Quick Approach To Estimate Law Enforcement Cost on Urban Roads

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Law enforcement costs on urban roads is a seldom-considered public cost, although it averages two to three times higher than maintenance costs. When law enforcement costs are considered, a typical value used by planners is about $5,000 per lane-mile. This value may be adequate for rural roads, but it significantly underestimates the costs on urban roads, as demonstrated through the study cases described in this paper. Law enforcement costs are not included in the cost calculation of urban roads due to the lack of an effective and simple procedure. This paper presents a "quick approach" for estimating law enforcement costs on urban roads, a step-by-step procedure that is both simple to understand and easy to apply. All the needed data can be obtained through a few telephone calls. The calculations are quickly performed on templates provided in this paper. The quick approach provides valid answers because it takes into account all the important parameters related to law enforcement activities. It is also based on sound, justifiable logic and contains few assumptions. The quick approach gives an average value for law enforcement cost per lane-mile of the city highway network. However, this value could be adjusted to represent the costs on a specific urban road.

A research study conducted at the University of Florida to compare the public costs involved in building a new highway versus providing a fixed transit system found that two types of public costs specific to highway projects are inadequately covered in the existing literature and available records. These are the costs of law enforcement and risk management of the highway system. While extensive up-to-date statistics are kept on the various costs of construction, operation, maintenance, and equipment for both the highway and the transit system, very little information is available on the costs of highway law enforcement and risk management.

When comparing the public cost of highway and transit systems, law enforcement and risk management costs are important to consider for the highway alternative because they are implicitly included in the rail transit operational budget. Although the Law Enforcement Cost (LEC) per lane-mile of highway is on average much higher than the maintenance cost, LEC was seldom considered in previous studies.

This paper focuses on evaluating the LEC and presents an easy, quick approach to estimate LECs on urban roads.

BACKGROUND

The public costs involved in law enforcement on the highway network can be subdivided into various cost components; including, patrolling roads, directing traffic, assisting traffic

accident victims, filing reports, investigating accidents, pursuing traffic law violators, writing fines, and testifying in traffic-court hearings. In summary, highway law enforcement activities are those related directly to traffic law enforcement, traffic control, and traffic accidents. LECs are the direct and indirect public expenses generated entirely by highway traffic.

Most studies estimating the public cost of a new highway fail to consider law enforcement costs. On average, LEC per lane-mile of roadway in an urban area is roughly two to three times the maintenance cost. The cumulative value of the annual LEC over the useful life of the road is significant. It should be estimated and taken into consideration when analyzing the cost-effectiveness of a specific highway or when comparing alternative investments.

From discussions with planners, it was found that LEC was considered in only a few instances. The most common LEC value used was about $5,000 per lane-mile of roadway. Although this value is appropriate for rural roads, it significantly underestimates the LEC on urban roads, which averages two to three times higher.

Study Objective

The quick approach proposed in this paper presents a methodology to estimate the LEC per lane-mile of urban road. The approach takes into account all relevant parameters specific to the study location. It is also simple to understand and easy to apply. The needed data can be obtained through a few telephone calls. The computations required are simple and can be performed on one standard sheet (a sample sheet is included in the tables). Planners, engineers, or technicians can apply the methodology to determine the LEC in any city and in a short period.

Study Approach

Two different techniques were investigated in order to determine the one that best satisfies the above-stated objectives. The first technique is based on a macro approach. The second is based on a micro approach.

The macro approach consists of determining the proportion of the city Police Department (PD) budget that is directly or indirectly related to law enforcement activities on the city highways. This part of the budget is then divided by the total lane mileage that falls under the jurisdiction of the city's PD (usually that excludes interstate, state, and country roads). This provides an average cost of law enforcement per lane-mile of urban roadway. If the procedure is applied to a specific

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highway in the city, the average LEC should be adjusted by a factor computed as the ratio of the measured (or simulated) traffic volume on that road to the city's average traffic volume per lane-mile. Normally, the frequency of accidents is related to the vehicle miles of travel (VMT). However, if the road location causes a higher accident rate (i.e., hazardous intersection, narrow bridge, interchange, etc.), the LEC should be further adjusted with an appropriate factor determined from past observation of incidents and tempered by practical judgment.

