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Journal of Educational and Human Resource Development 6:1-11 (2018)
Southern Leyte State University, Sogod, Southern Leyte, Philippines

Comparative Profitability Analysis of Electric, Pedicab, and Gasoline-Fuelled Tricycles

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Abstract

This study compared the profitability of the three transport service enterprises namely electric tricycle, gasoline-fuelled tricycle, and pedicab. These three enterprises are widely used as transportation facilities and serve as a means of livelihood for low-income drivers of the municipality of Isabel, Leyte. In assessing the profitability, the gross profit analysis and discounting cash flow analysis which includes Net Present Value (NPV), Internal Rate of Return (IRR), Benefit-Cost Ratio (BCR), and payback period were used. Based on the results of the gross profit analysis and the discounting flow analysis of a random sample of 177 drivers, positive returns of investment was experienced. Gasoline-fuelled vehicle has the largest net present values indicating highest financial profitability. Pedicab, with its lowest cost of investment and the lowest operating cost, generates highest benefit-cost ratios and lowest pay-back period. The electric-tricycle, with its highest purchase cost and highest maintenance cost, resulted in lowest positive returns compared with other two vehicles. However, these indicators of profitability only considered financial returns, and exclude the intangible benefits (i.e. the environmental benefits and other social benefits). This research highlighted the need to encourage adoption of vehicles that is economically profitable, but also environment-friendly vehicles. The results may also provide insights for local government initiatives to improve livelihood opportunities at the same time provide healthier environment for the communities.

Keywords: *Investment; Benefit-cost analysis; Discounting cash flow*

Introduction

Several studies emphasized that the utilization of renewable energy used in the transport sector could be a vital step to globally reduce greenhouse gas emissions (Gustafsson & Johansson, 2015). At present, the Philippines is extensively promoting the use of battery electric vehicles, as this is seen as one of the solutions to reduce carbon emissions in the country. Asian Development Bank (ADB) reported that electrically powered tricycles could reduce dependence on foreign fuel and could cut operating costs for tricycle drivers up to 60 percent (ADB, 2012). However, these vehicles have also been reported to suffer from high battery costs and short-range problems. The municipality of Isabel has already an extensive usage of electric tricycle and were reported to have replaced significant number of alternative vehicles like “pedicabs” (pedal operated vehicle) and gasoline-fueled tricycles in the municipality. The evaluation of the profitability of these three types of vehicles remains contentious and the economic potential of electric tricycle still needs to be fully understood.

In most developing cities of the world, the popular mode of transportation is the use of tricycle (Gullen et al., 2007). In India, the use of tricycle as mode of transportation by common people has posed a critical problem

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to the government and the growing population about maintaining good air quality (Kokaz & Rogers, 2002). In other countries like Nigeria the use of motorized tricycle is encouraged within the city to decongest the traffic (Taofeek & Afolabi, 2017). In Metro Manila, Philippines, tricycle is the popular mode of transportation in the secondary streets (Manasan & Mercado, 1999). In addition, Cabanatuan City which was dubbed as the "Tricycle Capital of the Philippines" also considered the tricycle as the common transport of their people. The city has about 30,000 registered gas-fed four-stroke motorized tricycles and has become the source of livelihood for around 10,000 families (Balaria et al., 2017). However, studies have shown that tricycles have largely contributed to the problem of noise and air pollution in the Philippines. For instance, in Quezon City which has the highest population of tricycles in the country with 20,316 units and was reported as a location of high traffic congestion and accidents, and air and noise pollution in Manila. Also in Puerto Princesa, capital of Palawan, the 2,824 tricycle units plying along the city proper accounted for about 153 million tons of carbon dioxide emissions. Also, it was reported as contributor for noise pollution, with levels measured at 83-97 decibels (dB).

