Development of Major Aspects of the Traffic Safety Program for Palestinian Cities

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Abstract. Very limited efforts have been applied to improving traffic safety in Palestinian cities. Therefore, establishing a traffic safety program is essential to achieving this purpose. The main component of this program that was the focus of this study is the planning component, which includes collecting and maintaining accident data, identifying hazardous locations, conducting safety studies, and establishing priorities.

Appropriate procedures and forms for collecting and maintaining accident data for Palestinian cities were identified. The police accident report form is the most important source to create the accident database. The existing police report is inappropriate for traffic engineering purposes. It was designed for the purposes of police and insurance agencies. A new comprehensive police accident report was designed in this study. A new computer program was also developed as a step towards a computerized system of data recording and filing.

Procedures and thresholds values for identifying hazardous locations were established for the largest Palestinian city, Nablus, based on the available accident data records. The expected value statistical method was used as an appropriate tool to determine critical values for identifying hazardous locations based on the accident number-rate technique. Threshold values for identifying hazardous locations for various classes of highways/intersections were also established.

Procedures, forms, and steps for conducting safety studies were proposed in this study based on modified international experiences to fit local conditions. The methodology for establishing project priorities was established based on the benefit/cost. The average accident cost by type was proposed in the study based on the records of Palestinian insurance companies.

The results of this research showed that Palestinian cities are in a dire need for adopting and implementing a traffic safety program. Therefore, it is recommended that the related Palestinian agencies take the proper steps, and this study is an appropriate guide.

INTRODUCTION

The Palestinian National Authority (PNA) gradually resumed control over some parts of the West Bank and Gaza Strip since 1994. Traffic accidents data were collected by the Israeli government up to 1995. At the current time, there is no systematic approach to deal with improving the traffic safety program in the Palestinian territories. This was due to political reasons, improper allocation of budget, ineffective use of specialized and qualified people, and lack of institutional infrastructure to deal with traffic problems.

Due to various political, financial, and administrative reasons, accident statistics in the Palestinian areas are not well documented, and as a result information is not highly accurate. A considerable number of property-damage and light-injury accidents go unreported. However, it has been stated by several local and regional professionals that accidents in the area has reached "alarming rates."

The main sources of crash data until 1994 were the Israeli Central Bureau of Statistics (ICBS) and the records of the Israeli Police Force. However, the ICBS crash data information is not easily accessible and the data available from the Palestinian Central Bureau of Statistics (PCBS) are very limited.

By the year 1994, the annual rate of increase in crashes and fatalities was about 5.0 percent. The total number of reported crashes in the West Bank was 1239 in 1994. Private and commercial vehicles represented 60.8 to 62.3 percent of all vehicles involved in these crahes. The involvement of taxis and buses was insignificant (less than 6%) while trucks were involved in about 26 percent of the crashes (Sinha and Hamideh, 1999).

The percentage of pedestrians involved in road crashes was high (about 30 percent) because residential areas and schools are located close to the roads. About 20 percent of the injuries were among the children group.

In the West Bank, the crash severity index increased from 4.4 to 5.1 percent during the period 1991-1994 (Sinha and Hamideh, 1999). The annual rate of increase in the number of fatalities ranged between 8.5 and 20 percent. Based on the available data, the road accident mortality rate in the West Bank increased from 8.6 in 1991 to 11.5 in 1994. Overall, an increase of 34.0 percent was registered in the four-year period. Similarly, fatality rate increased from 12.9 in 1992 to 13.5 in 1994. The number of casualties resulted from those accidents reached 6,492 (PCBS 1999).

Table 1 represents the road cash data in the West Bank during the period 1996-1998. Based on these data, the values for the severity index (1.6%), the mortality rate (6.1%), and fatality rate (8.8%) in recent years decreased when compared to the period 1991-1994.

In recent years, the number of road crashes and fatalities has remained stable from one year to another. Although the severity index, mortality rate, and fatality rate have decreased, they are still considered relatively high.

Table 1: Road Crashes in the West Bank

Year	Type of Injury					Total
	Slight	Moderate	Dangerous	Fatalities	Material Damage	
1996	4464	1760	491	110	1713	5562
1997	4363	1426	380	102	1384	5638
May-98	1879	496	160	43	590	2169

Source: PCBS 1999

EXISTING ACCIDENT REPORTING/RECORDING SYSTEM

Accident records are not recorded nor organized in a systematic way that serves safety traffic engineers. A study for Nablus City, a major and relatively developed Palestinian city, showed that it is hard to retrieve detailed information about accidents for a city or a particular location. This situation is typical for the rest of Palestinian cities.

