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Special Police Vehicles: A Cost Benefit Analysis Perspective

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ABSTRACT

The purpose of this paper is to investigate the economic feasibility of purchasing a special police vehicle for traffic enforcement operations. It includes a real world example intended to walk the reader through a basic Cost Benefit Analysis (CBA). The methodology employed in this paper is a strict mathematical and common sense analysis of the potential purchase of special policing vehicles, weighing the costs versus the associated benefits.

In the presented case, the analysis clearly indicates that the purchase and use of a special police vehicle makes economic sense. The broader question to ponder considers how an individual can utilize cost benefit analysis (CBA) to make their individual departments more economically sound. It is recommended that law enforcement agencies utilize CBA's whenever appropriate to justify expenditures or analyze the effectiveness and efficiency of a program or piece of equipment.

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INTRODUCTION

Law enforcement administrators and police fleet managers regularly use police vehicle cost analysis. Basic analyses generally comprise acquisition costs of purchasing vehicles and equipment as well as operating expenses associated with maintaining vehicles. More sophisticated and growing in use by law enforcement agencies is lifecycle cost analysis (LCA). (Sanow, 2004). A LCA measures all associated costs of police vehicles over their entire service life from acquisition to disposition. (Sanow, 2004). It is used to choose between alternative vehicle choices and to determine the best vehicle replacement policy. (Aryani, 2005).

Another advanced decision tool is cost-benefit analysis (CBA). A CBA not only measures the costs but also the benefits of the underlying project such as a specific police vehicle program. According to Zerbe & Dively (1994) and DeGarmo, Sullivan, & Bontadelli (1989), an LCA “compares the advantages and disadvantages, weighs the benefits of a purchase or program with the costs such a purchase or program generates over its expected lifetime” (p. 22).

A common example is the decision-making process of an agency deciding whether to implement a specialty police vehicle program such as the purchase of a squad for a selective traffic enforcement program (STEP). According to Aryani (2005), “A lifecycle cost analysis can assist in choosing a particular make and model for such a program” (p. 23). However, only a CBA can tell agency administrators and fleet managers whether the program makes economic sense. A CBA shows whether the program is efficient and does not constitute a waste of valuable agency resources and taxpayers’ money.

This paper will provide a real world example of a cost benefit analysis regarding the economic feasibility of a department purchasing and maintaining a special police vehicle for traffic enforcement use. It is hoped that the reader will be able to utilize cost benefit analysis in their own department in order to maximize available budgetary dollars.

REVIEW OF LITERATURE

The literature reviewed for this paper includes periodicals, journal articles, and books. Historically, law enforcement administrators allowed, or were forced to allow, City Councils and County Commissioners to make vehicle purchasing decisions for them. In the alternative they often followed a “low-bid” process when awarding purchasing contracts. Recently, Law enforcement administrators and police fleet managers have begun to utilize some form of vehicle cost analysis in their decision making process. Generally that analysis has been limited to Lifecycle Cost Analysis (LCA). According to Sanow (2004), LCA’s “[measure] all associated costs of police vehicles over their entire service life, from acquisition to disposition” (p. 81). Aryani (2005) explains that they were used to “choose between alternative vehicle choices and to determine the best vehicle replacement policy” (p.22).

Recently, law enforcement agencies and police fleet managers have begun to use Cost Benefit Analysis (CBA) as a more accurate gauge with which to make purchasing decisions. A CBA measures the complete acquisition and operating expenses of the underlying project, such as a police vehicle purchase. It also includes the benefits associated with its purchase and use. A CBA can tell agency administrators in visual terms whether the program they are proposing takes economic sense. This should help save vital taxpayer dollars available to the law enforcement agency.

There was a very limited amount of literature available regarding the use of CBA’s by law enforcement administrators or fleet managers during the vehicle procurement process. It is hoped that law enforcement agencies will see the efficiency and effectiveness of employing the use of CBA’s in all of their purchasing decisions.

METHODOLGY

The purpose of this paper is to provide the reader with a basic understanding of the concept of Cost Benefit Analysis. The specific example used would be the decision of whether or not to replace an existing STEP traffic enforcement vehicle for the examined department. The hypothesis proposes that the cost benefit analysis would prove that the vehicle would be a wise addition to a Police Departments fleet.

During the course of the investigation a number of data sources were examined. They included repair records for the current STEP traffic enforcement vehicle. Citations issued through the STEP traffic enforcement program were examined to determine violation trends and to establish a benchmark for average citation revenue. Time records were examined in order to establish patterns of use for the vehicle. Finally, receipts were examined to determine how many citations were being paid versus another form of disposal (defensive driving or deferred adjudication) which would affect the overall revenue expected for the city. The data received will be analyzed in a basic cost benefit structure utilizing basic math and common sense.

