Applying technical-economic indices to compare and select an investment option for transport infrastructure projects

Tran Quang Phu

Department of Transport Economics

Ho Chi Minh City University of Transport

Ho Chi Minh City, Viet Nam

Huynh Thi Yen Thao

***Abstract*— In terms of a project's evaluation, economic experts prefer to use the Discounted Cash Flow (DCF) technique to provide financial indices such as Net Present Value (NPV), Internal Rate of Return (IRR) and Benefit/Cost (B/C), while engineering experts concentrate on technical aspects based on design and construction standards. Thus, it is important to establish which approaches can combine both economic and technical indices for project evaluation. In line with this, this paper introduces the combination of a multi-criteria method (MCM) and financial analysis in order to produce technical-economic indices which can be used to compare and select the best investment option in transport infrastructure projects. The process of applying technical-economic indices is illustrated via the case of the Dong Nai Bridge project in Vietnam. Methods and indices used for project evaluation were; Analytic Hierarchy Process (AHP), Net Present Value (NPV), Internal Rate of Return (IRR) and Benefit/Cost (B/C). In this study, the AHP method was applied in order to compare the design options of the project, while the DCF technique was used for the purpose of financial analysis. The application of case study shows that the combined approach can improve the comprehensiveness of the decision-making process in investment projects.**

Keywords — Investment selection; project evaluation; and multi-criteria method.

I. Introduction

Due to large scope and the involvement of a varied range of stakeholders in infrastructure projects, the evaluation process at the initial stage is complicated and may have significant impacts on project performance in the following stages. Bristow and Nellthorp [1] assert that the evaluation of transport projects is usually viewed as a way to give relevant details to those making decisions for the purpose of prioritizing a program's projects: selecting alternative solutions that pertain to a common problem; ascertaining the social monetary value of specific projects; and determining when investments must be made. As a result, a transport project's evaluation needs to succeed in a situation whereby an outcome is obtained based on compromise and agreement, as the result will need to be determined by a combination of interests, ideas and actors [2].

The issue, though, is that the external environment is generating challenges for project managers. The relationship between project elements is varied and complex. Inter-elemental relationships can be quite non-linear whereby elemental changes may not be simply proportional to each other. Furthermore , the integral parts of a project's problems include judgment systems and human values [3]. Hence, an optimal decision-making ability is crucial to a project's success. Depending on experience and background, project managers could choose their own ways of undertaking tasks or utilise solutions for project problems determined by consultants. Most practitioners concentrate on utilizing static models pertaining to direct costs data and benefits of a given project, following which they utilise discounted cash flow (DCF) method, along with its indices like cost-benefit ratio (B/C), Net Present Value (NPV) and Internal Rate of Return (IRR) to assess the financial performance of the project. Some authors, however, argue that DCF technique's financial tools are hard to follow and could be devoid of benefits and practicality [4]. Thus it is difficult to determine values of projects utilising monetary terminology and it is vital to incorporate criteria of assessment into the processes of making decisions. Along the same lines, the multiple criteria decision-making (MCDM) is an approach that endeavours to resolve problems in the evaluation of projects. Such approaches form the core steps of decision analysis and theory, and aim to explicit account of more than one criterion to support the process of making decisions [5]. This process will decision-makers to realise the problems faced, realise other parties' and their own systems of personal values, and realise organisational objectives and values, along with exploring these in relation to the problem and guide them in identifying a practicable action course [5-8]. Thus the MCDA is useful in situations which need to consider multiple action courses, and should not just be single dimension-evaluated [5]. When MCDA is utilised in a transport project's evaluation, there are always analytical conflicts with regards to the project's impacts. Conflicts arise as different aspects such as political, environmental, socio-economic and technical play a part in the assessment of impacts. Hence the evaluation of transport aims to locate an acceptable and alternative compromise. The impacts can be hard to be valued monetarily from the point of view of some social aspects. Thus, this paper aims to combine a traditional method with MCDM in order to improve the efficiency of decision-making processes.