Several visits and contacts with various police centers in different Palestinian cities showed that the existing reporting system of traffic accidents can be summarized in four reports. The "Court Report" includes general information about the accident. However, key information for traffic engineering purposes is lacking in this report. The accident case is sent to court in the case of a vehicle-pedestrian accident and the injured did not give up his/her right or in case of fatality accidents.

The "Closed Report" is used when the parties involved in an accident reached a settlement. This report is kept at the police department and is not sent to court. The "Property Damage Only Report" is filled in cases of property damages and a settlement between the involved parties is not reached. The "Public Damage Report" is filled in cases of fixed-object accidents.

The main purpose of this study is to develop general outlines for some of the major aspects for a Palestinian traffic safety program. This study focuses on the planning component of the traffic safety program, which consists of four processes as shown in Figure 1. These processes are collecting and maintaining data, identifying hazardous locations and elements, conducting engineering studies, and establishing project priorities (FHWA, 1981).

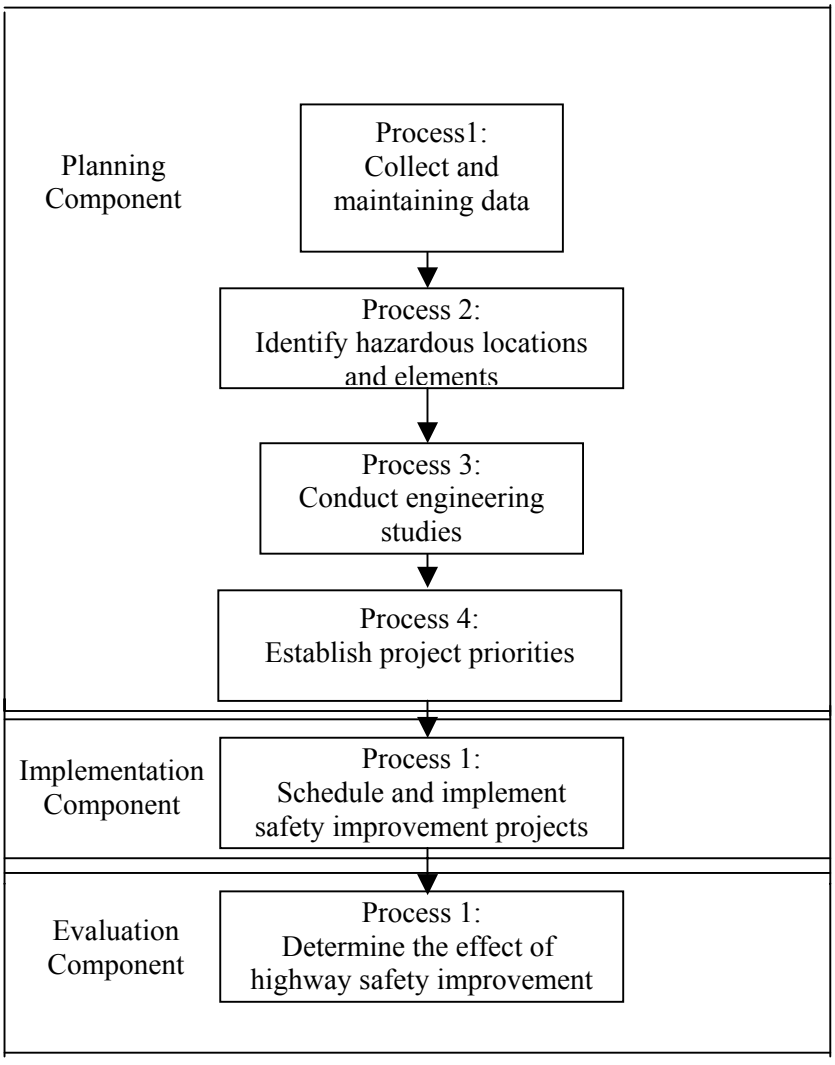

Figure 1: Highway Safety Improvement Program at the Process Level

The methodology for arriving at the major aspects of a Palestinian safety improvement program that was followed in this study was reviewing international and regional planning processes, determine steps and techniques that suit Palestinian conditions, and establish local values and thresholds related to these processes through analysis of available data.

COLLECTING AND MAINTAINING CRASH DATA

Accident data are usually obtained from state and local transportation and police agencies. The police crash report forms the basis of this information. This report varies from state to state, but it typically includes information about the location, time of occurrence, roadway and environmental conditions, vehicles and persons involved in the accidents, accident diagram, accident severity, and contributing causes of the crash. Accident data are stored and maintained in a systematic way at a central location for sometime to allow for the retrieval of information later.

In the Palestinian territories, various forms of crash reports are manually filled depending on the type and severity of the accident (as discussed before). However, these reports provide discrete information, are available at different locations, and are not well coordinated with each other so that it is difficult for a traffic safety analyst to derive useful information that enables him/her to improve traffic safety conditions. Therefore, there is a need for a new crash report that is comprehensive and designed to serve the needs of all related parties such as police, court, insurance companies, and traffic engineers.