FINDINGS

The examined police department is a midsize agency employing 55 full-time sworn officers. The department has successfully operated a one vehicle STEP program since the mid 1980s. The STEP program is solely operated as an overtime program. The STEP vehicle is only used for the program and for special events such as parades, cruises, crime prevention fairs, neighborhood events, and school events. Its main purpose is to enforce traffic laws in areas experiencing above average traffic violations and areas with statistically significant accident rates. The STEP vehicle is not used for general patrol or traffic enforcement duties during officers' regular shifts.

In 2001, the department was considering adding a second special service vehicle to its STEP program. In order to decide whether the purchase of a second STEP vehicle would be an efficient use of departmental resources, the department had to look at its past STEP experiences and project future costs and benefits of a second STEP vehicle.

The STEP vehicle at the time was a 1997 B4C special service Chevrolet Camaro and the department was considering adding a second B4C Camaro to its STEP program for the 2002 calendar year. Given the deployment as overtime vehicles only, the departmental STEP vehicles traditionally see much less use both in hourly use terms and in odometer mileage terms compared to regular patrol and traffic enforcement squads. For example, part of the STEP program is to respond to neighborhood complaints about increased traffic violations by monitoring traffic in such neighborhoods leading to very few odometer miles being accrued. Based on past experiences, it can be assumed that the second STEP Camaro would only accumulate a maximum of 7,000 miles per year. The vehicle would stay in service for 7 years given its low annual mileage before being auctioned off. The B4C Camaro considered for purchase was a 2002 model year vehicle. It is anticipated that the 2002 Camaro would be put into service in January of 2002 and taken out of service in December of 2008 leading to its projected service life of 7 years.

Just like in a LCA, costs are analyzed in periodic time intervals in a CBA such as on an annual basis. However, a basic CBA encompasses more data than a basic LCA. Whereas a basic LCA merely covers actual vehicle cost data, a basic CBA introduces some overhead cost such as officers' overtime expenses like in the departments STEP program's case. Importantly, a CBA covers the benefit side of a program as well. In our case this would be ticket revenue etc.

Therefore, the minimum data required for a basic CBA such as in RPD's example are: vehicle acquisition price, emergency equipment cost, insurance cost if applicable, fuel cost, maintenance and repair expenses, officer labor cost, and benefit items such as revenue from various traffic tickets such as speeding, failure to stop at a stop sign/light, etc. Other data required are numbers for the cost escalation rate and the discount rate without which a CBA would not be valid.

According to Flaig (1989), the cost escalation rate is an "approximate measure for future cost of living/cost of doing business increases" (p. 51). The escalation rate was set at 5%. Figures for the escalation rate can be derived from past consumer price index (CPI) numbers or future forecasts. Changes in the CPI represent a commonly employed measure for the inflation rate. The U.S. Department of Labor's Bureau of Labor Statistics publishes these figures and they are available on the Internet at http://www.bls.gov/cpi/home.htm.

The 5% assumption for the years ahead represented a reasonable estimate given past inflation rates, current economic trends, and the particular volatility of gasoline prices. Fuel expenses constitute a particularly large cost item among the operating costs of police vehicles. To be on the safe side, law enforcement administrators and fleet managers can therefore justify escalation rates slightly above estimated inflation rates if gasoline prices are expected to outpace core inflation rates.

Gittinger (1984), "The discount rate is an approximate measure to determine today's value of an expense or benefit to be paid or received in the future" (p. 73). The process of determining this value is called discounting. Discounting is simply looking backward from the future to the present. According to Aryani (2005), future costs and benefits are "discounted because their cash value in the present is less than in the future due to society's overwhelming consensus" (p.22).

For example, lottery officials across the nation use the same logic. They reduce actual cash payouts for winning advertised jackpots (to be paid out over a number of years) through discounting when winners opt for the cash payment option. In simple fleet management terms, discounting generates the present value of future operating costs incurred as well as future operating benefits derived throughout the service life of a STEP vehicle program.

The discount rate was set at 6%. Figures for the discount rate can be derived from government bond interest rates or commercial loan rates as published in the financial section of newspapers. The maturity of bonds or loans as measured in number of years chosen for the CBA's discount rate should be similar to the STEP vehicle's expected service life in number of years in order to employ justifiable discount rates.

For the department's CBA purposes, the analysis distinguished between variable vehicle costs, officer overtime costs, and fixed vehicle costs for the 2002 Camaro. Variable vehicle costs vary with the amount of use a vehicle experiences. These constitute operating costs and are fuel, maintenance, and repair expenditures.