The outline of this paper includes three main parts; background, research methodology, case study and its application. This research is focused on comparing design options of the project by using AHP and then finalizing the best option via applying Discounted Cash Flow (DCF) techniques of traditional methods.

II. BACKGROUND

Many studies have been undertaken to suggest possible approaches which could factor in problematic issues in the evaluation and selection of projects. The project's strategic intent, project selection factors, quantitative and qualitative models for project selections have been discussed extensively by [9]. Project selection methodologies were surveyed by Shpak and Zaporojan [10]. Utilisation of operation research tools were discussed in many articles on selection of projects. Utility function was used by Mehrez and Sinuany-Stern [11], while goal programming was applied by Dey, et al. [12]. Project selection processes utilising fuzzy theory were shown by Chu, et al. [13]. A 0–1 integer-based linear programming model was used to select ad schedule a project portfolio [14]. AHP has been used by multiple authors to aid in solving decision-making issues in the selection of projects [15, 16].

Saaty [17-19] developed the decision-aiding method of Analytical Hierarchy Process (AHP), which seeks to quantify relative priorities for a particular set of ratio scale alternatives , based on the decision-maker's judgment: in addition it focuses on the critical aspect of judgements that are intuitive, along with the consistency of the alternative's comparison [17]. The initial step is formulating the decision problem as a hierarchical structure. The top level mirrors the overall aim of the decision problem in a typical hierarchy. Intermediate levels represent the decision-affecting elements. Decision options occupy the lowest level. The decision-maker begins a prioritization procedure once a hierarchy is finalised, in order to ascertain the elements' relative importance across each hierarchy level. In regards to their importance of decision-making under consideration, elements in each level are taken and compared as pairs. Following the creation of comparison matrices, various elements are derived from relative weights. A normalised vector of the total options' weights is the aggregation's outcome.

The AHP approach augurs well in regards to a decision-maker's behaviour, as judgments of a decision-maker are based on experience and knowledge. This approach organises both intangible and tangible factors systematically, thus giving it an advantage, providing a simple yet structured solution to the problems of decision-makers [20]. Experts can connect the small to the large, through simple paired comparison judgments, by breaking a problem down in a logical fashion from the large, into gradual steps, to the smaller and smaller. In practice, AHP is used by researchers in many industrial applications. Decision-making using operations management was undertaken by Partovi, et al. [21]. AHP was applied in selecting a transhipment port by Lirn, et al. [22]. AHP was used in the selection of alternatives for public transport system by Tracz and Wawrzynkiewicz [23]. In their study of the evaluation of rural highway improvement projects in Korea, this process provided more balanced outcomes for many conflicting criteria. Project risk management was performed by Dey, et al. [24]. AHP was used by Korpela and Tuominen [25] for logistic operations benchmarking and project management. AHP was used recently by Nosal and Solecka [26] to evaluate urban public transport integration.

An approach based on AHP was used in this study to examine and select the design option for transport infrastructure which was illustrated in Vietnam by the Dong Nai Bridge Project Case Study, following which, the traditional method of DCF techniques were utilised to find the optimal option for the investment project.

III. RESEARCH METHODOLOGY

Wind and Saaty [27] developed the AHP by giving a flexible and lucid method of complicated problems analysis. The technique encompasses many criteria that allow both objective and subjective factors to be factored into the process of decision-making.

Active participation of decision-makers is allowed in AHP in attaining consensus and empowers managers with a rational basis to select decisions. AHP is based on three principles; namely decomposition, comparative judgment, and synthesis of priorities.

The following steps were developed by Saaty [18, 19, 28] for applying the AHP:

1. Definition of problem and determining its goals.

2. Hierarchy flow structure from the top level through the intermediate levels to the lowest level, which usually has the list of alternatives.

3. Construction of a pair-wise set with comparison matrices (size $n \times n$) for each of the lower levels with one matrix for each element in the immediately above level by utilising the relative scale

measurement as shown in Table 1. Based on which element dominates the other, the pair-wise comparisons are completed.