A new and comprehensive crash report and was suggested. The suggested form consists of 4 pages, which includes general information about involved parties, accident conditions, accident type, contributing causes, and spaces for narrative description and sketch of the accident. The first two pages of this report are shown in Figure 2. Furthermore, this report is designed for incorporation into a computerized system of data recording when such a system is adopted. An associated computer program that can be used for data recording, enquiries, and analysis was also designed based on the suggested police report (Abu-Zant, 2001). Proper training for the use of the crash report and the computer software is necessary for traffic police personnel.

Crash data can be recorded manually or using computers. A number of authorities are now beginning to include their accident data using a geographic information system (GIS) or digital mapping. A similar effort was done for Nablus through a university academic program (Kobari 2000). The manual filing system of crash data was found suitable for areas where the total number of accidents is less than 500 a year (Garber and Hoel, 1998). However, this technique becomes time consuming and inefficient when accidents total more than 1000 a year. At such time, a computerized system should be used.

Kobari, 2000, reported that the annual average number of accidents for the Nablus City was 407 based on 1997 and 1998 data. However, it must be noticed that there is a high number of accidents that were not reported in the total accidents by police centers due to several reasons. One main reason is the insurance regulations and compensation system. Most property-damage-only accidents and some slight injury accidents go unreported and settled outside the police and court systems. Although the average number of reported accidents in Nablus City was slightly less than 500 per year, the use of a computerized record system should be planned for the city in the near future. Computerized accident system is superior for retrieval

Page 1

Palestinian National Authority
Traffic Administration
Police Accident Report

Case Number		***Date of File Report***	

	Day of Week	*Day*	*Month*	*Year*	*Time*	***Location of Accident***	
Date of Accident						*City*	
Date of reporting						*Village*	
Number of vehicles involved						*At Intersection*	
						At mid Block	

		Vehicle No.1	***Vehicle No.2***	***Vehicle No.3***
Drivers Information	*Name*			
	Address			
	Date of Birth			
	Sex			
	Identification No.			
	No. of Drivers License			
	Degree of License			
Owners of Vehicles	*Name*			
	Address			
	Date of Birth			
Vehicles Information	*Vehicle Make*			
	Type and Color			
	Vehicle Use			
	License Plate Number			
	Vehicle Production Year			
	Date of Issuing vehicle License			
	Expiry Date of Vehicle License			
	Insurance Company			
	Policy No. of Insurance Certificate			
	Expiry Date of Insurance Certificate			
	Vehicle Damages			
	Signature of Police Expert	***Signature Driver No.1***	***Signature Driver No. 2***	***Signature Driver No.3***

Figure 2a. Proposed Police Accident Report – Page 1

Page 2

Palestinian National Authority
Traffic Administration
Police Accident Report

Date of File Report		***Case Number***

Accident Types **(Circle One)**			
Right angle collision at signalized intersection	*1*	*Sideswiped opposite direction*	*11*
Right angle collision at unsignalized intersection	*2*	*Sideswiped same direction*	*12*
Left-turn head on collisions	*3*	*Moving vehicle collided with parked moving vehicle*	*13*
Right-turn head on collisions	*4*	*Moving vehicle with fixed object*	*14*
Rear-end collisions at signalized intersection	*5*	*Moving vehicle with stopped vehicle*	*15*
Rear-end collisions at unsignalized intersection	*6*	*Moving vehicle backing against traffic*	*16*
Pedestrian –vehicle collision (at roadway)	*7*	*Moving vehicle and bicycle in collisions*	*17*
Pedestrian –vehicle collision (at sidewalk)	*8*	*Skidding of vehicle*	*18*
Head-on collisions	*9*	*Unknown*	*98*
Over-turn vehicle	*10*	*Other*	*99*