It was assumed that $1.60 was the average price of fuel for the first year of service for the Camaro in 2002. It was assumed that 18 miles per gallon was the average fuel efficiency figure for the Camaro. This is based on the manufacturer provided EPA city/highway (18/25) fuel economy ratings, past STEP Camaro service experiences, and the departments suburban enforcement environment encompassing an interstate highway, a couple of state highways, and various city and neighborhood streets. Dividing the annual miles driven of 7,000 by the 18 miles per gallon fuel consumption results in an annual gasoline consumption of 389 gallons.

Multiplying this figure by the assumed average price of fuel of $1.60 produces an annual fuel expenditure of $622 for the Camaro. This number is entered in row 2 of our CBA table below.

Maintenance expenses comprise fluid changes and other minor regularly scheduled service items including car washes. “Repair expenses typically cover more costly items such as brakes and tires in addition to items addressed because of impending or actual failure such as transmission, engine, electrical, and suspension work” (Wynne 1965). To keep the analysis simple, both maintenance and repair expenses were included under the same heading.

The purchase of a General Motors GMPP 5 year/ 100k miles extended warranty was incorporated into the analysis. This allowed me to keep projections for repair expenses at a minimum because the extended warranty would presumably cover most potential repairs. For example, the department did utilize the extended warranty in the spring of 2005. A failed starter and a flywheel with broken teeth were replaced at no cost to the department.

The annual maintenance and repair expenses for the years 2002 through 2008 are displayed in row 3 of the CBA table below. They were set after careful review of the department’s STEP vehicle service history and the manufacturer’s severe service maintenance schedule.

Next, officer overtime cost was calculated to be about $20,000 per year as shown in row 4 of the CBA table below. This dollar figure was derived by analyzing STEP vehicle use patterns of officers. Averaging the various overtime pay rates of officers and supervisors according to their different pay steps resulted in an overtime pay rate of $40 per hour. The use pattern analysis also revealed that the Camaro would be used about 500 overtime hours a year for STEP program purposes. Multiplying these 500 overtime hours by the average overtime pay rate of $40 per hour results in the above-mentioned annual $20,000 overtime labor expense.

Finally, fixed vehicle costs have to be accounted for. According to Wynne, fixed costs "are incurred once as set up expenses" (Wynne p.37). They comprise the Camaro's acquisition price, the cost of the emergency equipment installed, and insurance cost. The department is self-insured. Therefore, there is no cost of insurance to account for.

The 2002 B4C Camaro's bid price was $22,911. The cost of the GMPP extended warranty of $1,800 was added to this bid price resulting in a purchase price of $24,711. The department traditionally buys its squad cars outright. Therefore, there were no financing or leasing costs to consider. One could expect the Camaro's residual in 2008 to be $9,000 or about 36%. The reason for this expected high residual is the Camaro's relative low mileage at the end of its service life as well as the expected demand for such a last model year B4C special service Camaro in the enthusiast market. The 2002 model was the last model year for Chevrolet Camaro's as well as its B4C special service package.

Subtracting this $9,000 residual from the purchase price of $24,711 reveals the total vehicle depreciation of $15,711. This total depreciation is measured annually for CBA purposes. Used vehicle market research has shown that new vehicles depreciate the most during their first year of use. To be realistic yet keep the analysis still simple the analysis assumed an initial depreciation of $4,713 (a 30% first year depreciation) and a straight-line annual depreciation of $1,833 thereafter. These figures are reflected in row 8 of the CBA table below.

The department's STEP vehicles are equipped with a radio, siren, speaker, graphics, VHS camera, radar, and interior emergency lighting. The analysis assumed that the STEP Camaro would be a slick top vehicle with an interior LED light package. The analysis set the total cost of the emergency equipment installed at $10,150. STEP vehicle equipment is traditionally purchased new and not transferred to other vehicles at rotation. For simplicity's sake the analysis assumed that the equipment has only scrap value after its service life of 7 years. Therefore, it has no residual and the total depreciation is equal to the total equipment cost of $10,150. Dividing this figure by 7 years for a simple straight-line depreciation results in an annual emergency equipment depreciation of $1,450 as shown in row 9 of the CBA table below.

A main source of potential benefits of the department's STEP program is revenues from traffic citations. Examples are revenues from traffic tickets such as speeding, failure to stop at a stop sign/light, no insurance, no seat belt, etc.