In the Philippines, transport is a key sector of the economy (ADB, 2012). The latest report from the Philippine Statistics Authority noted that Gross Domestic Product (GDP) from the transport sector in the Philippines has increased from Php 7,1164.85 million in the first quarter of 2018 to Php 8,0303.47 million in the second quarter of the year (PSA, 2018). From 2008 until 2018, GDP from transport was recorded amounting to Php 5,0253.48 million on average with a recorded low value of Php 3,4827.71 million in the third quarter of 2009. These increasing contribution of the transport sector to Philippine economy indicates the important role of the transport sector in an archipelagic country such as Philippines. An efficient transport in the Philippines is vital to improve accessibility between, and mobility within, the islands of the country. However, the transport sector of the country continues to face important challenges including the poor quality of the road network, poor intermodal integration, weak sector governance and institutional capacity, lack of quality urban transport systems, and limited private investment in transport infrastructure (ADB, 2012).

The Philippines has various transport vehicles such as pedicabs, gasoline-fuelled tricycle, and the electric motorcycles. The most common non-motorized vehicle in the Philippines is the pedicab. Pedicab is a mixture of the words 'pedal', referring to how the bike is powered, and 'cab', referring to the sidecar that ferries people. It is also called the *padyak* or *sikad*, the equivalent of the phrase 'to pedal' in Tagalog and Bisaya. Since the great majority of urban trips are over short distances, non-motorized mode of transportations have an important role to play in supporting mobility within rural and urban cities. However, there are some problems associated with the use of non-motorized vehicles. Though it is environment-friendly, they add spaces which causes traffic and congestion especially in urban areas. Moreover, some studies noted that the use of pedicabs is often viewed as a symbol of economic "backwardness" (Repogle, 1992). Interestingly, Guillen (2000) contends that pedicab driving is becoming a major source of additional income for limited-resource families. Further, pedicab driving could generate an income that ranges from Php1,000-Php3,000 pesos per month (Guillen, 2000). The gasoline-fuelled tricycle is also a common means of passenger transport anywhere in the Philippines especially in the small town and cities. Unfortunately, the increased volume of commuters has also translated into higher number of complaints and even accidents. Studies have also reported that the direct nuisance is already a cost to society and have likely affected house prices and is indirectly contributing to health problems because of the high noise which are noted to lead to stress, hypertension and cardiovascular disease

(Jacobsen, 2003).

The Asian Development Bank is looking towards a national move to shift to a cleaner, more environment-friendly version of the tricycle. E-trikes are seen to help replace the noisy, more expensive motorized tricycle and energy wasting pedicabs (ADB, 2012). In the succeeding years, studies have shown that electric vehicles are widely spreading over the world. Until the present, electric vehicles are still used by people and has gradually developed to a new electric type of motor in year 2010 which is the electric tricycle or the 'e-trike'. The electric tricycle market is still a developing segment of the general tricycle industry, which shows generally a solid growth. The utilization of the electric tricycle will generate employment as job growth in electric tricycle industries will likely offset the reduction of jobs in traditional fuel industries. This will also create economic development through reduced energy spending, decreased reliance on foreign fuel and cut operating cost for tricycle drivers up to 60 percent (ADB, 2012).

The municipality of Isabel is one of the 1st class towns in Leyte based on the National Competitiveness Council of the Philippines. However, it considers tricycles and pedicabs as essential mode of transportation, aside from buses and multicabs. From August 1, 2015 to the present, the electrically powered tricycle is now one of the major public vehicles in town. This development in the transport system in the municipality has brought debates on the feasibility and potential effects for the existing other types of vehicles currently operating in the town.

Therefore, it is critical to determine the financial profitability of this vehicle as compared with its alternatives. In view of this, proper accounting of its associated benefits and costs should help drivers strategically plan, before switching to and investing in this new type of vehicle. For the current pedicab and gasoline-fuelled tricycle drivers, there could be significant changes to their operating cost and income associated with adopting e-trikes. Addressing the issue of financially feasibility in adopting an e-tike transport system is therefore also significant. The analyses presented in this study then addressed the issue of profitability of the three types of vehicles in Isabel, Leyte (Fig. 1).

