A FRAMEWORK FOR A COST BENEFIT ANALYSIS OF THE FAIRFAX COUNTY, VIRGINIA ALCOHOL SAFETY ACTION PROJECT

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by

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CHAPTER I

BACKGROUND

On September 9, 1966, after nearly three months of consideration and emendation, bill 3052 was approved by the United States Senate. This bill, now known as the Highway Safety Act of 1966, Public Law 89-564, included provisions for highway safety programs (§402), and highway safety research and development (§403). [1] The Alcohol Safety Action Project (ASAP), which is the subject of this study, was initiated as a result of the mandate outlined in section 204 of the act, which states that:

> The Secretary of Commerce shall make a thorough
> and complete study of the relationship between the
> consumption of alcohol and its effect upon highway
> safety and drivers of motor vehicles in consultation
> with such other government and private agencies as
> may be necessary .... [2]

The above requirement was met on August 2, 1968, when a study entitled 1968 Alcohol and Highway Safety Report was submitted by the Secretary of the Department of Transportation to the Speaker of the House of Representatives. [3] As a result of the congressional acceptance of the report's findings, the Secretary of Transportation assigned a task group to develop a comprehensive alcohol countermeasures program. [4]

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[1] Highway Safety Act of 1966, Public Law 89-564, Sections 402 and 403.

[2] Ibid., Section 204.

[3] National Highway Safety Bureau, Secretary of Transportation Report to the House Committee on Public Works, 1968 Alcohol and Highway Safety Report, U. S. Government Printing Office, Washington, 1968.

[4] U. S. Department of Transportation, National Highway Traffic Safety Administration, Forum on Traffic Safety Alcohol Countermeasures (brochure), U. S. Government Printing Office, Washington, D. C., June 30, 1971.

During the first half of 1970, the National Highway Traffic Safety Administration of the Department of Transportation responded by funding and approving proposals for nine demonstration Alcohol Safety Action Projects throughout the country. 5/ Thirty-five projects have been authorized to date, the latest six having been approved on July 8, 1971, by the Joint Senate House Committee on Appropriations. July, 1972, will be the launching date for these six additional projects. 6/

Realizing the need for an alcohol safety project in Northern Virginia, the Highway Safety Division of Virginia on October 30, 1970, submitted to the Department of Transportation an application for §403 funds. In December, the Virginia application was one of twenty approved from a total of fifty-four applications. The acceptance in June, 1971, of a proposal and working plan entitled Development and Evaluation of an Alcohol Safety Action Project (ASAP) for Fairfax County and the Contiguous Communities of Fairfax City, Falls Church, Vienna and Herndon fulfilled the contractual agreement for project funds between the Department of Transportation and the Highway Safety Division of Virginia. The Safety Division was allocated $2,123,000 for project implementation. 7/

Each of the twenty-nine operational and six newly approved Alcohol Safety Action Projects is designed to demonstrate the feasibility of the community countermeasures concept. 8/ The Department of Transportation outlined seven broad areas, each of which warranted a single countermeasure. 9/ The decision as to which areas should try individual countermeasures is partially dictated by the community resources, drinking habits of the residents, and previous experimentation. The project design is left to the applicant's discretion, although the federal government requires periodic roadside and household surveys. Most ASAPs include the five countermeasures which constitute the Fairfax project. These countermeasures are police enforcement, judicial, rehabilitation, public information and education, and administration and evaluation.

5/ These nine are: Seattle/King County, Washington; Portland, Oregon; Denver, Colorado; Nassau County, New York; State of Vermont; Albuquerque, New Mexico; Washtenaw County, Michigan; Marathon and Sheboygan Counties, Wisconsin; Charlotte, North Carolina.

6/ U. S. Department of Transportation, National Highway Traffic Safety Administration, "Office of Alcohol Countermeasures Staff Notes," Washington, D. C., August 1, 1971.

7/ Conversation with W. S. Ferguson, highway research analyst, Virginia Highway Research Council.

8/ The Virginia Highway Safety Division, The Fairfax Alcohol Safety Action Project, Spearheading a National Community Effort to Get the Problem Drinkers Off Our Highways (brochure), November 1971.

9/ U. S. Department of Transportation, National Highway Traffic Safety Administration, Guidebook for Proposal Development of Alcohol Safety Action Projects, Human Resources Research Organization (HumRRO), Alexandria, Virginia, November, 1970, p. 502.

First, increased police enforcement is the primary and most expensive counter-measure. Since enforcement of driving-while-intoxicated laws is handicapped by a shortage of officers and equipment, nearly 50 percent of the total Fairfax ASAP budget is allocated to enforcement. 10/ Second, the judicial countermeasure facilitates the court processing of defendants while providing a means of monitoring the rehabilitation of the offenders. Rehabilitation and treatment for drunken drivers is the third countermeasure. The solving of the offender's psychological or physiological problem is the primary ob-jective of this program element. Fourth, public information and education is a counter-measure designed to gain public support for the ASAP by changing public attitudes. Finally, program administration and evaluation is essential in coordinating the partic-ipating agencies, determining the effectiveness of each countermeasure, and measuring the overall project impact. 11/

These five countermeasures which form the Fairfax ASAP and are the subject of this cost-benefit study are designed to overcome the problem faced by the Fairfax public. This problem is a serious one in Fairfax County as well as elsewhere. The 1968 Alcohol and Highway Safety Report stated that the drinking-driving problem:

> ... was first identified in 1904, and was first
> shown to be serious in 1924. Since then, every
> competent investigation has demonstrated that
> the immoderate use of alcohol is a very major
> ·source of highway crashes, especially of those
> most violent. In fact, it contributed to about
> half of all highway deaths, and to appreciable
> percentages of the far more numerous non-fatal
> crashes. 12/

The contribution of alcohol as a causative factor in motor vehicle crashes and traffic violations has plagued the nation's highways since the early 1900's. Alcohol in-volvement in accidents is so pervasive that "the use of alcohol ... leads to some 25,000 deaths and a total of at least 800,000 crashes in the United States each year." 13/ This fatality figure might be understated by 3,000 per year. 14/ Despite the variability of the national fatality estimates, it is generally agreed that the excessive use of alcohol is a costly social and medical problem. Between $7 and $8 billion is a conservative estimate of the cost of the 800,000 annual nationwide alcohol-related accidents. 15/

10/ The exact figure is $968,103 out of the $2,123,000 project outlay. Detailed Project Plan, the Fairfax A.S.A.P. Compiled by B. F. Landstreet, project director, Fairfax, Virginia, December 15, 1971, p. 1.

11/ The Virginia Highway Safety Division, op. cit., pp. 5-9.

12/ National Highway Safety Bureau, op. cit., p. 1.

13/ Ibid.

14/ Steven L. Micas, Legislative Recommendations of the Virginia Highway Safety Commission to the Virginia General Assembly, Virginia Highway Research Council, Charlottesville, Virginia, October, 1971. p. 1.

15/ Guy Halverson, Stop the Drunk Driver, The Christian Science Publishing Society, Boston Massachusetts, 1970. p. 1.

Of special importance to the ASAP and the public is the detection of drinking and driving behavior which leads to or causes mortality, morbidity, and property damage. 16/ The widespread incidence of drinking and driving makes the development of a viable means of solution difficult. A certain class of drinker, the problem drinker, is responsible for a disproportionate number of crashes and loss of life. 17/ Efforts to reduce alcohol involvement in highway crashes are complicated because the behavior of a small minority of the population must be altered before a reduction in accident frequency can be expected.

In Virginia, the State Police calculated that during 1970, 22.7 percent of the drivers involved (not necessarily killed) in fatal crashes had been drinking. However, this figure is deceiving for several reasons. First, as noted by the Virginia State Police, intoxication may remain unreported if the arresting officer thinks he does not have enough evidence to warrant prosecution. 18/ Second, not all drivers involved in fatal accidents are routinely offered, or submit to, a blood test. Third, of the 303 driver fatalities tested in 1970, 60 percent had been drinking. However, this says nothing about the 327 driver fatalities who were not tested, nor does it mention those drivers who caused these fatalities. Only 46 percent of all highway fatalities (driver and passenger) in 1970 were given blood tests. Consequently, the State Police figure is an incomplete and complicated indicator of the extent of the drunken-driving problem. Finally, the determination of whether alcohol is a causal factor is frequently left to the officer's discretion. In the confusion surrounding an automobile accident, this information is often elusive or of low priority.

The widespread problem of drunken-driving must be placed in the context of the Fairfax ASAP community. Seven main deficiencies for controlling driving-while-intoxicated exist within many communities. These local and state deficiencies are:

Inadequate detection of problem drinking drivers. (local)

Limited availability of chemical tests. (local)

Restriction on the use of chemical tests. (state)

Failure to prosecute drunken drivers. (local)

Ineffective penalties for drunken driving. (state)

Inadequate treatment programs for problem drinkers. (local)

Enforcement of driving license suspension. (state) 19/

16/ Commonwealth of Virginia, Highway Safety Division, Proposal and Working Plan, Development and Evaluation of an Alcohol Safety Action Project for Fairfax County, Virginia and Contiguous Communities of Fairfax City, Falls Church, Vienna, and Herndon, May 3, 1971. p. 5.

17/ U. S. Department of Transportation, op. cit., pp. 1-4.

18/ Department of State Police, Virginia Traffic Crash Facts, Richmond, Virginia, 1970, p. 21.

19/ Edmund F. Fennessy, Jr., An Evaluation of the Ability of the Fairfax County Police Department to Detect and Apprehend Drunken Drivers, The Center for the Environment and Man, Hartford, Connecticut, November, 1970, p. 1.

The most obvious deficiency in Fairfax County's drunken-driver control system is the infrequency of detection and arrest of drunken drivers. The inability of the Fairfax County Police Department to control these offenders is mainly because:

> ... while Fairfax County Police Department officials clearly recognize the danger posed by the intoxicated motorist, they have not formulated any precise measurable objectives and programs for dealing with this threat. [20]

Partially due to a manpower shortage, the Fairfax County police enforcement offers little or no chance of altering the frequency of drunken-driving behavior. From 1964 through 1966, three-tenths of one percent of all Fairfax County traffic arrests involved driving-while-intoxicated (which seems to be fewer arrests than should be expected), and this meager enforcement effort did not prove to be a deterrent. The court's failure to prosecute drunken drivers causes police officers to charge suspected offenders with the lesser charge of reckless driving. Although one might expect the distribution of Fairfax County drunken-driving arrests to reflect the incidence of drunken driving, this is not the case. [21] Roadside survey results from the nine original ASAPs and from the Fairfax project indicate that the frequency of drinking and driving increases on weekend nights. [22] An increase in arrests for drunken driving on these nights is not present in the Fairfax County Police arrest figures.

During 1966, the Fairfax County Police arrested approximately one drunken driver per week. [23] Over the two-year period 1966-1967, sixty-two persons were convicted of drunken driving in the county. Using area population and the corresponding number of convictions throughout the state as indicators of the level of law enforcement, and assuming a constant statewide level of enforcement, one would expect a two-year total of 770 convictions for drunken driving in Fairfax County. [24]

A major aspect of the alcohol consumption motor vehicle operation problem is public opinion. The public's knowledge of alcohol's contribution to vehicle accidents seems minimal. Even if public knowledge and attitudes are changed, an alteration of deviant behavior cannot necessarily be expected. The 1968 Alcohol and Highway Safety Report

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[20] Ibid, p. 2.

[21] Ibid., p. 24.

[22] Edmund F. Fennessy, Pilot Study of DWI Offender Characteristics, The Center for the Environment and Man, Hartford, Connecticut, November, 1970, p. 12.

[23] Commonwealth of Virginia, Highway Safety Division, op. cit., p. 28.

[24] Ibid.

summarized the findings of studies on public knowledge of alcohol in relation to high-way accidents. Generally speaking, the public believes that:

> ... penalties imposed for drunken driving are
> too lenient. (and) ... an individual is "to
> intoxicated to drive safely" after drinking two
> drinks of an unspecified alcohol content. 25/

However, investigation into the drinking and driving problem tends to refute these beliefs. In most states, the penalties for drunken driving are considered so severe that the courts are likely to reduce the charge to reckless driving. With regard to the second public belief, it has been observed that the probability of being involved in an accident is greater for a driver with a zero blood alcohol content than for a driver with a blood alcohol content of .03. (This corresponds to approximately two drinks.) 26/

The public's ignorance of the following points, however, present the Fairfax public information countermeasure with a formidable task of public education. According to the National Highway Traffic Safety Bureau, there is no evidence to indicate public awareness that (1) fatal and serious crashes involve alcohol more frequently than non-fatal crashes; (2) the blood alcohol concentrations of drivers in crashes which involve alcohol are unusually high; (3) the legal definitions of driver intoxication and driver impairment are extremely "liberal;" and (4) most alcohol-related incidents involve "problem" drinkers. 27/

25/ National Highway Safety Bureau, op. cit., p. 88.