4. *n. (n – 1)/judgments* are needed to develop the set of matrices in step 3. In every pair-wise comparison, reciprocals are automatically assigned.

5. Weight of the eigenvectors by the weights of the criteria. Hierarchical synthesis is still used, and the total is taken over all weighted eigenvector entries corresponding to those in the next lower level in the hierarchy.

6. After making all comparisons pair-wise, consistency is determined by using the eigenvalue, λ_{max}, to calculate the consistency index, CI as follows: $CI = (\lambda_{max} - n)/(n-1)$ where n is the matrix size. Judgment consistency can be confirmed by taking the consistency ratio (CR) of CI with the appropriate value in Table 2. The CR is acceptable if it does not exceed 0.10. If it is more, the judgment matrix is inconsistent. To obtain a consistent matrix, judgments should be reviewed and improved.

TABLE 1. PAIRWISE COMPARISON SCALE FOR AHP PREFERENCES. ADAPTED FROM SAATY [18]

Number	Numerical rating	Verbal judgements of preferences
1	9	Extremely preferred
2	8	Very strongly to extremely
3	7	Very strongly preferred
4	6	Strongly to very strongly
5	5	Strongly preferred
6	4	Moderately to strongly
7	3	Moderately preferred
8	2	Equally to moderately
9	1	Equally preferred

To develop a decision support system for a project‘s evaluation and selection, Analytic hierarchy process (AHP) along with a multiple-attribute decision-making technique was applied in the case study. The model has been constructed via the involvement of key stakeholders of the Dong Nai II Bridge project. Expert Choice [29] was used to simplify the implementation of the AHP's steps and automate many of its computations.

In addition to AHP, the cash flow of all costs and benefits resulting from the project's activities were presented. Three indices of financial analysis are Net Present Value, Rate of Return, and Pay Back Period. Depending on selected interest rate or discount rate, results of financial indices based on cash flows at different points in time will differ [30].

IV. CASE STUDY AND ITS APPLICATION

A. Case study

Dong Nai Bridge II is an important project that will connect Bien Hoa City to big cities in the South of Vietnam. This project is located along National Highway 1 A and directly connects Dong Nai City to Binh Duong City and Ho Chi Minh City. The bridge has a length of 461.6 metres, and has 5 lanes, with a curb for pedestrians which is 3.6 metres wide.

Fig. 1. Overview of Dong Nai Bridge project. Adapted from Google Maps [31]

Based on design standard proposed by Transport Engineering Design Inc [32], there were three options regarding project design:

Option A - *Continuously pre-stressed reinforced concrete bridge, cantilever cast.*

- Diagram of bridge span: (55 + 4x73 + 55 + 2x24.7)m
- Total bridge length, allowing for 2 ends of abutment: 461.6m
- The structure of cantilever cast span: includes 6 continuous spans, pre-stressed reinforced concrete 55m+4x73m+55m. Box girder has a cross section in 3-wall form, the girder is 20m in width, the girder at the top of pier is 4.2m in height and in the middle of the span: 2m.
- The access bridge using box girder has the structure similar to the main span including 2 continuous spans 2x24.7m, the width of girder: 20m, the height of girder: 2m.
- Structure of lower part: The entire structure of abutment, pier is expected to use auger-cast piles, and the diameter of the pile is from 1.0m to 1.5m.
- Construction cost: 267 VND Billion

Option B - *Steel box-section girder bridge with a combination of external pre-stressing use.*

- Diagram of bridge span (55 + 4x73 + 55 + 2x24.7)m
- Total bridge length, allowing for 2 ends of abutment: 461.6m

- Structure of steel girder spans includes 8 continuous spans. Steel box girder, the width of girder: 20m, the height of girder at the top of pier: 4.2m, and in the middle of span: 2m.
- Structure of lower part: Entire structure of abutment, pier is expected to use auger-cast piles, the diameter of the pile is from 1.0m to 1.5m.
- Construction cost: 338 VND Billion