Conceptual Framework

An investment project makes a difference and the role of benefit-cost analysis (BCA) is to measure that difference (Campbell and Brown, 2003). This study used BCA as the underlying tool to assess the profitability of the three different vehicle enterprises. This study assumed that current pedicab drivers and gasoline-fed tricycle drivers are trying to examine the income potential of switching to an e-trikes operations. However, their capacity to decide where it is likely more feasible to invest is limited. Therefore, using the benefit-cost analysis in their decision to either undertake or not to undertake an investment shall be investigated by assessing the project benefits of the three existing vehicle enterprises in Isabel, Leyte. If Project X (such as e-trikes could provide bigger benefits for them than project Y (currently pedicab or g-trikes) then that course serves as bases to invest in Project X – the e-trikes (Fig. 2). Also, using the standard measures of profitability (NPV, IRR, BCR), the decision to adopt or invest into a new project shall then guide the vehicle operators with the wise decision for their investments (see Fig. 3).

The conceptual framework of this study was used to answer the study's objectives: to identify and compare the associated revenues and costs of each of the vehicle enterprise and to assess the profitability of each enterprise, using the standard financial discounting cash flow analysis. Results of the analyses will determine which project is to be recommended for investment.

Figure 1. *Three types of vehicles covered in the analysis of the study.*

Table 1. Types of vehicles and sample distributions of respondents

Type of Vehicle	Number of Drivers	Sample Size	%
Pedicab	125	55	31.07
Gasoline-fuelled tricycle	165	62	35.03
Electric tricycle	150	60	33.9
Total	**440**	**177**	**100**

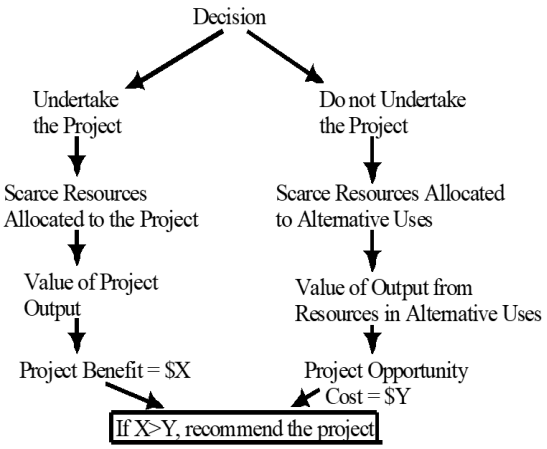

Figure 2. *Framework for project investment (Adapted from Campbell & Brown, 2003)*

Methodology

The main question answer when doing financial analysis is whether it is financially feasible to invest in a new project. This issue is relevant as a decision guide before investing in an enterprise such as the case of the three vehicle enterprises in Isabel, Leyte. The two most common tools in assessing profitability are the gross profit analysis and discounting cash flow analysis. However, the most widely used are the Net Present Value (NPV), Internal Rate of Return (IRR), and Benefit-Cost Ratio (BCR). Others include the net future value (rarely calculated), payback period and the peak deficit (Harrison & Herbohn, 2008). In this current study, the NPV, IRR, BCR and payback period were used. When comparing three projects, it is important to select a project from a number of alternatives and to rank a number of projects in order of priority. Using the investment decision-making criteria, this study assumes that a project with highest NPV, highest BCR, highest IRR, and lowest payback period