26/ R. F. Borkenstein, et al., The Role of the Drinking Driver in Traffic Accidents, Department of Police Administration, Indiana University, Bloomington, Indiana, May 1, 1969, p. 166.

27/ National Highway Traffic Safety Bureau, op. cit., p. 89.

CHAPTER II

COST-BENEFIT ANALYSIS AND THE ALCOHOL SAFETY ACTION PROJECT

In view of the importance of reducing the amount of drunken driving and of the uncertainties about the impacts of various countermeasures, more systematic efforts to evaluate these countermeasures as a whole appear to be worthwhile. In this study, the major costs and benefits of one such course of action, and the issues pertaining to the estimation of those costs and benefits, will be examined. However, a complete exhibit will not be prepared because much of the crucial information about the project's effects is not yet available.

A. The Nature of Cost-Benefit Analysis

Cost-benefit analyses are efforts to define in a useful form the advantages and disadvantages of alternative courses of action. The preparation and interpretation of these analyses are beset with difficulties and uncertainties. 28/ There exists a criterion or value-judgment difficulty, because one can legitimately object to the use of economic efficiency as a criterion, and therefore one can disagree with the use of observed or estimated market prices in the delineation of costs and benefits. The values of inputs and outputs of a single course of action are not the only sources of uncertainty. Additionally, there are uncertainties about the magnitudes of the outputs produced or the inputs required. For example, the "physical" consequences of actions such as the Fairfax ASAP's countermeasures are not easily defined. As a result, personal judgments inevitably enter into the preparation and use of cost-benefit analyses.

Nevertheless, systematic examination of the pros and cons associated with a public program such as the Fairfax ASAP can be worthwhile, because the alternatives to systematic consideration of the project's inputs and outputs are even less attractive. Therefore, the possibilities of estimating the consequences of certain ASAP countermeasures and of attaching values to some of those consequences will be explored. Additionally, in view of the limitations of cost-benefit analyses, some other crude indicators of the project's success will be presented and discussed. Both the cost-benefit framework and the crude indicators are intended to be points of departure for more ambitious studies. In using this study to appraise the program or the usefulness of cost-benefit "tools," the reader should keep in mind the incompleteness of this exhibit and the fundamental shortcomings of any such exhibits.

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28/ See Roland N. McKean, Public Spending, McGraw-Hill, New York, 1968, pp. 135-45.

B. Some Special Purposes of This Study

One primary purpose of this study will be that it will serve as an aid in the Fairfax ASAP Project decision-making process. Furthermore it will aid in the development of analytical tools for project evaluation. Four components of this general purpose follow.

> 1. Ultimately this cost-benefit study should facilitate rational decision making.

Reasons for accepting, rejecting, or altering the existing ASAP are ultimately based upon one's knowledge, experience, and understanding of each countermeasure's value. Systematic consideration of the project's monetary expense and reduction in drunken-driving behavior can contribute to countermeasure evaluation. By clearly defining and examining the consequences of the project as a whole, the decision maker can weigh these consequences against those of an alternative budgetary allocation.

Cost and benefit identification, coupled with an outline of factors to be weighed subjectively by the project director, does not preclude the possibility that seemingly inferior alternative project designs may be selected. Subjective valuation of impacts that are quite uncertain or externalities that do not pass through a market (they might be called "non-priceables") could override a course of action suggested by a particular quantitative analysis. As each decision maker implicitly translates "non-priceables" into a common denominator, the range of possible "acceptable" alternatives increases and the possibility of a consensus course of action decreases. Nevertheless, a systematic analysis should force the consideration of non-quantifiable and non-priceable costs and benefits. The resultant course of action should more closely approximate a decision made with full knowledge.

> 2. The cost-benefit study is intended to contribute to project guidance decisions.

This study will examine some specific indicators of the desirability of the present course of action. By evaluating the reductions in fatalities and injuries resulting from the existing allocation, the study could contribute to the formulation of personal preferences regarding "proper" program structure.

Cost-benefit analysis can provide a better "feel" for overall project impact and possible changes in allocations. If we can better understand what kind of data is pertinent, future data feedback becomes important, and may help suggest a series of feasible improvements in project design.

> 3. Cost-benefit studies may help improve federal funding decisions of additional ASAPs.

The thirty-five nationwide projects are intended to demonstrate and evaluate the feasibility, methodology, and impact of attempts to decrease automobile accidents caused by alcohol. A single cost-benefit study will not contribute substantially to an evaluation of community countermeasures in general. But, if the analysis indicates that the project contributes significantly to highway safety in Fairfax County, then a case can be made for future studies that are more detailed.

If new ASAPs employ alternative combinations of countermeasures, then future studies might assist in the selection of these new combinations. The present study will not evaluate different countermeasure mixes. Most importantly, however, this study should provide a framework in which new data can be used as data are collected — thus, helping officials decide about the Fairfax project's continuance beyond the three-year demonstration period.

4. Cost-benefit analysis is intended to help the decision maker fulfill his management responsibility.

One goal of the project director is to be able to make statements, supported by objective information, regarding the ASAP's success. Through the exploration of quantitative analyses and project performance indicators, this study may help provide such information. Furthermore, by examining the relevance of various data to decision making, an analysis may increase the reliability of evaluations. Special consideration will be given to the format of such an analysis. Any evaluation must be easily understood if these tools are to aid decision makers. Consequently, a flexible framework will be selected — one that can be altered as the project changes or as refined data become available.

A guide to decisions should not be considered a final determinant of choice. The findings must be weighed against other relevant facts. Hopefully, though, this partial groundwork will assist in the evaluation and identification of the nature and relative worth of traffic safety countermeasures.

C. Scope of This Study

The spatial area within which the ASAP operates is Fairfax County, Fairfax City, Falls Church, Vienna, and Herdon, Virginia. Alcohol-related "events" occurring within these jurisdictions from 1969 through 1974 are pertinent. "Events" include police contacts, vehicular accidents, alcohol-related traffic violations, and deaths. The project's time horizon is February 1, 1972 through December 31, 1974, with a base-line period extending three years prior to 1972.

Environmental factors which might have to be discussed include legal restraints and police enforcement levels. A quantitative estimate of external factors, such as national media campaigns, will not be attempted. Characteristics unique to Fairfax County are included if they appear to be significant. Obviously, numerous independent variables remain uncontrolled, but comparisons with data from a control group should increase the usefulness of the analysis.

There is no strictly comparable area against which the Fairfax ASAP's results can be judged. The nine original demonstration projects are only one year older than the Fairfax project and do not provide adequate comparative data at this time. Base-line data will be used, but they cannot be used to predict future years' accidents and fatalities. After the ASAP's initial year of operation, the resultant data will assist in measuring benefits. For the present, Henrico County alcohol-related statistics will provide the control data. The drinking and driving behavior of three groups of people

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might be considered: the entire state population, the control group population (Henrico County), and the population exposed to the Fairfax ASAP. Analysis will relate primarily to the third group.

The ASAP's effects will be delineated without attributing them to individual countermeasures. It is virtually impossible to attribute social behavior changes to individual countermeasures. Cause and effect relationships among countermeasures or between the project and behavior external to the Fairfax County area will not be traced. Therefore, a large portion of the experimental design will relate to the countermeasures as a unified effort.

The costs and benefits of the existing course of action will be listed, but possible reallocations of Department of Transportation funds either to the overall project or among the countermeasures will not be analyzed. Only the $2.1 million total will be used. Budget line items will not be examined, but useful line item changes may be suggested by the analysis. Deficient program areas might be revealed although no specific means of solving intercountermeasure problems will be offered. A model pertaining to the optimal mix of countermeasures is beyond the scope of this study. In a related vein, complementary countermeasures will not be directly studied, but the results may implicitly suggest complementary or substitute schemes for drunken-driver control.

The total systems costs and benefits, including both public and private costs, would provide a gauge with which the total Fairfax ASAP's effectiveness could be measured. The analysis will be restricted, however, to the examination of changes in incremental costs and benefits that stem <u>directly</u> from the project. Additionally, certain external costs and benefits will be brought to the decision maker's attention. Unfortunately, even direct program effects, such as the number of times a potential drunken driver did not drink (as a result of the program), often cannot be measured satisfactorily.

Sources of uncertainty about effects of the existing system will be mentioned. Also, ranges of numerical estimates and a review of the conclusions will be given, qualitative discussion being presented when variables cannot be quantified or given monetary price tags.

One point pertaining to the scope of the study merits special emphasis. The costs and benefits of the ASAP will be viewed from an overall standpoint — that is, the standpoint of overall economic efficiency. The study will <u>not</u> examine costs and gains from the viewpoint of the federal government (in which case only the federal expenditures might be counted as costs), or from that of Fairfax County (in which case only the County's sacrifices might be considered as costs). Instead, the <u>aim</u> will be to count costs and gains to any and all individuals as perceived by those individuals — as in the usual economic analysis.

D. Uncertainties About Relationships Among Variables

The chain of variables through which any policy operates is often difficult to perceive clearly. Models can be built — abstract representations of the relationships among the relevant variables — to help trace the effects of changes in a system. In the case of the ASAP, some of the variables and the relationships among them are especially difficult to identify and measure. If a policy changes the probability of arrest, it is by no means certain how this will affect the amount of driving-while-intoxicated or the amount of drinking in general and, in turn, the probability of arrest. Indeed, it is difficult to identify the relevant component variables — the types of behavior or performance on which attention should be focused. No integrated drunken-driving control system now exists, and consequently, Fairfax ASAP performance indicators have not been carefully defined. Furthermore, a lengthy exposure to the project is necessary before useful indicators can be devised. For example, knowledge of a change in a rehabilitated subject's absenteeism rate at work might not seem highly relevant, but this statistic may be a useful part of a model to help estimate the effects of the ASAP or a useful secondary indicator of treatment success. As means for coping with "alcohol behavior" become more indirect, relevant performance indicators must be identified and isolated from those indicators that are not affected by the project if the effects of the project are to be traced adequately. Gaining a knowledge of each countermeasure agency's function is the first step in the identification of the ASAP's components (i.e., identification of behavioral and other variables that may be affected). In the judicial or rehabilitation areas, however, the ranges of possible actions and project areas affected are wide.

Also, while experts on each countermeasure can devise adequate schematic diagrams of their own functions, the interaction of these agencies generates extraneous effects not attributable to any single program area. For example, the police agencies realize their responsibility to arrest all the drunken drivers they observe, but the treatment of problem drinkers is the responsibility of the rehabilitation staff. Because of the overload on the rehabilitation facilities, however, a subset of problem drinkers not receiving needed medical care may emerge. The driver education school might have less beneficial effect on these drinkers' behavior than on the behavior of the subset receiving treatment. Still other interrelated variables are often involved so that observed changes in behavior can be misleading. Without careful analysis of causal relationships, a behavioral change cannot be attributed entirely to the ASAP.

Dynamic change aggravates the preceding difficulties. The Fairfax ASAP involves a dynamic system in which most of the elements are undergoing continual change. For example, the number of vehicle miles travelled per year in the area is continually changing. Also, the exposure of a single individual to an automobile accident changes with respect to his amount and type of travel as well as other drivers' behavior. Unfortunately for research purposes, these changes are not subject to control. Spot checks at points in time do not adequately reflect short-term variations in behavior. For this reason, too, the numerical estimates are highly uncertain. Confounding factors in accident rates, for example, are difficult to identify, isolate, and remove. Falsely attributing observed results to one causal factor can result. One should use conservative estimates and recognize the uncertainties about the estimates that stem from these various factors.