The micro approach consists of adding the individual cost items that constitute the total cost of patrolling a particular road. These items include labor, equipment, vehicles, management, and overhead. The frequency of patrolling a specific highway is an important parameter for estimating the LEC per mile of roadway using the micro approach.

After careful analysis of both methods, the macro approach was found to be more appropriate for the quick approach technique because data needed for the macro approach are readily available and can be objectively analyzed, and calculations required by the macro approach are simple and easily performed.

On the other hand, data needed for the micro approach are extensive, not readily available, and difficult to assess. For example, the cost of equipment includes an annualized value of vehicles, computers, and telecommunication system costs. Furthermore, different police agencies may use distinct accounting methods that will considerably complicate the data-collection process.

One of the most important parameters in estimating LEC using the micro approach is the frequency of patrolling activities. Factors such as street location, traffic volume, and accident history may greatly affect the frequency of patrolling a particular road. However, because of the nature and difficulty of obtaining such data, the frequency of police patrolling cannot be reasonably assessed for all types of urban roads.

The micro approach depends on a large number of factors. It also deals with annualized costs that involve the value of time (interest and inflation). Consequently, calculations performed in the micro approach are tedious and complicated.

In conclusion, the macro approach is selected because it requires readily available parameters, accounts for all relevant factors, is easily applied, and is based on a sound logic.

DESCRIPTION OF MACRO APPROACH

As previously mentioned, the macro approach excludes from the PD budget all costs not related directly or indirectly to highway law enforcement activities. After excluding these costs, the remaining part of the budget is divided by the city road mileage under the PD jurisdiction. This is accomplished through the following stages:

1. Determine highway law enforcement-related budget.
   –Subdivide the PD work force into the various law enforcement units. Each unit should include the number of officers and supervisors.
   –Estimate the percentage of time that each police unit spends on highway law enforcement activities. These activities were defined earlier in the Background section.

A cumulative percentage of weighted averages will determine the ratio of the PD's budget reserved for highway law enforcement purposes.

2. Determine Police Department assets depreciation.
   –The depreciation amount of the PD assets is determined by dividing the value of each asset by its estimated service life. The same ratio calculated for the operational budget will be applied to the annual depreciation. Because buildings and land have different service lives, and because the budget might include some renovation works, it was found that replacing this step with a 1.05 multiplier of the operational budget will simplify the approach without affecting the accuracy of the results.
3. Compute total lane mileage.
   –This is accomplished by multiplying the city road mileage by the average number of lanes in both directions. The city road mileage does not include interstate, state, or county roads.
4. Adjust lane mileage to police jurisdiction.
   –In some cities, the PD assists in patrolling highways under county, state, or federal jurisdictions. If this overlapping is significant (greater than 5 percent of the city mileage), an adjustment factor might be appropriate. However, in the majority of cases, adjustment is not needed because the state's Highway Patrol monitors these roads.

Macro Approach Assumptions

The macro approach involves two assumptions. First, the indirect costs (i.e., management, clerks, secretaries, maintenance, vehicles, equipment, and training) can be proportionally distributed to the work force size in each unit (number of officers plus supervisors). This is a valid assumption because officer salary and benefits constitute the major portion of the operational budget. Furthermore, organization of the police departments justifies a proportionate distribution of the indirect costs.

The second assumption is that revenues generated by traffic fine payments, which normally go to the city general budget, are not considered, for the following reasons: (a) revenues from the traffic fine payments were found to be roughly equal to the city cost for collecting the fines plus the court cost (judge and clerks) incurred in appealing those fines (this conclusion was drawn by estimating these costs and revenues for the study cases); and (b) any residual amount (revenues versus costs) of the traffic fines is insignificant compared with the PD overall budget. Therefore, neglecting revenue generated by traffic fines will have no measurable effect on the results.