Option C – *Cable-stayed bridge, aperture of span: 200m.*

- Diagram of bridge span (40 + 85 + 200 + 85 + 40) m
- Total bridge length, allowing for 2 ends of abutment: 460.2 m
- Structure of cable-stayed span includes 5 continuous spans and pre-stressed reinforced concrete in which the cable stayed bridge includes 3 spans 85m + 200m + 85m. Structure of lower part: Entire structure of abutment, pier is expected to use auger-cast piles, the piles with diameter of 2 m are used as the foundation of two towers while the piles with diameter of 1.5m are used for the remaining piers.
- Construction cost: 446 VND Billion

Each option has pros and cons, and so it is important to select the option which can satisfy project requirements. In this case study, there are main seven factors used to make comparisons including structural characteristics, construction conditions, degree of safety to ship collision, the impact of air traffic, construction cost, maintenance cost, and aesthetics. These factors would be different according to the particular context of the project.

B. Findings and discussions

In the case study of Dong Nai II Bridge project, the process of AHP includes the following steps:

1. Design the hierarchy model that can structure the problem and show the relationship among problems' elements.

2. Collect judgements from experts based on their own experience and knowledge.

3. Use meaningful numbers to represent those judgments.

4. Prioritise the elements of the hierarchy model.

5. Synthesize these results to determine an overall outcome.

6. Adjust weighting score in judgement to exam the sensitivity analysis.

Based on the seven main factors, project team members and experts of the project developed the hierarchy model for design selection, before making adjustments. There are three levels in this tree analysis, which are presented in Figure 2.

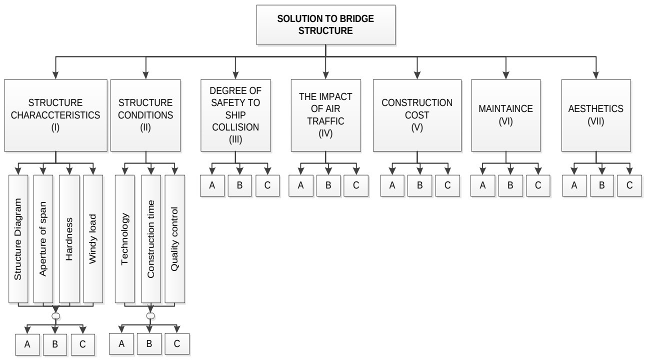

Fig 2. Hierarchy model for design selection of Dong Nai II Bridge project

In the case study, questionnaire interviews were carried out to obtain the judgment of fifteen experts about the three possible options for project design (A, B, C), based on the seven defined criteria. Next, these criteria were compared with each other with respect to the overall goal of project design. The inclusion of Expert Choice enabled the comparisons to be performed quickly. The numerical questionnaire for the first level of a decision model for selecting project design option is shown in Table 2.

TABLE 2. PAIR-WISE COMPARISON MATRIX FOR DESIGN FACTORS (DFS)

DFs	I	II	III	IV	V	VI	VII
I	1	9	3	3	1/5	3	3
II	1/9	1	3	3	1/5	3	3
III	1/3	1/3	1	3	1/3	1/3	3
IV	1/3	1/3	1/3	1	1/7	1/3	1/3
V	5	5	3	7	1	5	7
VI	1/3	1/3	3	3	1/5	1	3
VII	1/3	1/3	1/3	3	1/7	1/3	1

Similarly, the numerical questionnaire for the second level of a decision model for selecting project design option is shown in Table 3.

TABLE 3. PAIR-WISE COMPARISON MATRIX FOR STRUCTURE CRITERIA (SC).

Sc	Tech	Time	Quality Control
Tech	1	5	5
Time	1/5	1	3
Quality Control	1/5	1/3	1

The pairwise comparison mode was extended from 1-99 in the numerical mode at the lowest level. The Expert Choice software allows design options to be evaluated directly, based on predefined criteria for the project design.