Accident Causes **(Circle)**	**Veh 1**	**Veh 2**	**Veh 3**	***Accident Causes*** **(Circle)**	**Veh 1**	**Veh 2**	**Veh 3**
Excessive speed	*1*	*1*	*1*	*Improper right turn*	*18*	*18*	*18*
Improper passing	*2*	*2*	*2*	*Missing r.o.w for Pedestrian*	*19*	*19*	*19*
Driving not at right side	*3*	*3*	*3*	*Missing r.o.w for other vehicles*	*20*	*20*	*20*
Driving under influence of alcohol	*4*	*4*	*4*	*Driving anti road direction*	*21*	*21*	*21*
Pedestrian under influence of alcohol	*5*	*5*	*5*	*Poor visibility of signals*	*22*	*22*	*22*
Changing lane unsafely	*6*	*6*	*6*	*Restricted sight distance*	*23*	*23*	*23*
Traffic signal violation	*7*	*7*	*7*	*Inadequate signal timing*	*24*	*24*	*24*
Stop sign violation	*8*	*8*	*8*	*Following too closely*	*25*	*25*	*25*
Other traffic control violation	*9*	*9*	*9*	*Improper Load*	*26*	*26*	*26*
Falling asleep	*10*	*10*	*10*	*Improper vehicle brakes*	*27*	*27*	*27*
Dazzling	*11*	*11*	*11*	*Improper carriage way*	*28*	*28*	*28*
Improper illumination	*12*	*12*	*12*	*Opening of vehicle's door from left*	*29*	*29*	*29*
Illegal occupants bicycle	*13*	*13*	*13*	*Sudden stopping*	*30*	*30*	*30*
Leaving curb	*14*	*14*	*14*	*Slippery surface*	*31*	*31*	*31*
Pedestrian crossing not safely	*15*	*15*	*15*				
Careless Driving	*16*	*16*	*16*	*Unknown*	*98*	*98*	*98*
Improper left turn	*17*	*17*	*17*	*Other*	*99*	*99*	*99*

Figure 2b. Proposed Police Accident Report – Page 2

and analysis of data. Furthermore, there is a high number of PDO accidents that are not reported, as discussed earlier.

At the present time, the manual recording system is used in Nablus City. The traffic police department should upgrade their accident recording system to be computerized. Until then, the department should continue their manual system with the recommended improvements in this research.

A common approach to retaining records for a long period is to prepare accident summary sheets of each month (or year). These may be kept indefinitely, while the individual accident forms are discarded after three to five years (Ogden 1997). On this summery sheet, codes are usually used to describe accident types (for example, RA for right angle accidents). The use of summary sheets is recommended for the Palestinian cities. A proposed summary sheet is shown in Figure 3.

Based on international practices, it is recommended to retain accident records in active and dead files. "Active Files" are files that are kept current for a period of one year. As the records of each month are recorded in the files, records for the same month in the previous year are removed. "Dead Files" are files that are removed from the active files. It is suggested to maintain the files for a period of five years (Ogden 1997). After five years, these files will be discarded. Files that are not finished at the courthouse should be kept active.

Accident files should be stored at different locations. Copies should be kept at the local motor vehicle bureau, the highway safety agency for analytical purposes, the local traffic police office, and the city courthouse where the accident occurred.

IDENTIFYING HAZARDOUS LOCATIONS

The locations with an unusually or notably high number (or rate) of accidents are called *hazardous locations.* Identifying hazardous locations should be based upon information obtained from the process of collecting and maintaining data over several years. This process is predicated on being able to identify a specific site or group of sites where some form of remedial road or traffic engineering treatments may be applied to reduce the number of accidents occurring at such sites, or reduce their severity.

The overall goal of a hazardous road location (HRL) program is to identify locations at which there is both high risk of accident losses and an economically justifiable opportunity for reducing this risk and identify countermeasure options and priorities, which maximize the economic benefits from the (HRL) program.

There are several techniques used to determine the hazardous locations. These techniques include spot maps, number of accidents, accident rate, number-rate of accidents, rate quality control (RQC), rating by accident severity, and expected value. Details of these methods are discussed in the literature (Homburger et al, 1996; Ogden, 1997; FHWA, 1981; Garber and Hoel, 1998).

PALESTINIAN NATIONAL AUTHORITY

TRAFFIC ACCIDENT RECORD / SUMMARY SHEET TABLE

CITY / VILLAGE ***YEAR***

Case number	*Location (Intersection)*	*Location (Link)*	*Time*	*Date*	*Day*	*Number of lanes*	*Accident lane*	*Traffic control*	*ADT*	*Type of accident*	*Cause of accident*	*Fatal*	*Injury*	*Property damage only*	*Number of vehicles involved*	*Vehicle type1*	*Vehicle type2*	*Vehicle type3*	*Weather condition*	*Surface condition*	*Road condition (W/D)*	*Light condition (D/N)*

Figure 3: Proposed Accident Summary Sheet for Palestine

Most injury and fatal accident records are available in Palestinian cities in general and Nablus City (the case study) in particular. Most property damage accidents are not reported, as discussed before. Therefore, the determination of HRL in Palestine at the present time will be based on injury and fatal accidents only.

It is recommended to use spot maps as an initial stage for Palestine. Colored pins may be used to indicate sites of high number of accidents. A computerized program such as a GIS-based program will also help in using spot maps and makes it more efficient. The basis for this GIS environment for Nablus City is available (Kobari, 2000).