CHAPTER III

TYPES OF COSTS AND BENEFITS FROM THE ALCOHOL SAFETY
ACTION PROJECT'S COUNTERMEASURES

A. Costs

Costs are the values of those goods and services that are shifted from other employment in order to plan, develop, operate, and administer the Fairfax ASAP. The economic or opportunity costs of the Fairfax project is equivalent to the benefits that could have been realized had the §403 funds been allocated to their next best alternative use. Since the costs of any behavior depend upon the action which must be sacrificed, costs also depend upon those alternatives which are genuinely possible. Numerous alternatives to the countermeasure approach are presently in force, but the Fairfax ASAP decision makers have little influence on the reallocation of federal highway safety funds. In terms of an economic analysis from an overall standpoint, however, the assumption that would command widest agreement is that outputs by the private sector must be sacrificed. Hence, here resources are valued where possible as they are valued by the private voluntary-exchange sector.

The costs attributable to the ASAP can be divided into four groups. These are: the expenditure of Department of Transportation funds on each countermeasure, the expenditure of individual agencies' own funds, the cost to citizens of participation in the roadside and attitude surveys, and the costs to individuals of changing their means of transportation because of the Fairfax ASAP. A discussion of each group follows.

The U. S. Department of Transportation funds are allocated to the following countermeasure areas:

Police Countermeasure (men and equipment)

Judicial Countermeasure

Rehabilitation Countermeasure

Public Information and Education Countermeasure

Administration and Evaluation Countermeasure

These federal outlays are the majority of quantifiable project costs. Since these costs are actual cash expenditures, they will be relatively easy to compute. There are no difficult measurement problems because dollar values have been placed on police services, for example, through the market place. For the next three cost groups, this is not always the case.

Since some countermeasures utilize the services of agencies which work on other matters, a few agencies, including the courts, may have to expand their physical plants or human capital in order to accommodate the project's demands. Since the overall ASAP budget is fixed, these agencies will obtain funds to combat the drunken-driver problem from sources other than the project. For example, both the Bureau

of Alcohol Studies and Rehabilitation and the Fairfax-Falls Church Mental Health Center are participating in the Fairfax ASAP without being funded by the program. Their incremental costs arising from the project will be counted in the costs of the countermeasures.

The cost to individuals of participation in the roadside and attitude (household) surveys can be only roughly estimated. Figures of the average time per subject for each of the two surveys are available. However, there exists no single value of time applicable to all individuals, and the estimates in the literature vary over wide ranges. The value of time is dependent upon such diverse variables as occupation, the time of day, and those alternative courses of action which are available to an individual at the time of his participation in the survey. For example, wage rates cannot always be justified as opportunity cost figures because extra work is not always available. However, wage rates are the best estimates of opportunity cost available at this time.

The cost to individuals of changing their means of transportation because of the ASAP is the most difficult cost to estimate. First, one can only guess the number of instances in which potentially drunken drivers use means of transportation other than their own automobiles. For example, the cost in both inconvenience and money of taking a taxi rather than driving should be considered. However, inconvenience is not a commodity that passes through a market place, and hence this cost will have to be subjectively weighed by the decision maker.

B. Benefits

The formulation of objectives in such a way that achievements can be measured is essential to the estimation of benefits. Official statements of objectives are, of course, vague and general. The Fairfax ASAP's overall objective is "to reduce the frequency and severity of alcohol-related crashes in Fairfax County, Fairfax City, Falls Church, Vienna, and Herndon." [29] The National Highway Traffic Safety Administration objectives for all alcohol safety programs are as follows:

> Undertake research into the relationship between drinking and highway safety.
>
> Design countermeasures focusing on the problem-drinking driver.
>
> Develop and disseminate new technology.
>
> Develop materials and skills for use in implementing countermeasure programs.
>
> Demonstrate the feasibility and methodology of individual countermeasures.

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[29] B. F. Landstreet, op. cit.

Design comprehensive countermeasure programs.

Demonstrate the feasibility and methodology of comprehensive countermeasure programs.

Study the cost and effectiveness of countermeasures.

Stimulate official action.

Develop public awareness.

Achieve public and official acceptance of countermeasure programs.

Implement action programs against drinking-driving. [30/]

To study the ASAP's benefits systematically, however, one has to be more specific and pose such questions as: What is being accomplished? What specifically is being sought? Are there unanticipated impacts on the achievement of other desirable goals? The following appear to be the principal benefits that the countermeasures may produce.

The major portion of quantifiable ASAP benefits arise from a reduction in alcohol-related accident costs. Either a decrease in the alcohol-related accident rate or a shift in the distribution of accidents from fatal to injury or property damage can generate benefits. Since fatal accidents are the most costly type, a reduction in such accidents by a small amount will substantially increase benefits. The difference in alcohol related accident costs between two successive years will provide a clue to these benefits (if allowance can be made at least crudely for the influence of changes other than the ASAP itself).

In addition, there are possible benefits that it would be too costly — or, in all likelihood, misleading — to quantify. The following are ten possible project benefits that are believed to be appropriate only to describe:

1. Increased Public Education

Driver education classes for drunken-driving offenders and the three year media campaign directed at the Fairfax County area are expected to favorably affect attitudes and knowledge about drinking and driving. Although the ASAP decision makers are especially interested in those attitude changes which affect driving behavior (which, in turn, ultimately affects the costs of alcohol-related accidents), public education may be desirable per se. Hopefully, an increase in public knowledge will generate public support for other alcohol safety compaigns.

30/ U. S. Department of Transportation, Alcohol Safety Action Project Evaluation Manual, Dunlap and Associates, Darien, Connecticut, March 1971, p. 19.

Unfortunately, although there exist indicators of
increased public awareness, there is no one dollar
value which can be placed on these "outputs."

2. Support of Other Alcohol or Safety Campaigns

The ASAP will initiate community safety programs and augment
existing ones. The Fairfax County area has obtained a federal
grant for a Comprehensive Community Alcohol Program (CCAP).
Better hospital facilities for the treatment of alcoholics will be
one advantage of this program. According to expert opinion, the
Fairfax ASAP is one factor which influenced the decision to locate
the CCAP in the Fairfax area. Additionally, the federal government
has given the ASAP communities priority in sponsoring Accident
Investigation Teams. These groups of professionals will provide
investigation of severe (usually alcohol-related) accidents. The
dollar value of the Fairfax ASAP's contribution through affecting
such decisions cannot be realistically estimated.

3. More Exact Police Reporting of Alcohol-Related Events

Previous to the ASAP, the Fairfax area police departments
did not compile data on all alcohol-related events. During the
project, data are continually being collected by the police officers,
all of whom have been subjected to special training on drunken-driver
detection. It is expected that the reporting procedures initiated by the
ASAP will continue after the three year period, and this should have
value, although it would hardly be an amount on which many persons
would agree.

4. Research into Related Traffic Safety Problems

The Safety Section of the Virginia Highway Research Council has
begun research with Fairfax County data on the discrepancies among
the blood alcohol readings of private laboratories, chief medical
examiners, and breath testing machines. As the ASAP uses innovative
methods of law enforcement and treatment, evaluation of these methods
will be conducted by the Highway Safety Division and private firms.

A major non-priceable benefit of the ASAP is the knowledge of drunken-
driving behavior gained by the Department of Transportation. The collec-
tion of data concerning drinking and driving behavior should support more
reliable conclusions about alcohol programs, and, perhaps, lead to improved
policies in the future. The value of such information can only be assessed
subjectively by each individual for himself.

5. Beneficial Spillover Effects in Adjacent Counties

The increased police enforcement and the mass media campaign in
Fairfax County might affect the driving behavior of residents of Alexandria,

Arlington, and the outlying areas. The magnitude of this effect cannot be predicted at this time, but clues to these spillover effects will be reflected in the arrest rates of non-project-area residents and the accident rates in adjoining communities. Although a dollar value could be placed on the decrease in cost of alcohol-related accidents in outlying counties, it would be even more difficult to ascertain what portion of an observed decrease was attributable to the ASAP.

6. Better Future Treatment Facilities for Alcoholics

     The increased capacity of the courts and rehabilitation and treatment centers will remain after the three year project. While specially trained medical personnel are being hired by the project agencies, it is likely that they will continue to be on the rehabilitative staffs for more than three years. These extra capabilities would, presumably, not have arisen in the absence of the Fairfax ASAP and, presumably, yield some net value that is attributable to the project.

7. Improved Treatment of Drunken Drivers

     Previous to the ASAP, many offenders had their operators licenses suspended. During the program this will not necessarily be the case. The offender will be afforded a greater freedom to travel than in the past, and fewer offenders will be incarcerated. This treatment is especially important to heads of households because the cost of lost transportation is potentially great to these people. It is difficult, however, to place a dollar figure on the satisfaction or other gains attributable to this preferred treatment.

8. Increased Security Felt by Drivers

     During the ASAP, the public will, hopefully, realize that the Fairfax County highways are more safe than before the program. The first roadside survey revealed that between twelve midnight and three a.m. approximately fifty-one percent of the driving population had been drinking. If this percentage declines and the public becomes aware of this change, an increased feeling of security for motorists should result. (There might also be a reduction in insurance premiums which might, in part, reflect a transfer and, in part, the reduction in accident costs counted previously.)

9. The Decrease in Pain, Fear, and Suffering Attributable to a Decrease in Alcohol-Related Fatalities

     The psychological effects of fatal accidents on survivors are probably significant. By decreasing the incidence of (tragic) deaths the ASAP may increase "general public well-being and peace of mind." Needless to say, this is a rather speculative benefit. Different persons might reach quite different judgments regarding its importance.

10. Cost Savings of the ASAP Treatment

As problem drinkers are subjected to federally funded medical treatment, they receive this treatment at fees lower than those of private physicians. If the treatments were comparable, there might be a transfer from private doctors to the patients, a transfer to which some persons might attach positive value. In face, however, it is not known for sure what type of treatment the patients would have sought out in the absence of the program. The possible types of treatment range from free Alcoholics Anonymous care to specialized professional help.

CHAPTER IV

COST AND BENEFIT CALCULATION

In the preceding sections, the types of benefits and costs associated with the ASAP were discussed. These types can be summarized as follows:

QUANTIFIABLE COSTS

1. Individual countermeasure expenditures

2. Agency expenditures in excess of federal funds

QUANTIFIABLE BENEFITS

1. Reduction in alcohol-related accident costs

NON-PRICEABLE COSTS

1. Cost to citizens of changing their means of transportation
2. Cost to citizens of participation in roadside and attitude surveys

NON-PRICEABLE BENEFITS

1. Increased public education
2. Support of other alcohol or safety programs
3. More exact police reporting of alcohol-related events
4. Research into related traffic safety problems
5. Beneficial spillover effects in adjacent counties
6. Better future treatment facilities for alcoholics
7. Improved treatment of drunken drivers
8. Increased security felt by drivers in general
9. The decrease in pain, fear, and suffering attributable to a decrease in alcohol-related fatalities
10. Cost savings of ASAP treatment.

In order to discuss the estimation of quantifiable costs and benefits, one must trace out "models" of the functioning of the ASAP's countermeasures — i.e., trace out the relationships between the countermeasures, the immediate variables affected, and the ultimate impacts on costs and gains.

A. Some Basic Assumptions and Relationships

1. A program which reduces the number of motor vehicle operators with blood alcohol levels greater than the legal limit (presumptive level) for driving-while-intoxicated contributes to accident reduction.

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This assumption is fundamental to the design of the nationwide ASAPs. It implies that a specific class of drivers (i.e., those with blood alcohol concentrations greater than the presumptive level) contributes to motor vehicle accidents. Furthermore, these drivers cause a disproportionate number of accidents in relation to their numbers.

2. The mean blood alcohol level for drivers involved in fatal accidents is greater than the mean blood alcohol level of those motor vehicle operators not involved in fatal accidents.

Traffic safety research documents this phenomenon. Periodic roadside survey results will help establish the validity and quantitative significance of this relationship in the Fairfax ASAP area. A positive correlation exists between blood alcohol concentration readings and the probability of involvement in fatal accidents. Indeed, as noted above, drivers with alcohol problems are disproportionately represented in highway fatalities. Alcohol appears to be dominant among the causal factors. If this were not correct, one might more readily argue that the ASAP funds are misdirected in relation to alternative traffic safety programs.

3. The relationship between the ASAP and mortality, morbidity, and property damage is measurable.

A measurement of this connection is central to cost-benefit analysis. By relating the level of project activity to accident reduction, the study will compare costs and benefits. This assumption does not mean that the influences of individual countermeasures can always be traced to accident reduction. In any event, the problem of doing so is generally outside the scope of this study.