TABLE 4. PAIR-WISE COMPARISON MATRIX FOR DESIGN OPTIONS

Options/DFs		A	B	C
STRUCTURAL CHARACTERISTICS	Diagram of structure	80/99	80/99	60/99
	Aperture of span	50/99	50/99	80/99
	Hardness	80/99	80/99	60/99
	Windy load	80/10	80/99	50/99
CONSTRUCTION CONDITIONS	Technology	80/99	60/99	30/99
	Construction period	60/99	70/99	50/99
	Quality control	80/99	60/99	40/99
DEGREE OF SAFETY	Degree of clearance	99/99	99/99	99/99
	Probability of ship collision	70/99	70/99	99/99
IMPACTS OF AIR TRAFFIC		80/99	99/99	70/99
CONSTRUCTION COST		99/99	70/99	40/99
MAINTENANCE		80/99	60/99	30/99
AESTHETICS		60/99	60/99	90/99

Inconsistent expert judgment is an important factor to examine the inconsistency between judgments in the pairwise comparison method. The IR provides a measure of the logical rationality of the pairwise comparisons and a value less than 0.10 is generally considered acceptable. The Evaluation and Choice module of the Expert Choice can automatically calculate and display the inconsistency ratio (IR) of the AHP technique. In this case, The IR was 0.071 and this number supports the consistency of the expert judgments.

Based on the AHP approach and the use of Expert Choice Software, the results of evaluation processes are summarized in the analysis tree below.

Structure characteristics (L: 0.258)

- Diagram of structure (L: 0.507)
- Aperture of span (L: 0.124)
- Hardness (L: 0.215)
- Wind load (L: 0.154)

Construction conditions (L: 0.121)

- Technology (L: 0.701)
- Period of construction (L: 0.202)
- Quality control (L: 0.097)

Degree of safety, ship collision (L: 0.073)

- Requirements for clearance (L: 0.750)
- Probability of ship collision (L: 0.250)

The impact of air traffic (L: 0.033)

Economy (L: 0.343)

Maintenance (L: 0.110)

Aesthetics (L: 0.062)

In Figure 3 below, the solution also reflects the combined importance that the human experts gave to each of the seven criteria. In the case study, structure characteristics (DFs I) scored 0.258, construction conditions (DFs II) 0.121, degree of safety to ship collision (DFs III) 0.073, impact of air traffic (DFs IV) 0.033, construction cost (DFs V) 0.343, maintain cost (DFs IV) 0.11, and aesthetics (DFs VII) 0.062.

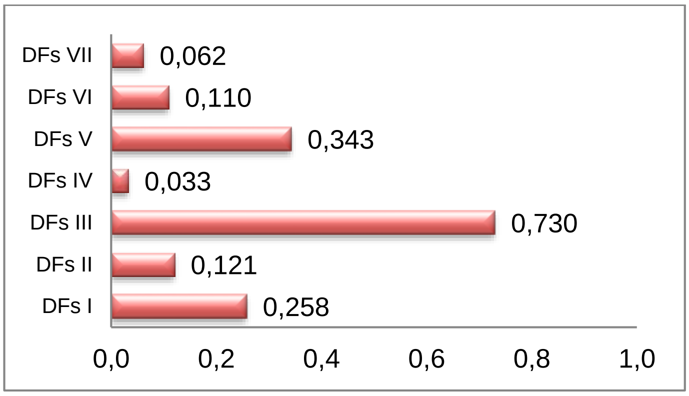

Fig. 3. *Priorities of project design selection*

Next, modules of Expert Choice were used to synthesize a solution to the model. The final result is an overall weight for each alternative. The results are presented in a bar graph (Figure 4). As shown on Figure 4, Option A has a weight of 0.414 (41.4 %), Option B 0.342 (34.2%) and end Option C 0.244 (24.4%). It can be concluded that Option A is the most attractive option for project design selection based on the expert judgment about the seven criteria.