At a later stage when the safety program is more developed, the "Number-Rate" method can be used to determine high accident locations. The rate method can be used only where traffic volumes are known at accident locations. Otherwise, hazardous locations can be determined based on frequency (number of accidents) threshold as the basic indicator. To determine the thresholds of both accident rate and frequency, statistical methods should be applied. The expected value statistical method is recommended to estimate these thresholds because it is based on accident statistics of all intersections or links in the network. In addition, it considers a specific statistical confidence level. Therefore, it is expected to produce reliable results.

The majority of publications, which deal with this statistical methods use the confidence level of 95 percent. The formula to be used in this method is

$$Ev = Xav \pm ZS$$

Ev = Expected value

Xav = Average number of accidents per location

S = Estimated standard deviation of accident frequency

Z = the number of standard deviations corresponding to the required confidence level; Z = 1.96 for 95% confidence level

Based on this method, hazardous locations are those locations that have higher number or rate than some expected (or critical) values.

Expected Values (Thresholds) for Links and Intersection

Accident data in Nablus City was available for the period of 1997-1998 (Kobari, 2000). The analysis showed that the expected values are as summarized in Table 2. Each city in Palestine has its own situation and may yield different results. Threshold values should be periodically updated every 3 to 5 years. This period is consistent with the period for which several international agencies keep accident records.

Table 2: Expected Values at All Intersections and Links in Nablus City (1)

	At Intersection	**At Links**
Frequency of Accidents (accidents / year)	3.263 (2)	3.301 (3)
Rate of Accidents (Accidents per MEV/year)	0.402 (2)	N/A (4)

(1) Results are based on 1997-1998 accident data.
(2) Based on 126 intersections.
(3) Based on 493 links.
(4) Volume data at links were not available.

The expected values of number of accidents were also calculated for intersections of various highway classes in Nablus City where data was available. The analysis showed the results presented in Table 3.

Table 3: Expected Values of Accident Frequency and Rate at Intersections/Links Based on Highway Classification – Nablus City (1)

Facility Type	No. of Facilities	E_V (2) Based on Accident Frequency	E_V (2) Based on Accident Rate
Intersection of Main / Main	29	4.5	0.31
Intersection of Main/ Collector	17	3.5	N/A
Intersection of Collector/ Collector	24	2.0	N/A
Main Links	42	4.0	0.8

Note (1) Based on a 2-year accident records.
(2) Expected value was calculated based on equation E**v** = X**av** + ZS.
(N/A) Accidents rates at secondary road/intersections were not available.

The expected value threshold for the accident rates was calculated only for the intersections of main highways/main highways because traffic volumes were available only at these intersections. The annual expected value of accident rate for these intersections was 0.31 accidents/MEV. The thresholds of expected values for both accident frequency and rate at main highways (links) were calculated to be 4 Accidents/year and 0.8 Accidents/Million Veh-Km per year.

Calculation of expected values at collector and secondary links based on accident frequency or rate was not possible because data was either not available or could not be easily assigned or calculated at specific links. In the absence of any other information, other Palestinian cities can use the values derived for Nablus City.

After applying the above threshold values, Al-Hesba and Al-Adel Intersections were found to be the most hazardous intersections in Nablus City. Several interviews were made with drivers and police traffic experts about their perception of the hazardous locations in Nablus City. Drivers and police experts agreed that Al-Hesba Intersection is the most hazardous location in Nablus City. For this reason, a safety study was applied at this intersection.

The determination of hazardous locations through accident analyses is the basis for the treatment of these hazardous locations. The extent of treating hazardous locations depends upon the available budget. This budget should be spent first on the most hazardous locations. Then, it should be spend on the less hazardous locations, and so on. This process is continued until the available budget is totally spent.

CONDUCTING TRAFFIC SAFETY ENGINEERING STUDIES

After a particular location has been identified as hazardous, a detailed engineering study is performed to identify the safety problem. Once the safety problem is identified, suitable safety-related countermeasures can be developed.

The first task is to analyze accident data; the second task is to perform the physical condition of the site; and finally, the third task is to conduct the cause of accident analysis to determine the specific safety deficiencies at the study site (Garber and Hoel, 1998). The output of this process is a listing of safety improvement projects for each site that should be priority ranked before implementation (FHWA, 1981).

The steps in this diagnosis phase include on-site and in-office studies. These steps are studying detailed accident reports, sorting of data sorting to determine groups of accident types and the locations, detailed on site investigation, detailed analysis of all data, identifying dominant factors and/or road features, and determining the nature of the accident problem. A summary of accident data can also be used to determine accident patterns.

There are sets of typical general countermeasures for different safety deficiencies that are available in the literature. Site analysis and field visits are also essential to specify the specific possible causes of accident at a particular location. Site analysis includes preparing field inventory, condition diagram, police accident reports, accident histogram, and collision diagram (FHWA, 1981; Ogden, 1997; Garber and Hoel, 1998; Abdelwahab, 1997). A Field Inventory Form for Palestine was developed by Abu-Zant, 2001.