Past departmental STEP vehicle logs and traffic citation records were examined in order to determine the statistical composition of the various traffic tickets issued. The analysis consistently found that on average speeding tickets made up two-thirds of all traffic citations issued. The makeup of the remaining citations varied. Given this fact, the conscious decision was made to concentrate only on the speeding tickets to keep the analysis as simple as possible.

The analysis revealed that on average 74 speeding tickets were issued per month on STEP duty. The investigation also revealed that the weighted average of the cited speed infractions amounted to 18 miles per hour over the posted limit. RPD's scheduled fine for 18 over the speed limit is $180.

The department's municipal court was contacted in order to analyze the final disposition of STEP issued citations. It was discovered that 40% of cited drivers take defensive driving courses and pay the state mandated fee and court costs. The department does not derive any revenue from these proceedings. However, half of the other 60% of drivers take deferred adjudication and pay the fine in full, whereas the remaining half simply pay the full fine amount without any further court proceedings.

The court data also showed that about $85 of the $180 fine remains for the city after deductions for state mandated fees and court costs. Therefore, 60% (44 citations) of the average number of monthly STEP speeding tickets (74 citations) were taken and multiplied by $85 to get the amount of the monthly revenue ($3,750) that the department's STEP Camaro is projected to derive from speeding citations. For CBA purposes the analysis multiplied this figure by 12 to get the annual revenue amount of $44,880, which is exactly the figure entered into row 14 of the CBA table below.

The benefit estimate of $44,880 per year is fiscally conservative in nature because the analysis concentrated only on revenues generated from speeding tickets. It is also conservative because the analysis focused only on cash flow items that are directly related to the STEP program and the department's budget.

The analysis did not incorporate other important benefits derived from the department's STEP program into our CBA for simplicity's sake. More advanced CBA's add such important benefit items. For example, a comprehensive analysis that takes into account the economic benefits of a STEP program going beyond the department's own individual budget would incorporate the $ value of a locally reduced accident rate in terms of property damages prevented, injuries prevented, emergency services saved, and lives saved at high STEP enforcement intersections and roadways. Moreover, intangible benefits defined as items not lending themselves easily to consistent measurement in $ figures could be included as well. An example is greater citizen satisfaction in neighborhoods voicing complaints about traffic problems. The smile on the faces of children checking out a specialty police vehicle such as a Camaro at a school or neighborhood event is priceless meaning it is one more intangible benefit.

Such a comprehensive economic analysis can reveal the true extent of societal benefits of a STEP program beyond the individual efficiency assessment for the department's budget. However, a basic CBA simply concentrates on the financial effects of a program on the individual agency. Agency administrators can always mention other potential benefit items and their expected effects above and beyond their basic CBA in their accompanying memo to their stakeholders such as city management staff, city council members, or county commissioners.

Cost and benefit estimates should be organized in table format by year and general item as illustrated in the CBA table below. This can be accomplished in plain pen and paper format, in a word processor utilizing the table command menu, or better in spreadsheet format.

Begin by entering annual estimates for operating expenses before summing them up. Next, apply the cost escalation rate by multiplying the respective factor with the sum of the annual operating costs to derive the sum of escalated annual operating costs as displayed in row 7 of the CBA table below.

Escalation rate factors can be found in publications such as J. Price Gittinger's "*Compounding and Discounting Tables for Project Analysis*"; under the formula command of spreadsheet software; through the use of calculators containing financial functions; or simply through hand calculation by making use of the cost escalation formula of $(1 + \text{escalation rate})^{\text{number of service years}}$. For example, the escalation rate factor for the seventh and last year of service of the Camaro using this formula and assuming an escalation rate of 5% is $(1 + 0.05)^7$ equaling 1.407. This is indeed the factor entered into the table for 2008.

It is important to realize that the factor is 1.407 meaning 40.7% and not simply 1.35 meaning 35% as in seven years times 5%. This difference is due to the escalating effect of inflation. The above formula takes into account that annual cost increases are not only applied to the original price of fuel, parts, and labor in a vehicle's first year of service but are also applied to the portion of the price of fuel, parts, and labor that has increased in latter years.

Next, list the annual vehicle depreciation and equipment depreciation estimates as well as the sum of these fixed costs in separate rows. Then add the sum of operating costs and the sum of fixed costs in a new row labeled 'total costs' as shown in row 11 of the CBA table below.

Apply the discount rate by multiplying the annual total cost estimates with the discount rate factor to get the discounted total cost (row 13). You can get this factor through the same sources listed above for the escalation rate factor. Alternatively, you can use the discounting formula of $1 / (1 + \text{discount rate})^{\text{number of service years}}$. For example, the factor for the fifth service year of the Camaro assuming a rate of 6% is $1 / (1 + 0.06)^5$ equaling 0.747. This is the discount rate factor given for 2006 in row 12 of the CBA table below.