4. A significant portion of the ASAP's activities can be quantified in useful ways.

A mere description of the project's functioning is not sufficient for relating project activities to accident reduction. The public information countermeasure's effects, for example, cannot be fully quantified. However, numerical estimates of the number of citizens exposed to advertising give some clues that contribute to the Alcohol Safety Action Project evaluation.

5. The Fairfax ASAP budget is fixed.

A fixed project budget dismisses certain alternatives and decisions which are not within the project director's authority. This is a realistic assumption because there is no evidence that the Fairfax ASAP will receive additional §403 funds within the project's time horizon.

6. The initial level of countermeasure effort per policeman-day will remain constant over the ASAP's time horizon.

In the absence of the project, a certain amount of police effort was expended on the detection of drunken drivers. If the number of police-hours (or days) is used as an indicator of enforcement effort, the police effort will increase during the Alcohol Safety Action Project time horizon. The employee's effort per day is assumed to be constant and therefore, the hourly wage rate times hours worked can be used as an indicator of police patrol effort. However, there are other factors that determine patrol effort that cannot easily be taken into account. The selective enforcement of drunken-driving laws in certain neighborhoods at certain times of the day is one example of intensive police effort that could cause difficulty and disagreement among those who attempt to place a value on the enforcement effort.

7. Beyond a certain point there exists diminishing returns on additional investments.

Since the entire \$2.1 million ASAP budget is fixed, diminishing returns apply to individual countermeasures. This study's findings must be scrutinized in the light of this principle. After experiments with different countermeasure "mixes", a reevaluation of costs and benefits should be made because it is not known how marginal costs and returns change. Thus the level of funding (for each countermeasure) beyond which incremental costs exceed incremental benefits is unknown.

In the absence of diminishing returns, there would be no logical ceiling on the funding of the "best" countermeasure, and there would be no reason to have a mixture of countermeasures. (Also, it is never economical to eliminate all of an undesirable phenomenon.) There is a point beyond which it becomes too costly, inefficient, or unrealistic to continue a countermeasure effort.

8. When two or more complementary countermeasures are introduced, the benefits derived from their simultaneous implementation may be greater than the sum of their individual benefits.

A good example of this phenomenon is the simultaneous work of the enforcement and judicial countermeasures. If drunken drivers are arrested but the courts are unable to try the defendants, then the benefits arising from the removal of drunken drivers from the roads are less than in the presence of a speedy judicial process. Conversely, a judicial system in the absence of a police force will not generate a level of benefits equal to the benefits in the presence of a police force.

B. Calculation of Costs

Each of the countermeasures and the corresponding items, activities, or agencies which are used for program budget purposes are listed below.

1. Enforcement

    a. Police orientation and training

    b. Special training for arresting drunken drivers

    c. Increased patrol and selective enforcement

    d. Mobile operational and testing facilities

    e. Police cruisers

2. Judicial

    a. Probation office

    b. Assistant Commonwealth Attorney

3. Rehabilitation

    a. Diagnostic and psychiatric evaluation unit

    b. Driver improvement school — Northern Virginia Community College

4. Public Information and Education

    a. Martin and Woltz, Inc. — Advertising Agency

    b. Driver education — Fairfax County schools

5. Program Administration and Management

    a. Project director and staff

    b. Evaluation — Virginia Highway Research Council

For each of these five countermeasures, quarterly expenditures figures are available from the Assistant Project Manager. Consequently, this portion of quantifiable ASAP costs is simply a matter of summing the figures.

The second quantifiable cost arises from the expenditures of agencies which, although they do not receive project funds, voluntarily participate in the program. Only the costs incurred by the ASAP participants are relevant. The "project participants" are those persons who, in the absence of the project, would not have been referred to the agency in question. These non-funded agencies are:

1. The Falls Church Bureau of Alcohol Studies and Rehabilitation

2. The Fairfax-Falls Church Mental Health Center

3. The Alcoholic Beverage Control Board

Perhaps other agencies are spending money for activities related to the ASAP, but these agencies' expenditures are not large, and it would not be feasible to trace these costs. Cost estimates for each of the above three agencies will be obtained by surveys or by obtaining cost factors from agency personnel. For example, with the knowledge of the number of persons referred to the Bureau of Alcohol Studies and Rehabilitation, the assistant project manager can obtain an estimate of per-patient expense and multiply this by the number of patients treated.

C. Calculation of Benefits

The largest quantifiable benefit category is the reduction in alcohol-related accident costs resulting from the ASAP. Benefits can be approximated either between two successive years during which alcohol-related accident costs declined or over the entire three year project time horizon. The cost elements of alcohol-related fatal accidents, personal injury accidents, and property damage accidents are:

Accident Costs

Fatal Accidents

Net production loss
Hospital costs (includes blood test)
Physicians' costs
Ambulance fees
Funeral expenses
Vehicle replacement and towing
Legal costs and court fees
Loss of transportation cost
Police time
Highway restoration
Insurance administrative costs

Personal Injury Accidents

Work time loss
Hospital bed days cost
Physicians' cost
Ambulance fees
Medication costs
Blood test cost (if charged)
Vehicle replacement, repair, towing
Legal cost and court fees
Police time
Highway restoration

Property Damage Accidents

> Custody time
> Blood test cost
> Legal and court fees
> Loss of transportation cost
> Vehicle replacement, repair, and towing
> Police time
> Highway restoration

Each of these cost categories is for a single individual or accident, but some categories can be calculated in the aggregate. The methods of estimation to be used for each category are discussed below. It is, of course, the reduction in these costs attributable to the ASAP that constitutes the major benefit of the program. It is the reduction in these costs on which the analysis will focus.

1. Net Production Loss

The net production loss attributable to a fatality is the sum of discounted expected future earnings minus expected future consumption. Accident data by age and sex make calculation of this cost element possible. The seven steps in net production loss estimation are:

a. For a given time period, the fatalities in the project area will be arrayed by age and sex.

b. The fatality data will be grouped in 10 year age intervals.

c. For a specific age and sex, the expected number of years to live will be defined as an average of the life expectancies of the ten ages in that 10 year interval.

d. The mean earnings in each age and sex interval will be taken from Department of Labor figures.

e. For each 10 year interval, the expected number of years to live will dictate the length of the summation of expected future earnings. For example, for the 10 year age interval 25-35, the expected number of years to live might be 40. Therefore, the expected future earnings will be summed through age 70 (i.e., 40 plus the midpoint of 25-35). A discount rate will be applied to each future year's earnings before these earnings are added. This rate must be chosen by the decision maker, but most Department of Transportation studies use between four and ten percent.

f. Unemployment effects will be included by multiplying an estimated ten year average expected probability of being in the work force times the present value of future earnings.

g. The number of fatalities in each age and sex group will be multiplied by the corresponding present values of future earnings.

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Some females will be considered as housewives by using the National Health Survey's estimate of the percentage by age of women who keep house. The number of housewives who were killed will be multiplied by the imputed value of housewives' services, which is approximately $3,000 per year. This is a domestic servant's mean annual earnings, and it admittedly understates a housewife's true worth.

2. Hospital Costs

Hospital costs must be estimated for both fatalities (who are nonetheless taken to the hospital) and injured persons. Since many fatally injured drivers in Virginia receive blood tests, a blood test cost will be obtained from the Virginia Department of Health and Mental Hygiene and applied to each fatality. The average hospital cost of a fatality (excluding ambulance costs) can be obtained from John Griffin, head of the Fairfax Hospital's Outpatient Support Services. This is the extent of hospital costs as they relate to fatalities.

Injured persons' hospital costs, while not easily tabulated, will be estimated in the following manner.

a. The number of persons injured in alcohol-related accidents will be determined from accident report data.

b. The percentage of injured persons who actually require hospital care will be multiplied by the number of persons injured to produce the estimated number of persons treated.

c. The estimated number of injured persons requiring care will be multiplied by the average duration of the hospital stay.

d. The resulting figure will be multiplied by the average patient-day cost to produce a total hospital cost estimate.

Included in the last category will be the cost of physicians' services, which is the number of physician visits per day multiplied by the average cost per visit. Two visits per day will be assumed for injured victims.

3. Physicians' Costs

Physicians' costs are the cost of injured victims' doctor visits in excess of those received in the hospital. In 1964, the National Health Survey estimated that each citizen averaged 4.5 physician visits per year. [31] Automobile accident victims are included in this statistic.

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[31] U. S. Department of Health, Education and Welfare, Motor Vehicle Injury Prevention Program, Washington, D. C., August 1966, p. 67.

However, automobile accident victims usually require more than the average number of visits per year. Therefore, it seems reasonable to assume that 6 to 8 visits per year are necessary for all health problems resulting from involvement in an automobile accident. Consequently, this estimate will apply to the injured persons in the project area. Average visit costs are approximated by dividing the total costs of accident-related visits by the total number of visits.

4. Ambulance Fees

For each fatality, one ambulance trip will be assumed. The percentage of injured hospitalized persons transported to the hospital by this mode is nearly 100 percent. Expert opinion suggests an average of greater than one, but less than two trips per injury. Ambulance fees are approximately $30 per hospitalized person.

5. Funeral Expenses

Funeral expenses can be estimated in the aggregate. This cost is "out of pocket" and does not include non-quantifiables such as pain, suffering, and anguish of the bereaved. The Fairfax Chamber of Commerce compiles funeral cost estimates. This estimate (approximately $1,200) will be multiplied by the number of alcohol-related fatalities. National total funeral expenditures are listed in Statistical Abstract. [32] By dividing the funeral expenses by the annual number of deaths, a rough funeral cost estimate can be obtained. Using 1971 data, calculation yields an estimate of $820 per funeral. This amount should be reduced, of course, since the funeral expenses are merely "accelerated." (That is, they would later be incurred anyway.)

6. Police Time

The police time costs associated with alcohol-related motor vehicle accidents is a cost not reflected in the Alcohol Safety Action Project budget. Processing costs for drunken drivers will not be included here because double counting would result. The relevant cost is the average police time expended on an alcohol-related accident multiplied by an officer's wage rate. An August 16 survey completed for audit purposes revealed the following pay rates:

Fairfax County	......	Four years' experience	$5.29 per hour
Fairfax City	......	Five years' experience	$5.28 per hour

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[32] U. S. Department of Commerce, Statistical Abstract of the United States 1971, U. S. Government Printing Office, Washington, D. C., 1971, pp. 55 and 740.

Falls Church	......	Total force average excluding captain, lieutenants, and sergeants, but greater than ten years' experience	$6.50 per hour
Vienna	......	Five years' experience $10,848 per year	$5.21 per hour
Herndon	......	Five years' experience	$4.50 per hour

The assumption of five years' experience has been used by the ASAP staff and will be used throughout this study. Corporal Barbee, head of the Fairfax County Police Essential Records Section, estimates the officer's time for each accident type to be:

Fatality	....	six hours
Injury	....	three hours
Property Damage	.....	two hours

Each accident type demands accident investigation tasks such as paper work, photographs, and messages. An estimate of police time cost can be prepared with the above data.

7. Insurance Administrative Fees

Since insurance payments to survivors are transfer payments, they will not be included in this study. The difference between the premiums received by the companies and the claims paid is an administrative insurance cost. A division of the nationwide 1970 insurance costs by the number of persons injured in all accidents: $5.9 billion divided by 10.9 million, yields an average per claim administrative cost figure of $541. For motor vehicle accidents, the estimate is $4.6 billion divided by 2.05 million; $2,243 is the resultant cost (National Safety Council Accident Facts, 1971). Unfortunately, these estimates include both death and injury. It is hoped that estimates can be obtained by type of injury.

8. Blood Test Costs

Only the blood test costs of those individuals who would not have been stopped by the police if it were not for an accident are of concern. The blood tests administered in the mobile van are already included in the ASAP budget. Although this category is defined as alcohol-related accident costs, money is spent to determine the nature of every accident. For example, a blood test might be given to a person charged with drunken driving who later proved to be innocent. If only the blood test costs for convicted drunken drivers are summed, the cost of those blood tests for those persons who were accused but later exonerated of drunken driving are not included. Consequently, special care will have to be taken in the estimation of this cost. The police contact card will assist in aggregating blood test costs. The medical technician's wage rate multiplied by the total number of hours worked plus the sum of materials and analysis cost, multiplied by

the number of subjects, yields total blood test cost. The cost of a blood test is about $15 in the private sector, but the cost of a blood test to the ASAP is considerably less.