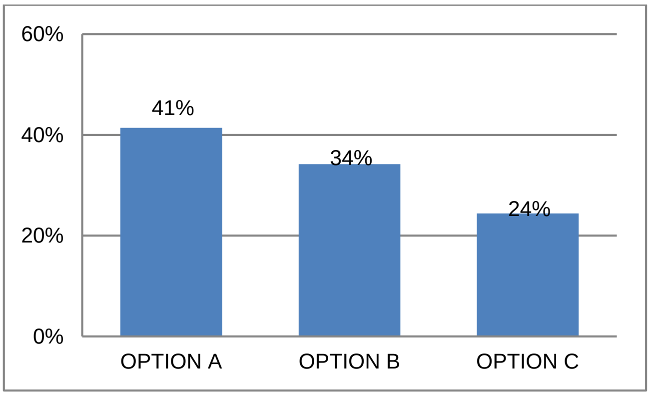

Fig 4. *Generated outcomes of the project.*

Comparing indices, it can be seen that the objective function satisfaction degree of alternative A is better than that of alternatives B and C. Therefore alternative A was selected.

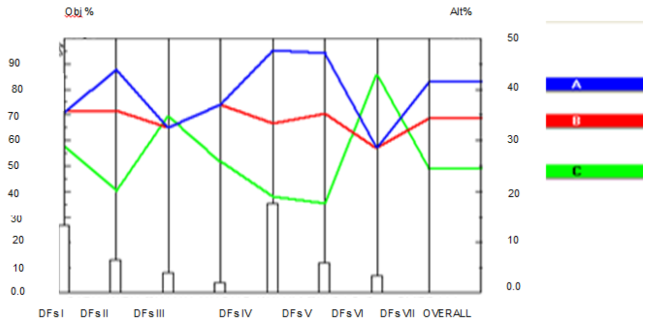

Fig 5. *Performance sensitivity analysis for project design selection*

Following the previous step, a sensitivity analysis was utilized to check the result's sensitivity towards changes in the criteria's priorities. Sensitivity analysis is an especially prime topic of analysis of AHP problem, as outcomes are derived from assessments by a subject expert. Currently, analysis of sensitivity was undertaken regarding the seven prime factors utilized for the design of the project. By altering the criteria weightage and checking the following differences in the alternative weights as well as checking their graphical representation, it can be demonstrated that the standards of 'A' produced bigger values when checked against the others.

However, the construction time of option B is 1.5 years, which is shorter than that for option A (two years), so it is important to consider the time factor in project operation. In other words, option B allows us to save the construction time and to operate the project early, and this may have significant impacts on the cash flow of the project. Thus, financial analysis would be a good technique to examine whether the investment option satisfies the requirements of investors. In this case study, financial analysis focused on comparing the direct benefits (revenue from project operation) and direct costs (construction and maintain costs) during a 30-year period. Based on surveys and the feasibility report proposed by Transport Engineering Design Inc [32], the results of analysis are summarized in Table 5 presented in Appendix 1 and Appendix 2.

TABLE 5. FINANCIAL ANALYSIS OF ALTERNATIVE OPTIONS

RESULT		**Discount rate**		**11.82%**
Option	**NPV**	**IRR**	**PB**	**B/C**
A	677.2	14.9%	17.4	1.4
B	637.4	13.7%	18.0	1.35

It can be seen from Table 5 that option A is the best design option since features of pre-stressed reinforced concrete bridge would allow a significant saving for maintenance costs, compared with that in option B (Steel Box Girder Bridge) during the 30-year period. Depending on the project's contexts and pre-defined goals, experts are required to set up a benchmark to decide whether AHP is the main or sub-method to be used in this combination.

V. CONCLUSION AND FUTURE WORK

To summarize, the combination between AHP method and economic indices allows experts to be flexible in selecting factors for project evaluation. AHP is a good option when some factors are hard to convert into monetary terms, while economic indices are useful when considering the efficiency of the project. Furthermore, this combination can improve the outcome of analysis processes when stakeholders have a chance to be involved in decision-making process.

However, the accuracy of the combination between AHP and economic indices depends on project inputs and stakeholders' perspectives, and so it is important to establish expert panels from diverse backgrounds and experience. This process can be improved via the support of an online platform that enables experts to interact with others via an online group discussion. In addition, it is important to develop a benchmark to decide whether AHP is the main method or sub-method in this combination. Future research needs to be carried out to improve the flexibility of this combination.

