germany: A Historical Overview. *Transportation Research* - A. 29A (1): 9-20, Elsevier Science Ltd.

Brzozowska, Krystyna. 2007. Cost-Benefit Analysis in Public Project Appraisal, *Engineering Economics*, 53 (3): 78-83, Lithuania.

FHWA. 1998. Procedural Guidelines for Highway Feasibility Studies. Federal Highway Administration, U.S. Department of Transportation. http://www.fhwa.dot.gov/hep10/corbor/feastudy.html

Fosgerau, M., and Jensen, T. 2003. Economic Appraisal Methodology- Controversial Issues and Danish Choices, *Proceedings of the European Transport Conference,* 8-10 October, Strasbourg, France.

Goode, J., Davie, M., Smith, L. and Lattanzi, C. 1991. Back to Basics: the Feasibility Study, *CIM Bulletin*, 84, No. 953.

Habib Associates. 1989. Feasibility Study for the Tafileh-Ghor Fifa Road. Final Report, February 1989, Amman, Jordan.

Johnson, R. and McCarthy, M. 2001. Essential Elements and Risks in Bankable Feasibility Studies for Mining Transactions, Parsons Behle and Latimer, Salt Lake City, Utah, March 2001.

Kulkarni, R., Miller, D., Ingram, R., Wong, C. and Lorenz, J. 2004. Need-Based Project Prioritization: Alternative to Cost-Benefit Analysis. *Journal of Transportation Engineering, ASCE*, 130 (2): 150-158.

Leleur, S. 2002. New Appraisal Methods in Transport Planning with an Emphasis on Large Transport Infrastructure Projects. Paper presented at the *VEJFORUM Conference* in Nyborg, Denmark, December, 2002. Published on the VEJFORUM website.

Morley, A. 2002. The Economic Benefits of Infrastructure Projects Procured with Private Finance. *FIG XXII International Congress*, April 19-26 2002, Washington, D.C. USA.

Salman, A., Skibniewski, M. and Basha, I. 2007. BOT Viability Model for Large-Scale Infrastructure Projects. *Journal of Construction Engineering and Management, ASCE*, 133 (1): 50-63.

Sullivan, W., Wicks, E. and Luxhoj, J. 2006. Engineering Economy, Thirteenth Edition, Prentice Hall.

Tanczos, K. and Kong, G. 2001. A Review of Appraisal Methodologies of Feasibility Studies Done by Public Private Partnership in Road Project Development, *Periodica Polytechnica: Transportation Engineering,* 29 (1-2): 71-81, 2001, Budapest Technical University.

Tsamboulas, D., Yiotis, G. and Panou, K. 1999. Use of Multicriteria Methods for Assessment of Transport Projects, *Journal of Transportation Engineering, ASCE,* 125, (5), September/October 1999.

Vancas, M. 2003. Feasibility Studies: Just How Good Are They? *Proceedings of Hydrometallurgy 2003 – Fifth International Conference in Honor of Professor Ian Ritchie*, Vol. 2: Electrometallurgy and Environmental Hydrometallurgy, The Minerals, Metals and Materials Society.

Vries, G. 2002. Instruction Manual and Template for Feasibility Studies for Large Scale Infrastructure Roads Projects. Publication Prepared and Published With Financial Support from the European Union, Tebodin B.V., the Netherlands.

Wong, C., Holt, G. and Cooper, P. 1999. Project Feasibility Studies- Their Role in Promoting Better Practice: A UK and Malaysia Comparison. *Proceedings of the 2nd International Conference on Construction Industry Development*, and *1st Conference of CIB TG 29 on Construction in Developing Countries*, 27-29 October 1999, The Pan Pacific, Singapore.

Ye, S. and Tiong, R. 2000. NPV-at-Risk Method in Infrastructure Project Investment Evaluation, *Journal of Construction Engineering and Management, ASCE*, 126 (3), May/June, 2000.