9. Vehicle Replacement, Repair, and Towing

An average automobile replacement or repair figure is not very useful for the purposes of this study. Since vehicle repair costs range between the minimum reportable damage of $100 and many thousands of dollars, and since the number of damaged vehicles in each "damage category" is small, an average cost multiplied by the number of vehicles involved would not adequately reflect the vehicle replacement cost. Furthermore, repair costs in fatality-producing accidents usually exceed those costs in other accidents involving the same type of vehicle.

A direct estimation method is to sum the vehicle damage costs of each ASAP area accident for the appropriate time period. Fortunately, all SR-300 accident reports include an estimated vehicle damage figure. This figure is not entered on the Virginia State Police IBM accident tapes, so fatal accident vehicle costs will be calculated individually. This method is more desirable than the use of an average figure. Since the frequency of accidents causing injury and property damage is high, random sample surveys might be preferred.

Towing costs are a flat rate of $25 per call and an incremental rate of $5 per hour. One hour of towing time is expended for injury and property damage accidents, whereas fatal accidents require two hours.

10. Work Time Loss and Hospital Bed Days

Both of these costs apply to injured persons and require expert opinion for estimation. The steps for calculating loss of work time will be as follows:

a. All injured persons admitted to the hospital will be arrayed by age and sex.

b. The mean work days lost due to an injury is assumed to be 5.78 days. [33]

c. The wage rate corresponding to each age and sex will be multiplied by the 46 hours (5.78 work-days), times the number of persons injured.

d. The costs by age and sex will be summed.

Hospital bed days are assumed to be three days per victim at the average daily cost of the Fairfax County area hospital care.

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[33] U. S. Department of Health, Education and Welfare, op. cit., p. 62.

11. Medication Cost

It is difficult to pinpoint an average medication cost per injured victim. The following statistics serve as guidelines. One out of five injured motor vehicle accident victims receives hospital care. Medication costs vary, however, with the length of hospital care, and hospital medication may be more expensive than private medication for injured persons not in the hospital. Obviously, the mean is greatly affected by the four-fifths of the victims who are not hospitalized and by severities of the injuries. Sample surveys and expert opinion will be used, but medication cost is a small portion of total accident cost and consequently a great deal of effort will not be spent in calculating a precise figure.

12. Legal and Court Costs

These costs involve numerous elements which vary with each accident case. The accident severity, the choice of filing suit, the delay in litigation, the type of injury, the victim's economic position, and the total economic loss all affect legal costs. Department of Transportation publications classify cost estimates of personal injury claims by numerous variables. 34/ With knowledge of those variables, it is possible to place a reliable cost estimate on each Fairfax County motor vehicle accident. The necessary tabulation would be enormous and would be a large study itself. Due to the variability of the legal situations, the validity of arithmetic means is questionable, but their use is necessary.

Many studies have determined that the legal cost per accident involving a fatality exceeds the cost per accident not involving a fatality. For example, in the state of Washington, legal and court costs are $1,363 and $75 respectively, for fatal and non-fatal accidents. In Illinois, the estimates are $998 and $142. Expert opinion will again be used in preparing estimates.

13. Highway Restoration

Highway property damage attributable to alcohol-related accidents will be identified by a scanning of the SR-300 accident reports. Significant public property destruction is infrequent and relatively easy to calculate.

34/ U. S. Department of Transportation, Automobile Personal Injury Claims, two volumes, July 1970. Also available from this Department are Automobile Accident Litigation, April 1970, Economic Consequences of Automobile Accident Injuries, April 1970.

The Virginia Department of Highways will provide highway equipment replacement cost figures. Road cleanup tasks are required by a high percentage of crashes. Consequently, an average cost estimate of this element will be included in the vehicle repair, replacement, and towing category.

14. Loss of Transportation

A loss of transportation is incurred when a vehicle is rendered inoperable for a period of time. Expert opinion will help approximate an average vehicle repair or replacement time. A mileage allowance will be multiplied by the estimated number of miles driven per driver per day to approximate this cost of alcohol-related accidents.

15. The Dollar Value of Time

A dollar value of time will be used in cost and benefit estimation. A survey of the literature indicates a range of $1.50 to $3.00 per hour in, roughly, 1965 dollars. [35] One confounding factor in the use of these estimates is that the opportunity cost of time varies and is dependent upon many factors such as the destination and alternative uses of time by the subject. A wage rate is not always justifiable as an opportunity cost figure because additional work at that rate is not always a viable alternative. If a wage rate is employed, then the qualification that the rate is either an upper bound or an overstatement might be appropriate.

D. Preliminary Estimates of the Alcohol Safety Action
Project's Costs and Benefits

The estimates presently available for each quantifiable cost and benefit category follow. Since the project became functional on February 1, 1972, many first quarter figures are unavailable. However, complete first quarter estimates can be utilized in the future.

1. Quantifiable Costs

a. Individual Countermeasure Expenditures

The countermeasure expenditures for January 1, 1972, through

35/ T. E. Lisco, "The Value of Commuters' Travel Time — A Study in Urban Transportation," Doctoral dissertation, University of Chicago, June 1967. T. C. Thomas, The Value of Time for Passenger Cars: An Experimental Study of Commuter Values, Stanford Research Institute, May 1967.

March 31, 1972, were: <u>36</u>/

March 31, 1972, were: <u>36</u>/

Project Management	$ 14,741.18
Police Countermeasure	83,548.20
Judicial — Probation Staff and Commonwealth Attorney	11,800.85
Rehabilitation — Diagnostic and Evaluation Unit	10,693.55
Public Information — Martin and Woltz, Inc.	7,653.40
Education — Driver Education and Driver Improvement Schools	3,712.30
Evaluation — Includes surveys	35,416.85
Total first quarter	$167,566.33

b. Agency Expenditures in Excess of Federal Funds

There are three main sources of expenditures in excess of ASAP funds. One is the Bureau of Alcohol Studies and Rehabilitation. In the first quarter of 1972, new patients were referred by the Alcohol Safety Action Project to this agency. The estimated staff time for each patient is:

3 months of services at 2 hours per week
plus
1 hour for intake and processing = 25 hours. <u>37</u>/

Since some patients will receive individualized care and others will be in group therapy, there is no one cost per patient-hour. The Bureau of Alcohol Studies and Rehabilitation will furnish figures for the different situations when they become available. Whatever the total Bureau expenditure on project patients, the following patient fees must be subtracted from the Bureau's project-related expenditures: $5 per clinic visit, and $10 per patient for group therapy (not per session). After the first year of the project, the costs per patient-hour and the number of patient-hours categorized by individual care and group therapy will be available. This quantifiable cost cannot

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<u>36</u>/   Conversation on May 8, 1972 with Clayton Hall — Assistant Project Manager.

<u>37</u>/   This two hour estimate is an overstatement and includes administration costs.

be estimated with much confidence for the first quarter, but if the 25 hours per patient cost \$3 per hour, the cost would be \$75 per patient or \$4,500 (\$75 x 60) for the first quarter. 38/

A second source of outlays in excess of ASAP funds is the Virginia Alcoholic Beverage Control Board. The Board is planning to print liquor bags with visible ASAP advertising. Since this has not yet been accomplished, the additional cost cannot be estimated at this time.

A third expenditure outside the project's budget is the Fairfax-Falls Church Mental Health Center. This agency will not spend project funds, and no services have been supplied to project patients to date. The first quarter ASAP referrals have been sent to the Alcohol Clinic for counseling. Although many of these people may have emotional or psychological problems, their immediate needs are for therapy and sometimes emetic drugs such as Antabuse. After the first 6 months of the program, these subjects will be referred to the Fairfax-Falls Church Mental Health Center for professional treatment. 39/

The major costs during the first quarter thus appear to be roughly \$170,000.

2. Non-Priceable Costs

One might develop helpful "clues" to the cost to citizens of participation in roadside and attitude surveys.

Attitude Survey — Baseline period

Number of respondents	= 500
Average interview time	= 30 minutes
Total time	= 250 hours

Assuming an opportunity cost of \$3 per hour, the cost to society is \$750.00

Roadside Survey

Number of respondents	= 1,578
Average interview time	= 6 minutes

38/ Conversation on May 8, 1972 with Mrs. Irene Schneiderman of the Bureau of Alcohol Studies and Rehabilitation.

39/ Mrs. Shirley Hyland, Assistant Director, Fairfax-Falls Church Mental Health Center.

Total time = 157.8 hours

Total survey time cost at $3 per hour = $473.40

The time cost for both surveys combined is $1,223.40.

When one uses both $2 and $4 per hour as estimates of the value of of time, the cost to society ranges between $816 and $1,531 respectively. However, these costs are considered "non-priceable" because although a a dollar value can conceivably be placed on this category, the estimates of the cost of time can seldom be agreed upon by many persons. Only to the extent that "time" is priced in the market place and that a value for time can be agreed upon can this cost be considered "priceable." This basic pricing problem also applies to the cost to citizens of changing their means of transportation because of the project.

3. Quantifiable Benefits

The reduction in alcohol-related accident costs is the principal benefit to be estimated. The Fairfax County accident data for the baseline period are being used by the Center for the Environment and Man Inc., (a consultant firm to the project). Therefore, the costs of baseline alcohol-related accidents cannot be calculated at this time. The accident data for the first quarter of 1972 will not be available from the Virginia State Police before July. Consequently, the benefits arising from two successive periods within which alcohol-related accident costs decline cannot yet be calculated. However, a rough fatality cost estimate will be calculated later in this section for demonstration purposes. This estimate could be applied to the number of fatalities prevented in order to give a rough idea of benefits arising from the ASAP. Without the accident data, the savings due to a reduction in accidents involving injury and property damage cannot be determined.

Fatality cost estimates are frequently misused because the user is not aware of the components used in the estimation of this cost. Some of these components are direct costs, indirect costs, costs by accident type, and costs per involvement (as opposed to cost per person). One major source of misunderstanding stems from the fact that direct costs of automobile fatalities do not include net production loss. Net production loss is invariably a major portion of any fatality cost estimate. Therefore, estimates not including this cost "element" are understated.

The White House Office of Science and Technology estimates the average traffic fatality cost as $140,000. Apparently, this figure accounts for both the direct and indirect costs of fatalities considering all ages, accident types, and both sexes. A 1971 National Safety Council estime of fatality cost was $45,000. 40/ The cost elements used for this figure were wage loss, medical

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40/ National Safety Council, Traffic Safety Memo 113, July 1971.

expense, insurance administrative cost, and property damage cost. The 1967 and 1971 National Safety Council fatality cost estimates by age and sex follow.

Age	1967 Male	1967 Female	1971 Male	1971 Female
Less than 15	$26,500	$19,400	$30,000	$21,500
15-54	55,400	34,500	64,700	39,200
55 Up	12,100	9,200	13,900	10,100

Other estimates have been $41,700 [41] for the average fatality cost in 1969; $113,000 [42] for the average loss of income per fatality in 1968; $63,000 and $77,000 for 1964 and 1968 average fatality costs respectively; [43] $80,000 for an automobile traffic fatality; [44] and $37,000 [45] for the indirect cost of an automobile fatality in 1969.

Still other cost estimates from various states are:

$18,000 - 1970 - Indiana - Fatal accident direct cost

$ 4,337 - 1970 - Ohio - Average direct cost for fatal injury

$ 8,627 - 1970 - Texas - Direct cost per reported fatal accident

$61,100 - 1970 - Texas - Cost per reported fatal accident

The differences, which are in part due to the use of different cost elements, are so great that it probably does not matter much what kind of dollars (e.g., 1970 dollars) the amounts reflect.

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[41] Department of Transportation memorandum dated May 14, 1971.

[42] Department of Health, Education and Welfare, op. cit., p. 26.

[43] Gerard L. Drake and Merwyn Kraft, "Motor Vehicle Accident Costs in the Washington Metropolitan Area, 1966," Highway Research Record Number 188, Highway Research Board, Washington, D. C., p. 127.

[44] H. C. Joksch and H. Wuerdemann, Comparative Estimates of Losses in Transportation Accidents, The Center for the Environment and Man, Hartford, Connecticut, 1970, p. 7.