Accident reduction capabilities for particular countermeasures are used to estimate the reduction in the number of accidents during a given period. There are values in different countries or states for accident reduction capabilities known as accident reduction factors (ITE, 1992; Ogden, 1997, Garber and Hoel, 1998). It is recommended to use these values in Palestinian cities at this initial stage because there are no local or regional reduction factors that are available. However, when sufficient historical data and experience are established in the Palestinian areas, local reduction factors can be developed.

Economic analysis becomes necessary as it summarizes an economic feasibility (costs and benefits) of the elected countermeasures. Costs are the capital and continuing costs for constructing and operating the proposed countermeasure (investment, operating, and annual maintenance costs). The benefits are obtained by the expected number of prevented accidents by an assigned cost for each type of accident severity. The National Highway Traffic Safety Administration proposed typical costs for various accident types. However, these costs are different from country to country or state to state depending upon the costs for each type of accident severity for that area.

Jadallah, 2000, studied accident costs by type in Palestine based on records of the insurance companies. Accidents for cost purposes were classified as slight, medium, sever, very sever, fatality type 1, and fatality type 2. Table 4 shows the proposed accident costs by type.

Future cash flows need to be reduced to equivalent present-day values. The current interest rate in Palestine ranges from 5 to 6.5 percent. For typical traffic engineering works, an appraisal period (over which future benefit streams are discounted) of around five years is used (Ogden, 1997). However, a longer period is appropriate if traffic is expected to be reasonably stable. Longer periods would usually be used for major construction projects, perhaps 10-20 yeas. In Palestine, there is no definite value for life period of construction. Life period depends on the nature of the construction and experience.

Table 4: Proposed Accident Costs by Injury Type

Severity	Cost ($)
Slight or property damage only	775
Medium	4,616
Sever	18,251
Very sever	62,068
Fatality	37,996

Source: Jadallah, 2000

The present values of future benefits and costs are used to calculate an index, which is used to assess the worth of the treatment, and perhaps to rank it against other candidate projects. Some of the common criteria used for the economic appraisal of projects are net present value (NPV) and benefit-cost ratio (B/C). Other techniques are also available (FHWA, 1981). The decision rule for mutually exclusive projects is to accept the project with the highest NPV and highest B/C ratio.

Improvements are then prioritized to determine the economic feasibility of each set of countermeasures and to determine the best alternatives among feasible mutually exclusive countermeasures. The benefit cost ratio may be applied to specify the best countermeasure.

In summary, the recommended steps for conducting engineering studies in Palestine are presented schematically in Figure 4.

IMPLEMENTATION, MONITORING, AND EVALUATION

Monitoring may be simply defined as the systematic collection of data about the performance of road safety treatments after their implementation (Ogden, 1997). It is the way by which the effectiveness can be measured. Monitoring gives an idea about what really is happening, but evaluation attempts to compare between what really has happened and what are expected to happen. There may be a long-term trend in accident occurrence, and thus changes over time in the number or rate of accidents at a site may merely reflect global trends. For this reason, it is usually necessary to use some form of control group and compare accidents at the test site with those at the control site.

There are mainly four ways or techniques that may be used. These are controlled experimentation, comparisons using control sites, time trend comparison, and before-and-after studies.

The simplest method is before-and-after, which compares accident records before and after the implementation of changes. The evaluation criteria used in this method are accident frequency or rate. However, this method involves some disadvantages that traffic engineers must be cautious of (Box and Oppenlander, 1976).

Because of the simplicity of before-and-after studies, it is recommended for use in Palestine. This method proceeds as follows:

- Determine the advance relevant objectives (e.g., the reduction of all accidents).
- Obtain and compare the data before and after treatment.
- Consider other plausible explanations for the changes.
- 2-3 years is recommended to be the period for analysis.
- The number of accidents before and after implementation must be divided by the relevant traffic volume.
- Resulting improvements should be tested for statistical significance.

ACTION PLAN SUMMARY FOR PALESTINIAN CITIES

The main objective of this research is to introduce the main planning aspects of a traffic safety program for Palestine. The suggested main framework for this program was illustrated in Figure 4.