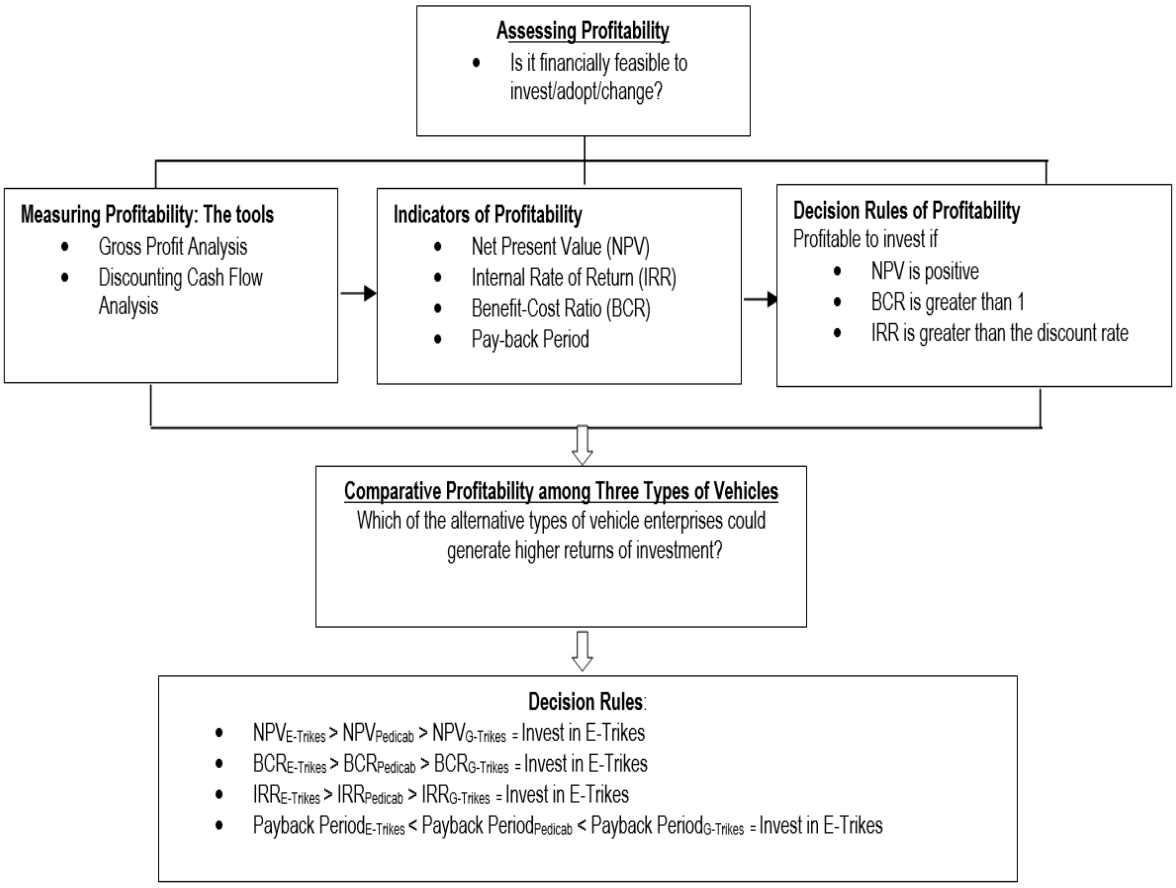

Figure 3. *Methodological framework for comparative profitability assessment*

should be the first priority project and the most profitable investment opportunity (see Fig. 3).

Data Collection and Procedure

Slovins' formula was used to determine the number of respondents of the study. Where n is the sample size, N is the population size, and e is the margin of error. From a total of 440 respondents on the three types of vehicles, 177 was the total sample size (Table 1).

$$n = \frac{N}{1 + Ne^2}$$

Using actual survey from the randomly sampled respondents, a total of 177 drivers were interviewed for the three different types of vehicles in Isabel, Leyte. About 31.07 percent were pedicab drivers, 35.03 percent were gasoline-fuelled tricycle, and 35.90 percent were electric tricycle drivers (Table 1.)

Data Analysis and Interpretation

Gross Profit Analysis

Gross profit is the firm's total revenue minus the cost of goods sold or the variable inputs used to produce the outputs sold. The total revenue comprises the fee multiplied by the number of passengers in the day. The variable cost includes per day cost of each of the vehicle enterprise. These may include fuel cost, charging cost, foods/snacks, plus the fixed operating costs such as boundary per day, installment per day, municipal tickets per day, and others. Mathematically, gross profit is the difference between the total revenue and the variable cost.

Table 2. Template used for discounting cash flow analysis

Discount Rate			DISCOUNTING CASH FLOW FOR E-TRIKES			
	NOMINAL			REAL		
Year	Benefits	Costs	Net Benefit Flow	Discounted Benefits	Discounted Costs	Discounted Net Benefits
Initial cost						
1						
2						
3						
4						
5						
	Present Value			-	-	
	Net Present Value (NPV)					
	Benefit Cost Ratio (BCR)					
	Internal Rate of Return					
NPV Check	$0	(This cross checks above workings with the Excel built in NPV Formula)				