[45] H. C. Recht, National Safety Council, head statistician.

Assume for the purposes of a sample fatality cost estimation that the victim is a male between 25 and 29 who will not be unemployed in the future.

Cost Category	Source	Estimate
Present value of future discounted earnings	HEW Study [46]	$150,512
(Less) Expected future consumption		(50,170)
Total medical costs	Wyoming Study [47]	350
Ambulance trip cost	(Guess)	30
Funeral costs	Washington Area Study [48]	1,200
Average legal fees	Combination of Joksch and State of Washington Studies	2,800
Police time cost	ASAP area estimates	40
Insurance administration cost	Wyoming Study	2,730
Highway restoration	(Guess)	300
Property damage	Wyoming Study	1,000

Illustrative fatality cost estimate or the benefit accruing from the saving of a life = $108,792

Again, I emphasize that this is the total cost of a death at the prime age of 25 to 29. Because this is not an average of all ages, it is an over-statement of the figure that would be relevant to the evaluation of the ASAP. As pointed out in the April 9, 1972, Washington Post article "The Economics of Death," fatality cost estimates range from $43,000 to $450,000. Since over ninety percent of any estimate is "net production loss," the age of the person at time of death greatly affects the appropriate figure.

As time passes, someone can compute the costs of all alcohol-related accidents in the ASAP area over the two time periods in question. If the accident costs in the later period are less than the accident costs in the

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[46] Department of Health, Education and Welfare, op. cit.

[47] Raymond W. Hooker, Traffic Accident Costs and the Effectiveness of Highway Safety Expenditures in Wyoming, University of Wyoming, Laramie, Wyoming, University of Wyoming, Laramie, Wyoming, 1966, p. 44.

[48] Gerard L. Drake and Merwyn Kraft, op. cit.

preceding period, this difference can be viewed as an estimate of the project's benefit. Admittedly, the accident cost reductions are not totally attributable to the project. The expected variation in fatality rates for two years might be a clue as to what percentage of a reduction in fatality costs may be due to ordinary variability.

It is recommended that annual data be used in benefit and cost estimation. Over a one year period, significant changes in accident costs might be detected. In addition, data for the entire three year period should be analyzed.

4. Summary

In principle, the first quarter ASAP costs and benefits could be added together. For most categories, however, either estimates cannot be calculated or ranges will have to be used. Note, however, that total quantifiable costs for one quarter would be in the vicinity of $170,000, and, if an average of $50,000 cost per fatality is used, the prevention of four fatalities per quarter would cover the major costs of the ASAP.

Quantifiable Costs (rounded to nearest hundred dollars)

1.	Individual countermeasure expenditures	$167,600.
2.	Agency expenditures in excess of federal funds	
	a. Bureau of Alcohol Studies and Rehabilitation	Cost per patient hour times number of patient hours minus patient fees.
	b. Virginia Alcoholic Beveral Control Board	Not available at this time
	c. Fairfax-Falls Church Mental Health Center	Cost per patient hour times number of patient hours minus patient fees.

Non-Priceable Costs

1.	Cost to citizens of changing their means of transportation	Cannot estimate
2.	Cost to citizens of participation in roadside and attitude surveys	408 hours times a value per hour

TOTAL

Quantifiable Benefits

1.	Reduction in alcohol-related accident costs	Not available at this time

TOTAL

- 36 -

Non-Priceable Benefits

1.	Increased public education	Cannot estimate
2.	Support of other alcohol or safety programs	Cannot estimate
3.	More efficient police reporting	Cannot estimate
4.	Traffic safety research generated by the ASAP	Cannot estimate
5.	Decreased alcohol-related accident rates in adjoining communities	Cannot estimate
6.	Better future treatment facilities for alcoholics	Cannot estimate
7.	Special treatment of alcoholics	Cannot estimate
8.	An increased feeling of security by the ASAP	Cannot estimate
9.	A decrease in pain, fear, and suffering	Cannot estimate
10.	Cost savings of ASAP	Cannot estimate

CHAPTER V

SOME CRUDE INDICATORS OF THE ALCOHOL SAFETY ACTION
PROJECT'S SUCCESS

Cost-benefit analyses themselves are merely "clues" or indicators to help decision makers identify preferred courses of action. With their many limitations, cost-benefit studies are not definitive guides to policy evaluation. These systematic efforts of evaluation only give an insight into the identification and values of the inputs and outputs of the project. Moreover, because cost-benefit information in this study is so fragmentary, it may be worthwhile to examine other more crude indicators of the advantages and disadvantages of the ASAP. These are referred to as crude indicators because they are proxies for, and often with rather remote connections to, the measurements or information that one would ideally like to have.

A motor vehicle operator's knowledge of and attitude toward driving influence his behavior which, in turn, has consequences for him and society. In traffic safety, such relationships are, at best, difficult to trace. However, it may be useful to augment the cost-benefit study with clues concerning such matters. Three main indicators that have sometimes been considered pertain to changes in driving attitudes, behavior (accidents), and consequences (costs). Each of the three main indicators of the ASAP's success will be discussed (along with less obvious clues which will be called secondary performance measures). These clues may be useful to the decision maker if the quantifiable costs and benefits are inconclusive.

A. **The extent to which public awareness increases regarding penalties for driving-while-intoxicated.**

The mass media campaign directed specifically at the Fairfax project area is one means by which public awareness of the problems of driving-while-intoxicated will be affected. Changes in public awareness are difficult to trace and are not directly linked with individual countermeasures; i.e., all of them contribute to increased public awareness. The national ASAP effort assumes that a change in public awareness influences driving behavior. The following indicators may assist in measuring any changes in public awareness. If the decision maker uses statistical techniques, sufficiently large confidence intervals should be used so as to minimize the probability of accepting as significant a negligible change of an indicator.

1. The extent to which the public's perception of the probability of arrest approaches the true probability. Prior to the project, the probability of arrest for a drunken driver was not relatively high. As the recent Fairfax area public attitude survey confirmed, the public perceived this risk as being low. Comparison of attitude survey results throughout the project will indicate any changes in the perception of the probability of arrest. Perception should gradually approach the actual new probability due to the increased police enforcement allocated to the detection of drunken drivers. Henrico County survey statistics will serve as a control in estimating changes in public attitude.

2. The extent to which the knowledge of drunken-driving penalties increases.

    The Fairfax residents perceive the penalty for the first offense of driving-while-intoxicated as less severe than the statutory definition. The deterrent effect upon drunken-driving behavior by problem drinkers is probably small. Due to the severity of the statutory first offense penalty for driving-while-intoxicated, a low arrest rate for drunken driving was observed prior to the project: before the ASAP, charges were often reduced from driving-while-intoxicated to reckless driving where either the arresting officer or judge considered the penalty overly harsh.

    If the public realizes that, under the ASAP, the existing driving-while-intoxicated laws will be enforced, then drivers may reduce their illegal driving behavior, benefiting people in general. (This says nothing, of course, about the cost of producing that change in public knowledge.)

3. The extent to which awareness of the causes of accidents increases.

    Alcohol is involved in forty to fifty percent of all fatal accidents. Public knowledge of this fact might alter drinking and driving behavior. As with the two previous aspects of awareness, the magnitude of the effect on behavior is unknown. The importance of an indicator of public awareness will have to be weighed subjectively by the decision maker.

4. The extent to which the judicial system aids police enforcement by increasing their capacity to handle driving-while-intoxicated cases.

    An indicator of increased judicial "capacity" may seem unrelated to knowledge or public awareness, yet it is a key ingredient. Fines and sentences must be levied before the public can become aware of them. The judicial system's ability to handle more driving-while-intoxicated cases should result in additional police arrests. In previous years, one reason for police reluctance to increase drunken-driving enforcement levels was that traffic cases overloaded the court system.

5. The extent to which the use of mobile alcohol testing vans aids police.

    Prior to the program, the processing of each drunken-driving suspect took two to four hours. With the use of mobile vans, this time can be reduced to less than one hour. The benefits of this time saving include the opportunity cost of an officer's time, or to look at it another way, the increased enforcement output that can be obtained from a "policeman-day," and an indicator of the increased productivity may be useful.

B. The change in the incidence of alcohol-related
motor vehicle accidents.

Accident rates by themselves, of course, do not indicate whether changes are consequences of the Alcohol Safety Action Project. The following secondary indicators provide clues that may help one attribute changes in accident rates to the project.

1. The extent to which the arrest rate of drunken drivers changes during the three year project.

It is assumed that a rise in the arrest rate reduces the number of potential drunken drivers from the highways, which, in turn, may reduct arrest rates. Obviously, the exact effect of this increase in arrests on alcohol-related traffic accidents cannot be specified, but the degree of correlation might yield some conclusions about this relationship. The main problem presented by this secondary indicator is that along with more intensive enforcement, there may also be occurring an independent change in alcohol-related behavior. Both enforcement levels and driver behavior tend to influence arrest rates. Consequently, this indicator must be used with other indices of changes in drinking and driving behavior.

2. The extent to which the alcohol-related accident rate decreases during the three year ASAP.

This indicator is a direct project performance measure. It refers to a rate decrease rather than a decrease in the absolute number of accidents. If, in the absence of confounding external factors, the alcohol-related accident rate increases, then the utility of the ASAP would be questionable. If an accident rate decrease is observed, then the nature of that reduction must be analyzed to determine if it is attributable to the project.

This performance measure, too, must be viewed in conjunction with other indicators. For example, if the number of alcohol-related accidents decreases, then the rate of decrease compared with policeman-days is one indicator of program effectiveness.

3. The extent to which the index of Henrico County alcohol-related accident rates exceeds the Fairfax County rates over the three year project.

By translating the two accident rates into an index number form (with one rate having a base of 100), one can easily compare the rates at the primary and control sites. A confusing factor affecting this and other indicators is the probability of detection. The choice of a standardizing variable (e.g., accident rate per million vehicle miles, or per police-day) is crucial. Using a variable other than the police

enforcement level could be deceiving because it could distort the picture of driving behavior in the ASAP area vis-a-vis the control site.

4. The extent to which the distribution of motorists' blood alcohol levels differs between the first and last roadside surveys.

Roadside surveys will be conducted annually in the Fairfax County area. To the extent that the distribution of the levels over time of day and day of week differs between two periods, the probability of alcohol-related accidents differs accordingly. A significant change in the time distribution of blood alcohol levels could indicate a response to the program and could be a useful aid in gauging program effectiveness.

This indicator might also be useful in deploying or designing the police enforcement efforts. As successive survey results become available, the police will change their enforcement configurations by spatial area, time of day, and day of week. Furthermore, one important criterion for police unit relocation could be the number of drivers with blood alcohol levels above a certain figure (such as the presumptive level).

5. The extent to which recidivism declines — i.e., the extent to which drunken driving decreases among persons previously subjected to rehabilitation.

This indicator may be significant, but is difficult to interpret because it depends, in part, upon the strength of the enforcement countermeasure. On the one hand, if few problem drinkers are arrested and referred to the rehabilitation countermeasure or if rehabilitation treatments are quite successful, then a low recidivism rate would be expected. On the other hand, as hard core drinkers enter the program, the rehabilitation success rate should decline. Consequently, both the recidivism rate and absolute increase in number of "treated" drivers not committing additional vehicle offenses must be used quite carefully as indicators of project success.

In the absence of better information, the above five indicators may give helpful clues to the extent to which ASAP objectives are satisfied. Obviously, some indicators are less direct and helpful than others, and in any event, judgment about the project's success ultimately rests with the decision maker. Through his first hand experience, he might be better able to detect a change in human behavior as reflected in the alcohol-related accident figures than through mechanical use of uncertain cost-benefit estimates.

C. The change in the alcohol-related accident costs.

As discussed in connection with cost-benefit analysis, the magnitude of alcohol-related costs is important because a decrease in accident costs is one component of project benefits. In the absence of more complete information about benefits, changes in accident costs, and the following secondary indicators of such changes, may be useful.

1. The extent to which mortality, morbidity, and property damage are reduced over the project's time horizon.

These three accident consequences influence total accident costs by varied amounts. An injury, for example, is not as costly as a death. (If he can calculate or assign figures to each of these accident consequences, the decision maker can convert them further along the line toward the kind of information desired.)