Step-by-Step Procedure

Table 1 is a sample sheet to be used for the quick approach. The sheet format lists the needed data and shows how the calculations should be performed. The ranges and default values for the percentage of time that each police unit spends on highway law enforcement activities are given. The default values could be used for every police unit except the patrol unit because this value could vary greatly from one PD to another. Because the patrol unit is by far the largest unit in

TABLE 1 LAW ENFORCEMENT COST ON URBAN ROADS

CITY:		DATE:		USER:		

POLICE UNIT.	NUMB.OF OFFICERS	% TIME LEH	% TIME RANGES	% TIME DEFAULT	RELAT. WEIGHT	% TIME WEIGHTED
(COLUMN)	(2)	(3)	(4)	(5)	(6)	(7)
(EQUATIONS)					(2)/(8)	(3)*(6)
PATROL UNIT			20%-70%	--		
MOUNTED PATROL			10%-30%	15%		
TRAFFIC UNIT			95-100%	100%		
COMMUNITY POL			20%-60%	40%		
ORGAN. CRIME			10%-20%	15%		
SPECIAL UNIT			0%-5%	0%		
K-9(DOG) UNIT			0%-10%	5%		
AIRPORT SECUR.			10%-40%	20%		
INVESTIGATIVE			3%-15%	8%		
MARINE UNIT			0%-0%	0%		
AVIATION UNIT			5%-15%	10%		
OTHERS:						
	SUM(8)					SUM (9)

BUDGET (10): $		YEAR:	
DEPRECIATION OF NET ASSETS (11):	5% OF (10)	OR	$
ADJUSTED CITY LANE-MILEAGE (12):		YEAR:	

COST OF LAW ENFORCEMENT PER LANE-MILE: EQ.= [((10)+(11))*(9)]/(12)	$ DOLLARS PER LANE-MILE

* LEH - Law Enforcement on Highway

all PDs, any small variation will greatly affect the results. If the time spent by the patrol unit on highway-related law enforcement activities is not readily available from the PD, Table 2 should be used to estimate this value. In no case should a default value be used for the patrol unit. For all other police units, using the default values given in Table 1 will not significantly affect the accuracy of the result.

The quick approach procedure consists of the following five steps:

Step 1.

From the Police Department accounting office, determine the number of officers and supervisors in each police unit in the department (column 2 of Table 1).

Step 2.

For each police unit, determine the percentage of time related to highway law enforcement activities (column 3 of Table 1). If the PD cannot readily provide these figures, ranges and default values could be used for all police units except the patrol unit. Calculate patrol unit in this case using Table 2.

The ranges and default values were determined by interviewing experienced police officers from the various units. In every city selected for the study cases, a "round table" meeting was held with 12 to 15 senior officers representing all the police units. An effort was made to achieve consensus on each of the values presented in Table 1.

Likewise, the data needed for Table 2 can be obtained by asking a senior patrol officer or by gathering the same information from two or three experienced patrol officers.

TABLE 2   PATROL UNIT HIGHWAY LAW ENFORCEMENT TIME

City:	Date:	User:

Police Patrol Unit			
Unit Activity	% time spent	% time LEH	cumulative percentage
(equations)	(1)	(2)	(1)*(2)
Preventive Patrol		85%	

Call For Service:
  - Accidents
  - Report Writing
  - Crimes in Progress
  - Disturbances (family,
    neighbors, roommate,...)
		100%
		65%
		5%
		0%	

Miscellaneous:
  - Special Assign.
  - Court Testimony
  - Training
		50%
		85%
		0%	

TOTAL % OF TIME RELATED TO LAW ENFORCEMENT ON HWY :			

* LEH - Law Enforcement on Highway

Step 3.

From the Police Department accounting office, obtain the operational budget for the current year. The PD budget normally does not include detention and correction (jail) functions. This is usually performed by the county or the state, but if the budget includes such functions, as in Jacksonville, it is better to subtract the amount allocated for the correction and detention functions from the budget, and likewise, to subtract the number of correction officers from the police work force. Both values should be readily available.

If the annual depreciation of the PD net assets is readily available, use this figure to adjust the operational budget. Otherwise, add 5 percent to the budget to account for it. As mentioned earlier, 5 percent was found to be an adequate value that will not have a significant effect on the overall accuracy of the results.

Step 4.

From the Public Works Department, find the total lane mileage of the city highway network. From the PD, get a rough estimate of the mileage where the jurisdiction is overlapping (county, state, or federal roads patrolled by the city PD). If the overlapping is more than 5 percent of the city mileage, it is appropriate to adjust the total mileage by that value. In most cases, there is no need for adjustment because these roads are monitored by the state Highway Patrol.