Table 3. Revenue earned from the operation of the vehicles

Revenue Items	Pedicab	Gasoline-fuelled Tricycle	Electric Tricycle
Gross Revenue			
Seating Capacity (# of seats)	2	7	4 & 8
No. of Passengers (person/day)			
Minimum	25	40	66
Maximum	45	74	121
Most Likely	38	50	90
Fee (Pesos/passenger)	P10.00	P63.00	P20.00 & P40.00
Total Revenue			
Minimum	P127.00	P362.00	P332.00
Maximum	P224.00	P664.00	P607.00
Most Likely	P191.00	P448.00	P452.00
Revenue (Pesos/Day)	**P191.00**	**P448.00**	**P452.00**

Discounting Cash Flow Analysis (DCFA)

In project evaluation, the challenge for the analysts is to identify the relevant cost and revenue items for a project over time, derive the monetary estimates of these, and then calculate the incremental annual net cash flows. Once these net cash flows are derived, it is relatively mechanical procedure to derive various financial performance cirteria for a proejct (Harrison & Herbohn, 2008).

In this study, the concept of annual incremental net cash flow was used to calculate the benefits and cost associated with the investment of these three different vehicle enterprise, which state that: $C_t = B_t - CO_t - OC_t$

Capital outlays (COt) are the 'investment' component in a project in each year t (i.e. the investment in new vehicle). The operating costs (OCt) are the recurrent expenditures of items such as repairs and maintenance, electricity or fuel, and other relevant operating expenses. Cash inflows (Bt) are typically the annual revenue generated by a project (i.e. income earned from passenger's fee).

Table 2 shows the template used for discounting cash flow. The benefits calculated were from the gross revenue of each enterprise. The per day revenue (Fee/passenger x Qty. passengers/day) were converted into annual revenue. These associated annual cost and revenue were spread and discounted based on the lifespan of each enterprise.

Results and Discussion

The results presented below are based from the standard tools of assessing financial

feasibility. Answers to the objectives of the study are also presented. The first part of the results and discussion introduces the results from the identification and comparison of revenue and costs followed by the comparison of the difference in gross profits from the three different vehicle enterprises.

Identification and Comparison of Revenues and Costs

The Different Revenues Earned from the Operation

Table 3 shows the comparative revenues of the pedicab, gasoline-fuelled tricycle and electric tricycle of the vehicle owners. It is shown that among the three passenger vehicles being examined in this study, it is the e-trikes who had the highest revenue that could be earned in a day by the vehicle owner. G-trikes had higher revenue, but relatively lesser than the e-trikes. The pedicab, on other hand had the lowest revenue earned in a day. These differences could primarily be attributed by the different seating capacities of the vehicle enterprises being examined. Also, this study shows the range of the possible number of passengers that each of the vehicle enterprise could take in a day.

Pedicab. This type of vehicle is commonly known in rural areas as "potpot" that has a seating capacity of only 2 persons because of its limited space for the seats of the passengers. This study identified that pedicab operators could get a minimum of 25 passengers in a day that could generate a minimum of Php127 per day from a Php10 fare per passenger. This pedal-operated vehicle could also get a maximum of 45 passengers a day that could provide the operators of this vehicle a maximum of Php224 revenue in a day. Interestingly, this study found that the common experience of the pedicab operators is that they could only get about 38 passengers in day that in return is already gives them about Php191 revenue in a day.

G-Trikes. G-trikes have a 7 passenger capacity and could get a number of passengers from a minimum of 40 persons to a maximum of 74 passengers in a day. This study found based on actual surveys that owners of the vehicle could get a range from a minimum of Php 362 to a maximum of Php 664 per day. Interestingly, the vehicle owners noted during the survey that commonly they could get passengers of about 50 persons a day that is in return giving them about Php 448 revenue per day.

E-Trikes. For e-trikes, vehicle owners noted that they could get about 66 to 121 passengers a day. Owners of e-trikes could get a minimum revenue of about Php332 to a maximum of Php667 a day. Owners noted that most likely they get about Php452 revenue in day for operating E-trikes.

B. The Different Costs of Operations

Table 4 shows the comparative cost of the pedicab, gasoline-fuelled tricycle, and electric tricycle of the vehicle owners.

Pedicab. The daily costs and expenses of the drivers are: Php1 for municipal tickets for daily operation, Php21 for food and snacks, and dispatcher's fee of Php2. The operating costs is Php39 everyday including the Php15 for maintenance cost of their pedicab.