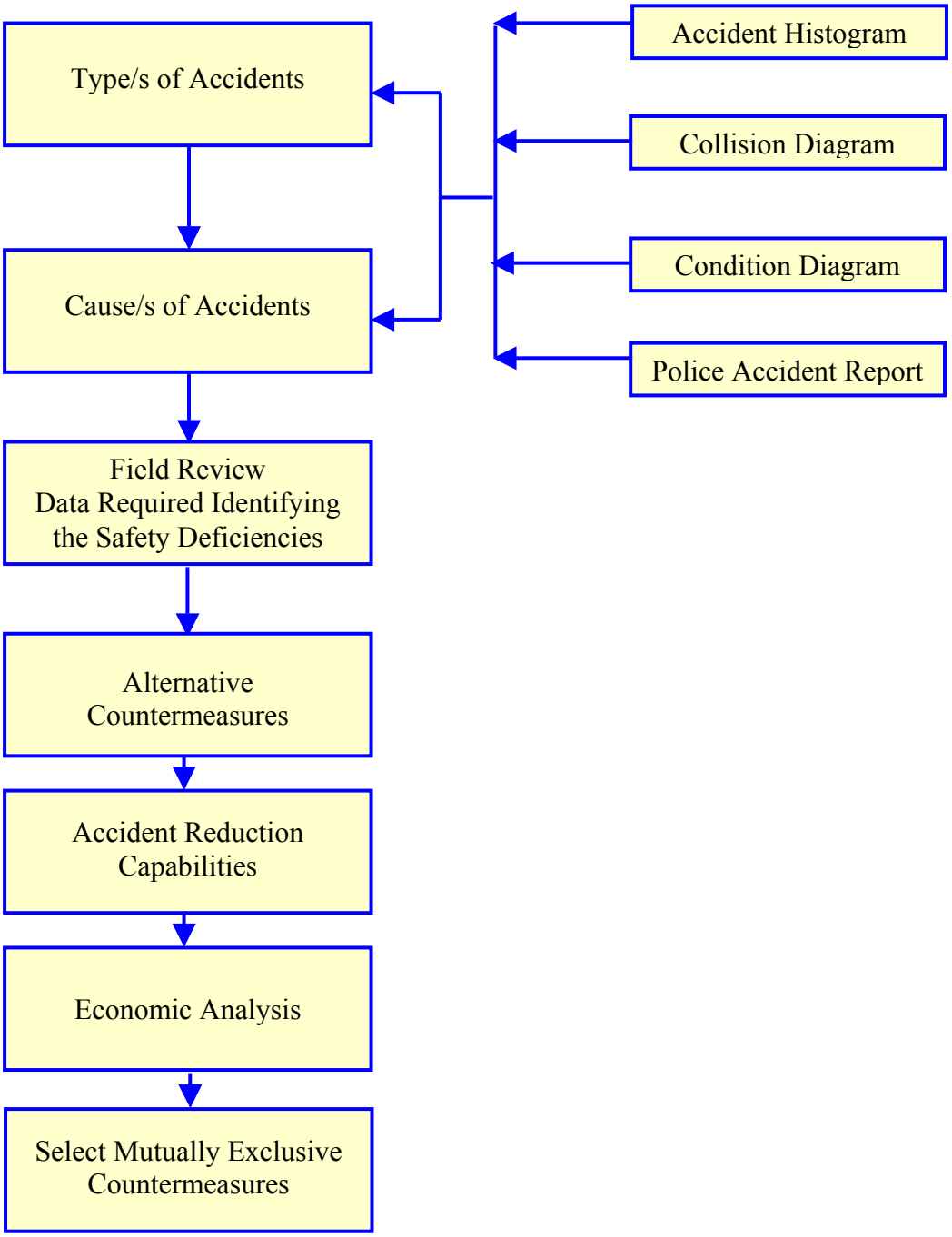

Figure 4: Recommended Steps of Conducting Engineering Studies for Palestine

a. General Guidelines: There are many factors that affect this program. Among these factors are the following (Wilbur Smith associates, 2000):

1. Enact the appropriate laws and legislation covering roadway operation, driving licensing, and vehicle licensing.
2. Establish traffic courts, fines, and penalties.
3. Initiate communications and cooperation between related agencies.

4. Establish the databank and computer works necessary for client/server operation in conjunction with data collection, storage processing, and statistical evaluation.
5. Initiate data collection programs regarding highway operational characteristics and accident data.
6. Establish a highway improvement program focusing on operational features like signs and pavement markings.
7. Procure equipment and new technology to upgrade first aid administrated by ambulances and hospitals.
8. Initiate training programs in the safety agencies.
9. Initiate roadway safety programs for school children.
10. Initiate mass media roadway safety awareness programs.

b. Establishing a Traffic Safety Unit: To establish an efficient highway safety program for Palestinian cities, a traffic safety unit, under the umbrella of Ministry of Transportation, should be established. The main tasks for this unit are:

a) An effective coordination with the Traffic Police Department, municipality, Palestinian Central Bureau of Statistics, Ministry of Local Government, and other related safety agencies
b) Employees of this unit with high qualifications are to be involved in traffic safety program.
c) Procure equipment to develop the highway traffic safety program.
d) Learn from international safety expertise to assist in the safety program.
e) Filing, analyzing, and applying an effective treatment for all highway accidents, which occurred in a certain area. Furthermore, this unit should establish a database for these accidents.

c. Collecting and Maintaining Data: It is the first main item in the highway safety program, which includes the following items:

Accident Reporting and Filing System: A new police accident report is proposed in this study. The existing police reports should be completely replaced with the proposed one. Accident data can be filed either manually or using computers.