List your benefits in a new row as was done in row 14 by entering the annual speeding ticket revenue estimates. Note that the analysis assumed annual revenues to stay the same throughout the service life of the Camaro for simplicity's sake. Apply the discount rate here the same way as above for the cost side to derive the discounted total benefit shown in row 16. The final step is to subtract the discounted total cost estimates from the discounted total benefit estimates to get the net present value figures as illustrated in row 17. The annual net present value (NPV) estimates indicate the net cash flow of RPD's second STEP vehicle program.

TABLE: CBA COMPUTATION FOR RPD'S STEP CAMARO

1	Year of Service	2002	2003	2004	2005	2006	2007	2008
2	**Fuel**	622	622	622	622	622	622	622
3	**Maintenance & Repair**	910	935	960	1110	1159	1285	910
4	**Officer Overtime**	20000	20000	20000	20000	20000	20000	20000
5	**Sum of Operating Costs**	21532	21557	21582	21732	21781	21907	21532
6	**Escalation Factor at 5%**	1.050	1.103	1.158	1.216	1.276	1.340	1.407
7	**Sum of Escalated Operating Costs**	22609	23777	24992	26426	27793	29355	30296
8	**Vehicle Depreciation**	4713	1833	1833	1833	1833	1833	1833
9	**Equipment Depreciation**	1450	1450	1450	1450	1450	1450	1450
10	**Sum of Fixed Costs**	6163	3283	3283	3283	3283	3283	3283
11	**Total Costs**	28772	27060	28275	29709	31076	32638	33579
12	**Discount Rate Factor at 6%**	0.943	0.890	0.840	0.792	0.747	0.705	0.665
13	**DISCOUNTED TOTAL COST**	**27132**	**24083**	**23751**	**23530**	**23214**	**23010**	**22330**
14	**Revenue from Speeding Tickets**	44880	44880	44880	44880	44880	44880	44880
15	**Discount Rate Factor at 6%**	0.943	0.890	0.840	0.792	0.747	0.705	0.665
16	**DISCOUNTED TOTAL BENEFIT**	**42322**	**39943**	**37699**	**35545**	**33525**	**31640**	**29845**
17	***NET PRESENT VALUE in $ (Row16 – Row13)***	***15190***	***15860***	***13948***	***12015***	***10311***	***8630***	***7515***

DISCUSSION/CONCLUSIONS

The most critical aspect of a CBA is to correctly interpret the estimates. The goal of a basic CBA is to determine whether a program makes efficient use of scarce budget resources. To determine this you can use two alternative but related measures: the NPV mentioned above and the benefit-cost ratio.

To employ the NPV all the estimates must added in row 17 to derive an overall NPV. This is relevant because some projects have negative net cash flows in early years before rendering positive net cash flows. If this overall NPV is equal to 0 or a positive number, then your proposed program is efficient at the chosen discount rate. However, if the overall NPV were negative, your proposed project would be inefficient and waste valuable agency's resources. For example, the overall NPV for RPD's STEP Camaro is $83,469. Therefore, the program was deemed efficient. It is important to point out that the amount of the overall NPV has no bearing whatsoever on how efficient a program is. It is impossible to compare two programs, both with positive NPV's, and pick the one with the higher NPV. The NPV merely demonstrates whether a program itself is efficient or inefficient. It is not a measure for ranking various programs. Other measures exist for this purpose in more advanced CBA's.

The benefit-cost ratio (BC) is an efficiency measure widely used by the Army Corps of Engineers, for example. To derive the BC ratio, add the annual estimates of the discounted total benefit in row 16 and divide this number by the sum of the annual estimates of the discounted total cost in row 13. In the department's STEP Camaro case this amounts to $250,519 / $167,050, which is equal to a BC ratio of 1.5. A BC ratio of 1.0 or greater means that the analyzed program is efficient at the chosen discount rate. A BC ratio of less than 1.0 indicates that a proposed project would make inefficient use of resources. The BC ratio as well is not an appropriate measure for ranking different programs even though some analysts have misappropriated it for such a purpose in the past.

You can use the information provided here to do a basic CBA for a specialty vehicle program you are trying to convince your stakeholders to authorize funds for. In the department's case, the second B4C Camaro was purchased. Since 2002, the department's STEP program has successfully operated with two specialty squads. The information can also use for any other program under consideration for which you are able to list cost and benefits in a coherent manner. Assumptions can be set based on experiences and circumstances to see whether the program would make efficient use of funds.

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