If the city limits extend to large rural areas not frequently patrolled by the police units, the city lane mileage should be reduced to account for this situation.

Step 5.

Perform the calculations as outlined in Table 1. If an estimate of the time spent by the patrol unit on highway law enforcement activities was not provided by the PD, Table 2 should be used to estimate this value. The procedure's accuracy greatly depends on a good assessment of this value.

Performing the computations as indicated in Table 1 will provide a reasonable estimate of the city LEC per lane-mile of road. This average LEC can be adjusted to reflect the cost of a specific road by using two factors. The first factor is related to the traffic volume. The second factor accounts for unsafe or hazardous locations.

STUDY CASES

The quick approach was applied to four Florida cities. The information about each city's lane mileage, the PD budget, the annual depreciation of the net assets, and the number of officers in each police unit was easily obtained. In addition, two state documents summarized most of this information for all Florida cities was obtained.

In order to determine the percentage of time each police unit spent on highway law enforcement-related activities, round table meetings were organized with several senior officers representing all police units. The consensus served as the basis for determining these values.

For Jacksonville, it was necessary to subtract the detention and corrections budget from the total PD budget. The number of officers in that position was also subtracted from the PD total work force. Furthermore, because the city limits extend

TABLE 3 LAW ENFORCEMENT COST ON URBAN ROADS (Miami)

CITY: MIAMI, FL	DATE:		USER: F. N.

POLICE UNIT.	NUMB.OF OFFICERS	% TIME LEH	% TIME RANGES	% TIME DEFAULT	RELAT. WEIGHT	% TIME WEIGHTED
(COLUMN)	(2)	(3)	(4)	(5)	(6)	(7)
(EQUATIONS)					(2)/(8)	(3)*(6)
PATROL UNIT	423	22.5%	20%–70%	--	40.6%	9.1%
MOUNTED PATROL	16	10%	10%–30%	15%	1.5%	0.2%
TRAFFIC UNIT	137	95%	95%–100%	100%	13.1%	12.5%
COMMUNITY POL	37	20%	20%–60%	40%	3.5%	0.7%
ORGAN. CRIME	39	10%	10%–20%	15%	3.7%	0.4%
SPECIAL UNIT	13	0%	0%–5%	0%	1.2%	0%
K-9(DOG) UNIT	22	3%	0%–10%	5%	2.1%	0.1%
AIRPORT SECUR.	0	0%	10%–40%	20%	0%	0%
INVESTIGATIVE	141	3%	3%–15%	8%	13.5%	0.4%
MARINE UNIT	13	0%	0%–0%	0%	1.2%	0%
AVIATION UNIT	0	0%	5%–15%	10%	0%	0%
OTHERS:	202	3%			19.4%	0.6%
	1043 SUM(8)				100%	23.9% SUM (9)

BUDGET (10): $ 75,561,000	YEAR: 1987

DEPRECIATION OF NET ASSETS (11):	5% OF (10)	OR	$ 5%

ADJUSTED CITY LANE-MILEAGE (12): 1,392	YEAR: 1988

COST OF LAW ENFORCEMENT PER LANE-MILE: EQ.= [((10)+(11))*(9)]/(12)	$ 13,617 DOLLARS PER LANE-MILE

* LEH – Law Enforcement on Highway

to cover almost all of Duval County, it was assumed that half the city mileage falls in rural areas and is not regularly patrolled by the city police units. Consequently, Jacksonville city mileage was adjusted to reflect the actual patrolling operations.

Applying the quick approach method produced the following LEC for the selected cities:

City	LEC per lane-mile ($)
Miami City	13,600
Jacksonville	9,770
Fort Lauderdale	12,592
West Palm Beach	7,960

Although the data were easily obtained and the calculations quickly performed, the quick approach yielded good estimates of the LEC. These costs per lane-mile reflected the charac-

teristics of each city's highway network, and the PD budget and structure. The work sheets for these cities are presented in Tables 3–6. Table 7 presents a detailed estimate of the percentage of time the patrol unit spent on law enforcement activities for Jacksonville.