Accident location: It is suggested that each intersection be located by a "node." While at midblock it can be located as follows: (Street name, Node, Distance away from node with its direction) or (ST, Node, Dist.).

Retention of Records: The system of Active Files/Dead Files should be used.

Accident files are suggested to be stored at different locations: the local motor vehicle bureau, the highway safety agency (for analytical purposes), at the local traffic police office, and the courthouse at the city where the accident occurred.

Accident Summary Sheet: It is very useful and practical to summarize accidents periodically for each key location or region of the city in a summary sheet.

d. Identifying Hazardous Locations (HL): Among several methods to identify HL, a spot map is recommended in Palestine, especially at the early stages of implementing the highway safety program. It is also suggested that an accident rate method be used once the accident safety program is more developed and data is more available and accessible. If traffic volume data is not available, the accident frequency method can be used to determine HL. The expected value statistical method is recommended to determine threshold values for HL.

Caution must be used while identifying HL by rate or frequency of accident method. Accident frequency does not relate the number of accidents to the exposure (traffic volume); low volumes can cause misleading results when using the accident rate method.

e. Conducting Engineering Safety Studies: The following procedures are to be followed at each location by qualified traffic engineers:

1. Determine accident types and identify probable causes.
2. Obtain the data needed and the suitable treatment based on the literature and the traffic engineer's professional judgment.
3. Conduct a field inventory of the accident location, establish a condition diagram, and establish a collision diagram.
4. Determine alternatives to be applied at the HL.

f. Establish Project Priorities: Based on economic appraisal (Benefit/Cost Ratio) or (B/C).

g. Implementation, Monitoring, and Evaluation: The "before-and-after" technique is recommended for monitoring and evaluating of the effectiveness of countermeasures.

CONCLUSIONS AND RECOMMENDATIONS

The aim of this study is to develop a general highway safety program for Palestine with Nablus City as the case study. This study focused on the planning component of the program. It consists of collecting and maintaining data, identifying hazardous locations, conducting engineering studies, and establishing project priorities.

The study of the components and processes of the highway safety program resulted in the following conclusions:

- The existing traffic safety program can be described as non-existing. The main function of the existing traffic accident procedures is just to judge between the involved parties of an accident. There is no systematic approach of collecting and retrieval of data. Collecting and filing data are done manually.

- A new police accident report form should be established. This form has to be comprehensive and serves all involved parties such as police, insurance companies, and traffic engineers. A new police accident report, which can be used for manual/computerized data entries and analysis was designed and recommended.

- Spot map is an appropriate method for determining hazardous locations at the initial stage. Where traffic volume data is available, the accident rate method is recommended. In the absence of traffic volume data, the accident frequency method is recommended for use to determine the hazardous location.

- The recommended threshold values were determined based on accident frequencies and accident rates for various classes of links and intersections.

- Based on review of existing Palestinian conditions, regional, and international experiences, an "Action Plan" for developing the major aspects of the Palestinian Traffic Safety Program was recommended.

- In Palestine, there are several challenges facing the development of a safety program. Among these challenges are proper budget allocation, political conditions, effective use of local experience, and lack of central agencies to improve safety in general.

Recommendations

This study showed the importance of developing and applying the suggested highway safety program. As a result of this study the following recommendations were depicted:

1. The elements of the safety program presented in this study are general outlines, which form the first step to establishing a more detailed and comprehensive safety program in Palestine. It is recommended that other serious efforts be started to build this program based on the steps and procedures established in this research.

2. It is recommended that the suggested elements of the highway safety program forms, and computer software referred to in this study be implemented. This program can be implemented gradually to fit the budget and required expertise.

3. To enrich the accident databank, it is recommended to establish a centralized unit in Palestine to gather accident's information (locations, types, causes, data, time, etc.) for all cities in Palestine.

4. Establish a "Palestinian Traffic Safety Law", which will facilitate police enforcement.

7. The Palestinian Authority must procure equipment and technology for traffic police enforcement and accident reporting.

8. Traffic police should have adequate computer facilities for administration and reporting. Traffic police must be trained on the use of new equipment and procedures regarding traffic operations, accident reporting, and safety.

ACKNOWLEDGEMENTS

The results presented in this paper were extracted from the MS thesis from Hussein Abu-Zant, carried-out at the Department of Civil Engineering of An-Najah National University, Nablus, Palestine, under the supervision of Dr. Khaled Al-Sahili.

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