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APPENDIX 1: FINANCIAL ANALYSIS OF OPTION A

Year	Vehicles/year	Costs **(C)**				Revenue (Rt)	Cash flow **$CF_t=R_t+C_t$**	Discounted factor **$1/(1+r)^n$**	Present value **$PV(CF_t)$**	Accumulated value **$PV(CF_t)$**
		Construction	Maintenance	Operation	Total cost **(C_t)**			**11.82%**		
								1.40		
		598.05		**10%**	**-598.05**		**-598.05**	**1.25**	-747.79	-747.79
		598.05			**-598.05**		**-598.05**	**1.12**	-668.74	-1416.53
2015	4,152,970		0.66	9.00	-9.66	80.99	71.33	1.00	71.33	-1345.20
2016	4,735,802		0.66	10.29	-10.95	92.63	81.68	0.89	73.04	-1272.16
2017	5,318,634		0.66	11.59	-12.25	104.27	92.02	0.80	73.59	-1198.57
2018	5,901,466		0.66	12.88	-13.54	115.90	102.37	0.72	73.21	-1125.35
2019	6,484,298		13.22	14.17	-27.40	127.54	100.15	0.64	64.06	-1061.30
2020	7,067,130		0.66	15.46	-16.13	139.18	123.05	0.57	70.39	-990.91
2021	7,649,962		0.66	21.78	-22.45	196.06	173.62	0.51	88.81	-902.09
2022	8,232,794		0.66	23.47	-24.13	211.19	187.07	0.46	85.58	-816.52
2023	8,815,626		0.66	25.15	-25.81	226.32	200.51	0.41	82.03	-734.48
2024	9,398,458		13.22	26.83	-40.05	241.45	201.40	0.37	73.69	-660.80
2025	9,981,290		0.66	28.51	-29.17	256.58	227.41	0.33	74.41	-586.39
2026	10,594,855		0.66	38.97	-39.63	350.69	311.06	0.29	91.02	-495.37
2027	11,208,420		0.66	40.87	-41.53	367.82	326.29	0.26	85.38	-409.99
2028	11,821,985		0.66	42.77	-43.43	384.96	341.52	0.23	79.92	-330.07
2029	12,435,550		33.06	44.68	-77.74	402.09	324.35	0.21	67.88	-262.19
2030	13,049,115		0.66	46.58	-47.24	419.22	371.98	0.19	69.62	-192.57
2031	13,662,680		0.66	63.03	-63.69	567.27	503.58	0.17	84.29	-108.28
2032	14,276,245		0.66	65.50	-66.17	589.54	523.37	0.15	78.34	-29.94
2033	14,889,810		0.66	67.98	-68.64	611.81	543.17	0.13	72.71	42.77
2034	15,503,375		13.22	70.45	-83.68	634.09	550.41	0.12	65.89	108.66

2035	14,317,855		0.66	76.07	-76.73	684.59	607.87	0.11	65.08	173.73
2036	14,379,212		0.66	99.21	-99.87	892.87	793.00	0.10	75.92	249.65
2037	14,440,568		0.66	99.53	-100.19	895.76	795.57	0.09	68.12	317.77
2038	14,501,925		0.66	99.85	-100.51	898.66	798.15	0.08	61.11	378.88
2039	14,563,281		13.22	100.17	-113.40	901.56	788.16	0.07	53.97	432.85
2040	14,624,638		0.66	100.49	-101.16	904.45	803.30	0.06	49.19	482.04
2041	14,685,994		0.66	131.06	-131.72	1179.55	1047.83	0.05	57.38	539.43
2042	14,747,351		0.66	131.48	-132.14	1183.32	1051.17	0.05	51.48	590.91
2043	14,808,707		0.66	131.90	-132.56	1187.08	1054.52	0.04	46.19	637.09
2044	14,870,064		33.06	132.32	-165.38	1190.84	1025.47	0.04	40.17	**677.26**