G-trikes. Daily, the usual cost for g-trikes drivers is Php117 for the gasoline, including the dispatcher's fee, food, and municipal tickets.

E-trikes. Drivers usually acquired their e-trike unit through an installment basis which has a price of Php120,000 within three years, but once the unit is paid in cash it is only Php101,400, including the battery. Expectedly, drivers of e-trikes have to pay for Php120-Php180 on a daily basis for a duration of 2-3 years. Additionally, they spend Php30 for charging the two batteries and Php49.06 for maintenance cost per day.

Table 4. Identified costs of operations of the three different vehicle enterprises

Costs Items of Operation	**Pedicab**	**Gasoline-fueled Tricycle**	**Electric Tricycle**
A. Fixed Operating Costs			
1. Boundary per day	P 0.00	P 0.00	P 0.00
2. Charging Cost per battery per day	P 0.00	P 0.00	P 30.00
3. Payment for installment per day	P 0.00	P 0.00	P 120.00
4. Payment for Municipal Tickets	P 1.00	P 2.00	P 1.25
Total Fixed Operating Cost	***P 1.00***	***P 2.00***	***P 151.25***
B. Variable Cost			
1. Gasoline expenses	P 0.00	P 117.00	P 0.00
2. Food/Snacks	P 21.00	P 17.00	P 15.00
3. Dispatcher	P 2.00	P 10.00	P 0.00
Total Variable Cost	***P 23.00***	***P 144.00***	***P 15.00***
C. Maintenance Cost			
1. Front Wheel	P 2.00	P 2.83	P 2.40
2. Side Wheel	P 6.00	P 14.9	P 6.00
3. Interiors	P 0.75	P 0.75	P 2.49
4. Back Bearings	P 1.00	P 9.51	P 0.72
5. Front Bearings	P 1.00	P 9.51	P 1.98
6. Spraket	P 0.86		
7. Rios	P 0.09		
8. Plato	P 2.00		
9. Chain Wheel	P 1.00	P 0.68	
10. Change Oil		P 1.27	P 0.67
11. Sparkplug		P 0.47	
12. Headlights		P 0.05	P 0.25
13. Break lights		P 0.16	P 0.10
14. Signal lights		P 0.24	P 0.12
15. Break shoe		P 3.88	P 0.94
16. Change Grease			P 0.67
17. Gasket Maker			P 0.20
18. Gearbox			P 5.49
19. Motor (winding)			P 3.33
20. Lead Acid Battery			P 23.7
21. Mini Battery		P 6.11	
Total Maintenance Cost	***P 15.00***	***P 50.33***	***P 49.06***
Total Cost of Operations (A+B+C)	**P 39.00**	**P 196.33**	**P 215.31**

Table 5. Discount cash flow of the three different types of vehicles

Discount Rate (15%)	**Net Present Value (NPV)**	**Internal Rate of Return (IRR)**
pedicab	259,627	365%
gasoline-fuelled tricycle	344,705	82%
electric tricycle	184,230	80%

Assessment of the Profitability using the Financial Discounting Cash Flow

Discounting Cash Flows

Table 5 shows the future valuation for the investment through discounting cash flows. Results tell if these three different types of vehicles are financially worthwhile for investment and when all costs can be recovered through time. NPV was used as a valuation method and as the basis to estimate the attractiveness of an investment opportunity. IRR was used in capital budgeting measuring the profitability of potential investments. It is a discount rate that makes the NPV of all cash flows from a particular project equal to zero. It also ensures that the investment makes more money than its actual cost.

Table 5 presents the NPV of the three enterprises. At a 15 percent discount rate, the expected net present values for pedicab, gasoline-fuelled tricycle, and electric tricycle were Php259, 627.00, Php344, 705.00, and Php184, 230.00, respectively. These represent an internal rate of return of approximately 365 percent for pedicab, 82 percent for gasoline-fuelled tricycle, and 80 percent for electric tricycle.

Sensitivity Analysis

Sensitivity analysis tests how financial performance criteria vary in response to changes in the levels of cash flow parameters. Table 6 reveals how much the performance criteria (usually NPV and BCR) vary when the benefits, the costs, and discount rates are changed. These parameter values are usually adjusted individually, and not in combination.