2. The extent to which the severity of alcohol-related accidents decreases during the project's time horizon.

This indicator refers to any time periods during which mortality, morbidity, and property damage decrease with a constant accident rate. The severity of an alcohol-related accident is then said to be decreasing because each accident involves less loss.

Possible indicators of the ASAP's success are summarized in Table 1. As each indicator is considered and tested statistically by the decision maker, he can enter the change in such a table. After systematically considering each of the indicators, the decision maker may reach more reliable conclusions regarding the project's success than he would on the basis of quantifiable costs and benefits alone. Economizing — reaching preferred positions in terms of economic efficiency — may call for information of various sorts and degrees of sophistication. For the evaluation of some policies, cost-benefit estimates may be sufficiently accurate and complete that they can provide the most useful assistance to decision makers. For the evaluation of other policies, the costs and benefits of using fragmentary indicators versus cost-benefit estimates may suggest that such indicators (or a mixture of the two types of information) may give the most valuable assistance.

TABLE 1

INDICATORS OF ASAP SUCCESS

+ = Increase

– = Decrease

Y = Yes

N = No

Desired Direction of Change	Actual Change Direction	Significant?	
			ATTITUDE
			Attitude Survey Results
+	————————		Problem Recognition
			Knowledge of
+	————————		Offender Characteristics
+	————————		Extent of the Problem
+	————————		Consequence of Illegal Behavior
+	————————		Legal Definition of Illegal Behavior
+	————————		Awareness of ASAP
	————————		Desirability of Behavior Change Methods
+	————————		Perception of Illegal Driving Behavior
			BEHAVIOR
			Roadside Survey Results
–	————————		% Who Drive With Positive BAC [49]
–	————————		Mean of Positive BACs
–	————————		% Who Drive With BAC Greater Than the Presumptive Level
			Trend Analysis
–	————————		Alcohol-Related Accidents
–	————————		Alcohol-Related Fatal Crashes
–	————————		Alcohol-Related Injury Crashes

[49] BAC is blood alcohol concentration level.

TABLE 1 (Continued)

Desired Direction of Change / Actual Change Direction / Significant?

BEHAVIOR (Cont.)

— Alcohol-Related Property Damage Crashes

— All Fatalities

Alcohol-Related Fatalities

+ Convergence of Police Contact and Roadside Survey BAC Distributions

— DWI Arrests Among Program Entrants [50]

CONSEQUENCES

— Alcohol-Related Accident Costs

— Alcohol Related Fatal Accident Costs

— Alcohol-Related Injury Accident Costs

— Alcohol-Related Property Damage Costs

INTERNAL EFFICIENCY

— Cost Reduction Break-Even Level

Mobile Van Analysis

— # of Subjects Necessary to Break Even

— DWI Processing Time

+ Convergence of Police Contact and Roadside Survey BAC Distributions

Interstate and Non-Interstate Alcohol-Related Accidents

Reduced Charges From DWI to Reckless Driving

— DWI Case Processing Time

? Alcohol-Related Arrest Rates

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[50] DWI is driving-while-intoxicated.

CHAPTER VI

SUMMARY AND DISCUSSION

Cost-benefit analysis is sometimes a useful tool for evaluating the advantages and disadvantages of alternative courses of action. The first half of this study was an attempt to further the use of such analysis in the evaluation of a highway safety project — the Fairfax Alcohol Safety Action Project (ASAP). This project is designed to reduce the frequency and severity of alcohol-related crashes in the Fairfax County area.

A complete cost-benefit analysis was not prepared because crucial information about the program's effects was not available. However, a cost-benefit framework was designed which will hopefully serve as an aid to the decision makers involved in the ASAP.

Both quantifiable and non-priceable costs and benefits arising from this project have been examined. The quantifiable costs are simply the ASAP expenditures of federal funds. Non-priceable costs include the value of citizens' compliance time in program surveys and the cost attributable to changes in the means of transportation. Quantifiable benefits are the reduction in alcohol-related accident costs, whereas the non-priceable benefits include increased public education and more exact police reporting. Such measurements imply that observed or simulated market prices and the conventional criteria of economic efficiency are regarded as being relevant to the decisions.

The quantifiable costs and benefits were estimated for the first quarter of 1972. The major costs (expenditures) appeared to be roughly $170,000. Since alcohol-related accident costs depend upon many uncertain factors and include the costs associated with the loss of life, estimates of quantifiable benefits are quite uncertain. Ten factors which determine the cost of a fatality were discussed. The most significant factor is the present value of future earnings, which accounts for roughly ninety percent of the costs of a fatality. An illustrative estimate of the benefit arising from saving a 25-year old male's life was $110,000. If a figure as low as $50,000 is used, it seems reasonable to assume that the prevention of roughly fifteen to twenty deaths per year would cover the quantifiable costs of the project.

Neither this framework nor comparatively polished cost-benefit analyses would provide final evaluations of the Fairfax ASAP. Hopefully, though, the estimates, discussions, and indicators which will now be examined may assist policy makers to formulate judgments about the project's success in a more systematic way and on a basis that does not consist mainly of personal guesses.

Many persons would argue that the non-priceable costs and benefits are of primary concern. Because the cost-benefit information is so fragmentary, crude indicators of the advantages and disadvantages of the ASAP might aid the judgments of those persons who are especially knowledgeable of the project's functioning. These intermediate variables that are relatively remote from the variables which one would in principle like to know about will now be discussed. The results of statistical tests of

significance of simple mathematical analysis might shed further light on the exact nature of changes in the indicators and the validity of the indicators themselves. Various means by which the project data can be analyzed will be discussed in the following chapters.

CHAPTER VII

TREND ANALYSIS

The application of trend analysis to accident statistics might assist in evaluating the Fairfax ASAP. By fitting regression lines to fatalities, injuries, and property damage crashes, one can define intervals outside of which, with a specified degree of confidence, a future period's observation would not be expected to fall. A "clue" as to whether or not accidents have been significantly reduced might result. However, an observed improvement cannot necessarily be attributed to the ASAP. Trend analysis is only one rough gauge by which a project's success or failure can be measured. The variation and unpredictability of the raw data make refined statistical techniques of little value for rough evaluation purposes. Consequently, statistical techniques more sophisticated than trend analysis are not applicable. Trend analysis can be used with various types of data, but certain statistics (such as alcohol-related accidents) more readily reflect the behavior which the project is attempting to alter.

A. An Example of Trend Analysis

An example of trend analysis applied to the annual fatalities in Henrico County, the ASAP control site, follows. Trend lines were fitted to data for the eleven-year period 1960-1970 inclusive. Fatalities for 1971 were estimated by the regression equation, and confidence intervals for an individual forecast were defined. The actual 1971 values were then compared to the expected values.

Year	Number of Fatalities	
	Henrico County	ASAP Area
1960	17	34
1961	26	36
1962	21	40
1963	17	56
1964	15	57
1965	25	60
1966	31	65
1967	19	64
1968	24	65
1969	26	60
1970	26	63

Trend line equation: $Y = 18.42 + .672 X$ $Y = 36.00 + 3.09 X$

95% Confidence Interval for a forecast   16.22   (Lower bound)
                                                       87.64   (Upper bound)

1971 Fatalities   17   98

(Source: <u>Virginia Crash Facts</u> 1965-1970 and conversations with Jack Williams, Department of State Police)

       Unfortunately, in both localities, the 1971 fatalities were significantly different from the 1970 figures. In the final year of the baseline period (1971), fatalities were "abnormally" high in the ASAP area and "abnormally" low in Henrico County. Since one can neither explain the cause of these abnormalities nor predict their occurrence, a great deal of reliability cannot be placed in the estimates generated by the trend line. In this case, other types of raw data might be helpful. For example, a "standardizing" or "exposure" variable such as million vehicle miles travelled (MVMT) per year might assist in comparing the fatality <u>rates</u> between the ASAP and control sites. Estimates of this exposure variable are not presently available, and ASAP area fatalities were weighed by population instead. The resulting rates were also subjected to trend analysis. This analysis suggests that other methods of evaluating the ASAP are necessary.

       Using the ASAP area fatality rates, the following regression equations were derived:

       Regression line $Y = 14.16 + .045 X$

       Regression parabola $Y = 13.79 + .1024 X^2$

where X is the year (for 1960 X = 0, for 1971 X = 12).

       A parabolic trend line was also calculated because the data were poorly fitted to a straight line. However, it is not assumed that the accident rates will continue to decline after 1970. The accident rates given by the regression line and parabola can be considered as bounds within which the future rate might be expected to fall.

       For 1971 these bounds are 14.70 — 14.26. These bounds were calculated from the two regression equations:

       Regression line $Y = 14.16 + .045 \times 12$ $Y = 14.70$

       Parabola $Y = 13.79 + .1024 \times 12 - .0052 \times 12^2$ $Y = 14.26$

       Since a precise estimate of 1971 ASAP area population is not available one must assume that it is approximately 500,000. This population estimate yields two expected numbers of 1971 fatalities:

$$\frac{X_1}{5.00} = 14.70 \text{ and } \frac{X_2}{5.00} = 14.26$$

Fatalities $X_1 = 73.5$ $X_2 = 71.3$

Furthermore, the upper bound of the 95% confidence interval for an individual forecast from the regression line is 90.1. This was calculated as follows:

$$Y = Y_c + \sigma_{.05} \times S_{y-yc}$$

$$Y = 14.70 + 1.131 \times 2.94 = 18.02$$

$$\frac{X}{500} = 18.02 \qquad X = 90.1 \text{ fatalities}$$

Similarly, for an 80% degree of confidence interval the upper bound of a forecast is 83.6. This was calculated as follows:

$$Y = Y_c + \sigma_{.20} \times S_{y-yc}$$

$$Y = 16.73$$

and $\frac{X}{500} = 16.73$ $X = 83.6$ fatalities

Given the ASAP area police departments' 1970 fatality statistics of 87 deaths, and the State Police figure of 98, these results could not have been predicted by the regression equations.

This result emphasizes that trend analysis is of little predictive value for ASAP area fatalities or fatality rates. However, the application of this technique to other data might be useful. Raw data and a table which might help the decision maker follow.

B. Raw Data

The ASAP area traffic fatalities coupled with the ASAP area population statistics generate the fatality rates which were used in trend analysis. The national and ASAP area accident statistics by accident type might also be of some use.

By completing the accident statistics in Table 2, the evaluators can observe if the actual numbers of accidents by type approximate the estimated or expected numbers.

TABLE 2

ACCIDENT STATISTICS

ASAP Area Population Statistics 1960 — 1970

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Fairfax County	262,248	279,609	278,619	313,780	333,082	327,796	366,949	389,396	422,496	443,324	433,574
Fairfax City			15,218	16,500	17,000	$^p17,800$	$^p18,600$	$^p19,400$	$^p20,200$	$^p21,000$	21,970
Herndon											17,146
Vienna											4,301
Falls Church	10,192	10,196	10,175	10,486	10,505	$^p10,550$	$^p10,600$	$^p10,650$	$^p10,700$	$^p10,750$	10,772
ASAP Area Population Totals	272,440	289,805	304,012	340,766	360,587	356,146	376,149	419,446	453,396	475,074	487,763

Note: 1960 - 1964 Figures are from Statistical Abstract of Virginia, 1966.

1965 - 1969 Figures for Fairfax County are from Bureau of Population and Economic Research Correspondence.

1970 Figures are from 1970 Census Commonwealth of Virginia, Department of Highways, Division of Traffic and Safety Publication.

1960 - 1961 Fairfax City figures are included in Fairfax County.

1960 - 1969 Herndon and Vienna figures are included in Fairfax County.

p Denotes author's projection, figures unavailable.

ASAP Area Traffic Fatalities 1960 — 1970

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Fairfax County	30	36	36	51	54	58	65	62	61	57	58
Fairfax City	2	0	3	4	3	1	0	2	1	1	2
Vienna	1	0	1	1	0	0	0	0	0	2	2
Falls Church	1	0	0	0	0	0	0	0	3	0	1
Herndon	N/A	N/A	N/A	N/A	N/A	1	0	0	0	0	0
Total	34	36	40	56	57	60	65	64	65	60	63

(Source: Virginia Crash Facts)

N/A: Not Available, but insignificant.