In order to compare the magnitude of LEC on urban and rural roads, the Florida Turnpike (a toll road) was selected to estimate the LEC on rural roads. The turnpike is located in rural areas and exclusively patrolled by its own Highway Patrol force. Because the Turnpike Highway Patrol has no function other than enforcing the traffic law and assisting accident victims, the LEC per lane-mile was found by dividing the Turnpike Highway Patrol budget ($5,689,400 for 1988) by the Turnpike total lane-mileage (1,416 lane-miles in 1988). This resulted in a LEC of $4,015 per rural lane-mile, about one-third the average value found for urban roads.

TABLE 4 LAW ENFORCEMENT COST ON URBAN ROADS (Jacksonville)

| CITY: Jacksonville, Fl | DATE: | | USER: F.N | | | |

POLICE UNIT.	NUMB.OF OFFICERS	% TIME LEH	% TIME RANGES	% TIME DEFAULT	RELAT. WEIGHT	% TIME WEIGHTED
(COLUMN)	(2)	(3)	(4)	(5)	(6)	(7)
(EQUATIONS)					(2)/(8)	(3)*(6)
PATROL UNIT	514	58%	20%-70%	--	61%	35.4%
MOUNTED PATROL	4	15%	10%-30%	15%	0.5%	0.1%
TRAFFIC UNIT	62	100%	95%-100%	100%	7.4%	7.4%
COMMUNITY POL	18	45%	20%-60%	40%	2.1%	1.0%
ORGAN. CRIME	34	20%	10%-20%	15%	4.0%	0.8%
SPECIAL UNIT	24	0%	0%-5%	0%	2.8%	0%
K-9 (DOG) UNIT	7	3%	0%-10%	5%	0.8%	0%
AIRPORT SECUR.	0	0%	10%-40%	20%	0%	0%
INVESTIGATIVE	164	6%	3%-15%	8%	19.5%	1.2%
MARINE UNIT	4	0%	0%-0%	0%	0.5%	0%
AVIATION UNIT	12	5%	5%-15%	10%	1.4%	0.1%
OTHERS:	0	—				
	843 SUM(8)				100%	45.9% SUM (9)

BUDGET (10): $ 62,284,000		YEAR: 1987
DEPRECIATION OF NET ASSETS (11):	5% OF (10)	OR $ 5%
ADJUSTED CITY LANE-MILEAGE (12): 3,078	YEAR: 1987

| COST OF LAW ENFORCEMENT PER LANE-MILE: EQ.= [((10)+(11))*(9)]/(12) | $ 9,772 DOLLARS PER LANE-MILE |

* LEH - Law Enforcement on Highway

TABLE 5   LAW ENFORCEMENT COST ON URBAN ROADS (Fort Lauderdale)

CITY: Fort Lauderdale, FL	DATE:			USER:	F. N.	

POLICE UNIT.	NUMB.OF OFFICERS	% TIME LEH	% TIME RANGES	% TIME DEFAULT	RELAT. WEIGHT	% TIME WEIGHTED
(COLUMN)	(2)	(3)	(4)	(5)	(6)	(7)
(EQUATIONS)					(2)/(8)	(3)*(6)
PATROL UNIT	195	34 %	20%-70%	--	54.0%	18.4 %
MOUNTED PATROL	5	15 %	10%-30%	15%	1.4 %	0.2 %
TRAFFIC UNIT	14	100 %	95-100%	100%	3.9%	3.9%
COMMUNITY POL	10	35%	20%-60%	40%	2.8%	1.0 %
ORGAN. CRIME	22	10 %	10%-20%	15%	6.1%	0.6 %
SPECIAL UNIT	11	0%	0%-5%	0%	3.0 %	0 %
K-9(DOG) UNIT	9	3%	0%-10%	5%	2.5%	0.1%
AIRPORT SECUR.	13	15%	10%-40%	20%	3.6%	0.5 %
INVESTIGATIVE	60	3 %	3%-15%	8%	16.6%	5.0 %
MARINE UNIT	11	0%	0%-0%	0%	3.0%	0 %
AVIATION UNIT	5	5%	5%-15%	10%	1.4 %	0.1 %
OTHERS:	6	0%			1.7 %	0 %
	361 SUM(8)				100%	25.3% SUM (9)