APPENDIX 2: FINANCIAL ANALYSIS OF OPTION B

Year	Vehicles/year	Costs **(C)**				Revenue (Rt)	Cash flow **$CF_t=R_t+C_t$**	Discounted factor **$1/(1+r)^n$**	Present value **$PV(CF_t)$**	Accumulated value **$PV(CF_t)$**
		Construction	Maintenance	Operation	Total cost (**C_t**)			**11.82%**		
								1.40		
		630.64		**10.0%**	**-630.64**		**-630.64**	**1.25**	**-788.54**	-788.54
2014	3,530,025	**630.64**	1.80	6.23	**-638.67**	**62.30**	**-576.37**	**1.12**	**-644.50**	-1433.04
2015	4,152,970		1.80	8.10	-9.89	80.99	71.10	1.00	71.10	-1361.94
2016	4,735,802		1.80	9.26	-11.06	92.63	81.57	0.89	72.95	-1288.99
2017	5,318,634		1.80	10.43	-12.22	104.27	92.04	0.80	73.61	-1215.38
2018	5,901,466		1.80	11.59	-13.39	115.90	102.52	0.72	73.32	-1142.05
2019	6,484,298		35.91	12.75	-48.66	127.54	78.88	0.64	50.45	-1091.60
2020	7,067,130		1.80	13.92	-15.71	139.18	123.47	0.57	70.62	-1020.98
2021	7,649,962		1.80	19.61	-21.40	196.06	174.66	0.51	89.35	-931.63
2022	8,232,794		1.80	21.12	-22.91	211.19	188.28	0.46	86.13	-845.50
2023	8,815,626		1.80	22.63	-24.43	226.32	201.89	0.41	82.60	-762.90
2024	9,398,458		35.91	24.15	-60.05	241.45	181.40	0.37	66.37	-696.53
2025	9,981,290		1.80	25.66	-27.45	256.58	229.13	0.33	74.97	-621.56
2026	10,594,855		1.80	35.07	-36.86	350.69	313.82	0.29	91.83	-529.74
2027	11,208,420		1.80	36.78	-38.58	367.82	329.24	0.26	86.16	-443.58
2028	11,821,985		1.80	38.50	-40.29	384.96	344.67	0.23	80.66	-362.92
2029	12,435,550		89.77	40.21	-129.98	402.09	272.11	0.21	56.95	-305.98

2030	13,049,115		1.80	41.92	-43.72	419.22	375.51	0.19	70.28	-235.70
2031	13,662,680		1.80	56.73	-58.52	567.27	508.74	0.17	85.15	-150.55
2032	14,276,245		1.80	58.95	-60.75	589.54	528.79	0.15	79.15	-71.40
2033	14,889,810		1.80	61.18	-62.98	611.81	548.84	0.13	73.47	2.07
2034	15,503,375		35.91	63.41	-99.32	634.09	534.77	0.12	64.02	66.09
2035	14,317,855		1.80	68.46	-70.25	684.59	614.34	0.11	65.77	131.86
2036	14,379,212		1.80	89.29	-91.08	892.87	801.79	0.10	76.76	208.62
2037	14,440,568		1.80	89.58	-91.37	895.76	804.39	0.09	68.87	277.49
2038	14,501,925		1.80	89.87	-91.66	898.66	807.00	0.08	61.79	339.28
2039	14,563,281		35.91	90.16	-126.06	901.56	775.49	0.07	53.10	392.38
2040	14,624,638		1.80	90.45	-92.24	904.45	812.21	0.06	49.74	442.12
2041	14,685,994		1.80	117.96	-119.75	1179.55	1059.80	0.05	58.04	500.16
2042	14,747,351		1.80	118.33	-120.13	1183.32	1063.19	0.05	52.07	552.23
2043	14,808,707		1.80	118.71	-120.50	1187.08	1066.58	0.04	46.71	598.94
2044	14,870,064		89.77	119.08	-208.85	1190.84	981.99	0.04	38.46	**637.41**