At normal (no change) discount rate, normal cost, and normal benefit, the NVP and BCR for pedicab is Php 259,627 and Php 4.04, respectively. However, when cost is increased by 50 percent, and without changes in the discount rate and benefit, the NPV was reduced to Php 216,895. Also, the BCR was decreased to Php2.69 (for every Php 1 cost invested, the benefit is Php2.69). Using another scenario where the benefits were reduced by 50 percent, it also resulted to a reduced NPV and BCR. When the parameters were tested with a worst case scenario (i.e. increased cost by 50 percent and reduced benefits by 50 percent) the analysis revealed that the NPV for pedicab is Php 44,350 with a benefit:cost ratio of 1.35 indicating that the investment for pedicab is still financially feasible. A further increase in cost to 60 percent and reduced benefits by 60 percent can lead to a financially infeasible project case (see table 5, for pedicab).

For the gasoline-fuelled tricycle, Table 6 showed that an increase in cost and a decrease in benefits resulted to an inverse change of NPVs and BCRs. The analysis revealed that an increase in costs by 50 percent, at normal discount rate and normal benefit would lead to a reduction of NPV to Php 112,345 from Php 344,705. The benefit:cost ratio is also reduced to 1.16. Further, a decrease in benefits of 50 percent for gasoline-fuelled tricycle will most likely translate to a negative NPV (-Php 60,008) and less than 1 benefit:cost ratio (0.87) which are indicators of a financially infeasible investment. A larger increase in cost and decrease in benefits would lead to higher negative returns suggesting a dim investment, at worst, a case scenario.

A different result of the scenario analyses were observed for e-trikes. Table 6 shows that at normal discount rate (15 percent), and when the benefits and costs remain unchanged, the project for e-trikes is still financially worth investing. However, the analysis reveals that if the costs are increased by 50 percent, it would result to a lower NPV (Php 3,614) and a break-even benefit:cost ratio (1.01). A further increase in costs by more than 50 percent will certainly result to a negative NPV. If the benefits are decreased by 50 percent but costs remain unchanged,

Table 6. Sensitivity analysis of the three-different types of vehicles

Enterprise	**Discount rate (normal discount rate, normal cost, normal benefit)**	**Increased cost (normal discount rate, normal benefit)**	**Decreased benefits (normal discount rate, normal cost)**	**Increased cost and decreased benefits (worst case scenario_1)**	**Increased cost and decreased benefits (worst case scenario_2)**
Change		***△50%***	***△50%***	***△50%***	***△60%***
pedicab					
NPV	259,627	216,895	247,394	44,350	1,295
BCR	4.04	2.69	2.75	1.35	1.01
gasoline-fueled tricycle					
NPV	344,705	112,345	-60,008	-292,369	-419,784
BCR	1.74	1.16	0.87	0.58	0.44
electric tricycle					
NPV	184,230	3,614	119,820	-269,117	-359,787
BCR	1.51	1.01	1.26	0.5	0.38

the project for e-trikes is still financially worth investing where NPV is Php119,820 and BCR is Php 1.26 (see Table 6).

Conclusion

This study intended to assess the profitability potential for investment of different public vehicle enterprises used in Isabel, Leyte. Based on the results of the gross profit analysis and the discounting flow analysis conducted, the three different types of vehicles have experienced positive returns on their investment and operations. The results suggest that gasoline-fuelled vehicle have the largest net present values indicating the highest financial profitability. Pedicab, with its lowest cost of investment and the lowest operating cost, generated the highest benefit-cost ratios and lowest pay-back period. The electric-tricycle, with its highest purchase cost and highest maintenance, resulted to lowest positive returns compared with the two vehicles. This result is a product of an unbiased analysis of the alternative vehicles. Apparently, when financial indicators are used as decision guide for adoption of these vehicles, e-trikes provided lesser net returns than its best alternative - the gasoline-fuelled tricycle. Further, it is also expected that pedicabs are still feasible for the limited-resource driver operators who cannot afford to invest on e-trikes and g-trikes. It is important to note that these indicators of profitability only considered financial returns, excluding the intangible benefits (i.e. the environmental benefits, and other social benefits). Further study should be conducted to include these variables to provide new information.

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