BUDGET (10): $ 37,352,000		YEAR: 1987	
DEPRECIATION OF NET ASSETS (11):	5% OF (10)	OR $	5%
ADJUSTED CITY LANE-MILEAGE (12): 788		YEAR:	1987

COST OF LAW ENFORCEMENT PER LANE-MILE: EQ.= [((10)+(11))*(9)]/(12)	$ 12,592 DOLLARS PER LANE-MILE

* LEH - Law Enforcement on Highway

TABLE 6   LAW ENFORCEMENT COST ON URBAN ROADS (West Palm Beach)

CITY: West Palm Beach, Fl	DATE:	USER: F.N.

POLICE UNIT.	NUMB.OF OFFICERS	% TIME LEH	% TIME RANGES	% TIME DEFAULT	RELAT. WEIGHT	% TIME WEIGHTED
(COLUMN)	(2)	(3)	(4)	(5)	(6)	(7)
(EQUATIONS)					(2)/(8)	(3)*(6)
PATROL UNIT	110	37%	20%-70%	--	73.3%	27.2%
MOUNTED PATROL	0	0%	10%-30%	15%	0%	0%
TRAFFIC UNIT	20	100%	95-100%	100%	13.3%	13.3%
COMMUNITY POL	3	25%	20%-60%	40%	2.0%	0.5%
ORGAN. CRIME	5	15%	10%-20%	15%	3.3%	0.5%
SPECIAL UNIT	0	0%	0%-5%	0%	0%	0%
K-9(DOG) UNIT	4	5%	0%-10%	5%	2.7%	0.1%
AIRPORT SECUR.	0	0%	10%-40%	20%	0%	0%
INVESTIGATIVE	8	5%	3%-15%	8%	5.3%	0.3%
MARINE UNIT	0	0%	0%-0%	0%	0%	0%
AVIATION UNIT	0	—	5%-15%	10%	0%	0%
OTHERS:	0	—				
	150 SUM(8)				100%	41.9% SUM (9)

BUDGET (10): $ 13,555,000		YEAR: 1987
DEPRECIATION OF NET ASSETS (11):	5% OF (10)	OR $ 5%
ADJUSTED CITY LANE-MILEAGE (12): 749		YEAR: 1987

COST OF LAW ENFORCEMENT PER LANE-MILE: EQ.= [((10)+(11))*(9)]/(12)	$ 7,956 DOLLARS PER LANE-MILE

* LEH — Law Enforcement on Highway

TABLE 7   PATROL UNIT HIGHWAY LAW ENFORCEMENT TIME (Jacksonville)

city: Jacksonville, FL	Date:	User:	F. N.

Police Patrol Unit			
Unit Activity	% time spent	% time LEH	cumulative percentage
(equations)	(1)	(2)	(1)*(2)
Preventive Patrol	20%	85%	17%

Call For Service:
  - Accidents
  - Report Writing
  - Crimes in Progress
  - Disturbances (family, neighbors, roommate,..)
	10%
	31%
	7%
	14%
		100%
		65%
		5%
		0%
			10%
			20.2%
			0.4%
			0%

Miscellaneous:
  - Special Assign.
  - Court Testimony
  - Training
	4%
	10%
	4%
		50%
		85%
		0%
			2%
			8.5%
			0%

TOTAL % OF TIME RELATED TO LAW ENFORCEMENT ON HWY :			58%

* LEH - Law Enforcement on Highway

CONCLUSION

The quick approach for estimating the LEC on urban roads is both simple to understand and easy to apply. It could be used for estimating an average LEC per lane-mile of urban road. This value can then be adjusted to reflect the LEC of a particular road in the city. All the needed data could be obtained through a few telephone calls. Two standard calculation sheets (Tables 1 and 2) are provided to assist in the data-collection process and efficient application of the quick approach. The five step procedure covers all that is needed to acquire the necessary data and calculate the LEC of urban roadways.

As presented through the study cases, the quick approach provides a reasonable estimate of the LEC because it takes into account all the important parameters relative to law enforcement activities. Furthermore, the approach's sound, justifiable logic includes few assumptions.