ASAP Area Fatality Rates

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Deaths Per 100 Thousand Population	34/2.72	36/2.89	40/3.04	56/3.40	57/3.60	60/3.56	65/3.96	64/4.19	65/4.58	60/4.75	63/4.87
Rate	12.50	12.45	13.15	16.47	15.83	16.85	16.41	15.27	14.34	12.63	12.93

Accident rate rose drastically   Different data source for population statistics

TABLE 2 (Continued)

Virginia and National Accident Statistics

National

Year	Fatalities	Injuries	Property Damage Accidents	Total Accidents
1970	54,800	2,000,000	14,700,000	16,000,000
1971			Not Yet Available	

Virginia

Year	Fatalities	Injuries	Property Damage Accidents	Total Accidents
1970	1,231	48,354	103,561	136,923
1971	1,218	50,051	109,776	

(Source: Mr. Jack Williams, Virginia State Police)

ASAP Area Accident Statistics

February 1972

	Fairfax County	Fairfax City	Herndon	Vienna	Falls Church
Fatal Crashes	1 (fatality)	0	0	0	0
Injury Crashes	40	2	2	2	1
P. D. Crashes	78	4	3	0	3

March 1972

	Fairfax County	Fairfax City	Herndon	Vienna	Falls Church
Fatal Crashes	2 (fatalities)	1 (fatality)	N/A	N/A	0
Injury Crashes	36	2	N/A	N/A	2
P. D. Crashes	79	12	N/A	N/A	8

(Source: Conversations with Reed Rodman)

ASAP Area Accident Statistics

	Fatalities	Alcohol-Related Fatalities	Non-Related Fatalities	Injury Crashes	AR Injury Crashes	Non-AR Injury Crashes
1969						
1970						
1971						

	Estimated	Actual	Estimated	Actual	Estimated	Actual	Estimated	Actual	Estimated	Actual	Estimated	Actual
1972												
1973												
1974												

C. Standardizing or Exposure Variables

Other reliable data which might translate raw fatality figures into useful forms are given in Table 3.

TABLE 3

MILEAGE AND ACCIDENT DATA FOR HENRICO AND FAIRFAX COUNTIES

Primary — Arterial — Interstate

		100 MVM** per year
Henrico Co. — 1968 — DVMT* —	2,226,000	8.12
Fairfax Co. — 1967 — " —	3,777,452	13.78
1969 — " —	4,590,457	16.75

Above plus secondary roads estimates yield:

Henrico Co. — 1968 — DVMT —	2,226,000	8.12
Fairfax Co. — 1967 — " —	7,490,400	27.33
1969 — " —	9,232,600	33.69

(Source: Mr. Chas. Rasnick by telephone on 3-22-72 # 770-2984)

DVMT on primary — arterial — interstate

Henrico Co. — 1970 — DVMT —	1,266,088	4.62
Fairfax Co. — 1970 — DVMT —	4,726,102	17.24

(Source: Mr. Powell, 369-2868)

Million Vehicle Miles Travelled Per Year by Highway Type

1969

Interstate

	Vehicle Miles Per Year	Fatalities	Injuries	Property Damage Accidents	Total Accidents
Henrico Co.	196,000,000	3	120	177	245
Fairfax Co.	886,000,000	12	523	910	1,277

Arterial and Primary

Henrico Co.	248,000,000	9	524	1,048	1,421
Fairfax Co.	794,000,000	23	1,627	3,967	5,066

Secondary

Henrico Co.	Not available — maintains own secondary system				
Fairfax Co.	700,000,000	20	1,518	3,956	5,097

Table 3 (Continued)

1970

Interstate

	Vehicle Miles Per Year	Fatalities	Injuries	Property Damage Accidents	Total Accidents
Henrico Co.	210,000,000	3	140	171	263
Fairfax Co.	919,000,000	11	561	1,000	1,398

Arterial and Primary

	Vehicle Miles Per Year	Fatalities	Injuries	Property Damage Accidents	Total Accidents
Henrico Co.	252,000,000	14	457	1,038	1,351
Fairfax Co.	805,000,000	26	1,814	4,233	5,486

Secondary

	Vehicle Miles Per Year	Fatalities	Injuries	Property Damage Accidents	Total Accidents
Henrico Co.	Not available — maintains own secondary system				
Fairfax Co.	700,000,000	19	1,541	4,565	5,751

* DVMT is daily vehicle miles travelled.
** MVM is million vehicle miles.

With the following formula, the vehicle miles travelled per year were extrapolated using the absolute number of accidents and the accident rates.

$$\text{Miles travelled per year} = \frac{\text{Number of accidents} \times 100,000,000}{\text{Accident rate}}$$

Source: Summary of Accident Data State Highway Systems, Department of Highways, Calendar years 1969 and 1970.

CHAPTER VIII

BREAK-EVEN RATE OF RETURN ANALYSIS

Since long-range estimates of project costs and benefits are not always reliable, a break-even rate of return analysis can assist in defining intermediate measures of the ASAP's success. This rate (Q) is the percentage reduction in accident-related economic loss necessary for the ASAP to break even, that is, generate neither net gains nor losses from the existing investment.

$$Q = \frac{\text{Investment: ASAP expenditures, A}}{\text{Economic loss, L}}$$

For the three-year baseline period (1969-1971), a regression line will be fitted to the economic losses and expected levels of L will be estimated for 1972, 1973, and 1974. Table 4 can be completed with the estimates of expected "L".

TABLE 4

BREAK-EVEN RATES OF RETURN FOR THREE-YEAR ASAP

Year	L (Actual)
1969	
1970	
1971	

Year	L (Expected)	L (Actual)	A	Q = A/L	Percentage Decrease in Economic Loss $\frac{\text{L (expected)} - \text{L (actual)}}{\text{L (expected)}}$
1972					
1973					
1974					
1972-74					

The invested capital for the years 1972 through 1974 need not be constant for this analysis to proceed. Since a series of Q's are calculated, fluctuations in expenditures are taken into account.

The economic loss, L, in time period "t" is estimated as follows:

Cost Source	Frequency		Cost Per Incident [51]		Estimated Economic Loss
(time "t")					
Fatalities	m	x	$45,000	=	a_1
Injuries [52]	n	x	2,700	=	a_2
Property Damage Accidents	p	x	400	=	a_3
Other Accident Related Costs					a_4
Total economic loss in time "t"				=	$\sum_{1}^{4} a_i$

The ASAP expenditures, A, can be estimated at some point during the year or calculated at the end. The A (actual or forecast) divided by the expected L yields a rate of return, Q. The expected L is compared to the actual L and if the percentage decrease in the actual L from the expected L is greater than the break-even rate of return, then a positive return is being made on the annual investment.

The above methodology will be demonstrated by the following example. All figures are hypothetical.

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[51] Source: National Safety Council estimates (July 1971).

[52] If the number of persons injured is unavailable, the number of injury accidents multiplied by 1.5 approximates the number of persons injured.

A. An Example

Given these accident statistics:

Year-Number	Year	Fatalities	Number of People Injured	Property Damage Accidents
1	1969	59	4,200	12,500
2	1970	56	4,500	13,000
3	1971	63	4,400	12,000

for each year, L is

1969 L_1 = 59 x $45,000 + 4,200 x $2,700 + 12,500 x $400 = $18,995,000

1970 L_2 = 56 x $45,000 + 4,500 x $2,700 + 13,000 x $400 = $19,870,000

1971 L_3 = 63 x $45,000 + 4,400 x $2,700 + 12,000 x $400 = $19,515,000

By least squares regression, the above three L_i yield the following regression line:

$$L_i = 19,460,000 + 260,000 \text{ X}$$

where X is the year number.

For years   1972, x = 4 and L_4 = $20,500,000

1973, x = 5 and L_5 = $20,760,000

1974, x = 6 and L_6 = $21,020,000

If one assumes that the ASAP expenditures for each year in the future will be:

1972 A = $600,000
1973 A = $800,000
1974 A = $700,000

then the preceding table is completed as follows:

Year	L (Actual)
1969	$18,995,000
1970	$19,870,000
1971	$19,575,000

Year	L (expected)	L (actual)	A	Q = A/L(exp.)	Percentage Decrease in Economic Loss $\frac{L\ (exp.) - L\ (act.)}{L\ (exp.)}$
1972	$20,500,000	$19,950,000	$600,000	.0292	.0268
1973	$20,760,000	$19,980,000	$800,000	.0385	.0375
1974	$21,020,000	$20,000,000	$700,000	.0333	.0485

In 1972 and 1973, Q is greater than the percentage reduction in economic loss. For example, in 1972 Q is .0292 but the percentage decrease in economic loss is .0268. Although it might be concluded that the ASAP was initially a poor investment, one must investigate further. By using L (expected), L (actual), and A figures for the three-year period, the break-even rate of return analysis can be applied to the entire project. This would yield the following figures:

Year	L (expected)	L (actual)	A	Q = A/L(exp.)	Percentage Decrease in Economic Loss $\frac{L\ (exp.) - L\ (act.)}{L\ (exp.)}$
1972-1974	$62,280,000	$59,930,000	$2,100,100	.0337	.0377

It is clear that in this hypothetical case the three-year ASAP returns a small investment. The entire project expenditure is $2,100,000, whereas the reduction in economic loss is $2,350,000. This occurs despite the fact that in 1972 and 1973, the rate of return, Q, is not met. However, in 1974 and 1972-74 the percentage reduction in L exceeds the Q.

This is not to say that in this example the ASAP is an unqualified success. The consideration of items (such as non-quantifiables or non-priceables) which are crucial to cost-benefit decisions is not included in this analysis.

The following problems limit the usefulness of this analysis. First, since economic loss depends upon fatality and injury rates which fluctuate in the short run, the lengths of the time intervals affect the reliability of the results. Second, since accident reduction cannot be undeniably traced to ASAP expenditures, changes in economic loss cannot be wholly attributed to the project. Third, a choice between including either the economic loss generated by alcohol-related accidents or all accidents must be made. As the accident type becomes more narrowly defined, it becomes more difficult for the ASAP to break even. To attribute any reduction in all accident costs to the ASAP is unrealistic, but to consider only changes in alcohol-related accident costs could be misleading. Consequently, both accident types can be subjected to break-even rate of return analysis and the results can be compared to indicate roughly whether the ASAP is functioning properly. Fourth, due to a lag effect, a decrease in ASAP expenditures and the accident rates (which affect L) could occur. The methodology can be easily

altered to account for this phenomenon. Fifth, this analysis is highly dependent on the cost estimates of a fatality. As higher estimates are used, the break-even rate of return declines. Sixth, it is desirable to fit a regression line to loss estimates for more than three baseline years. A moving average cannot be used because those years within which losses have presumably been effected by the ASAP cannot be included. Seventh, this annual break-even analysis is more desirable than a total project break-even rate because increasing funds to combat increasing accident losses can be taken into account. Eighth, a time cost of money is not accounted for in this analysis. At the margin, this might be a major factor in demonstrating a net gain or loss. Finally, as with cost-benefit ratios, the rate of return indicates only whether a positive return is being made. This one figure (Q) does not reveal the magnitude of the return. It would be unrealistic to use Q as an investment rate of return because Q depends upon the highly subjective estimates used for cost of fatalities. Hence, this rate of return method is not sufficient for investment decisions. Accident losses do not entirely describe the changes in those occurrences which the ASAP is attempting to alter. It is conceivable that total losses due to accidents could decline while the number of fatalities increases. If a decrease in fatalities is the main ASAP objective, changes in the total economic loss would be a misleading indicator of ASAP success.

Since a time cost of money was not included in the initial analysis, changes in the break-even figures with different discount rates are next considered.

B. Sensitivity of the Analysis to Changes in the Discount Rate

By subjecting the ASAP expenditures (A) to various discount rates, one can observe the corresponding changes in the break-even rates of return (Q = A/L). The discounted expenditures are:

Year	Non-discounted	4% Rate	6% Rate	8% Rate	10% Rate
1972	$ 600,000	$ 600,000	$ 600,000	$ 600,000	$ 600,000
1973	800,000	769,000	754,000	740,000	727,200
1974	700,000	647,500	623,000	599,900	578,200
1972- 1974	$2,100,000	$2,017,100	$1,977,400	$1,940,700	$1,905,400

Using the hypothetical figures for percentage decreases in economic loss:

$$\frac{\text{L (expected) minus L (actual)}}{\text{L (expected)}}$$

one can compare these hypothetical decreases to the break-even rates of return. The different rates are:

Year	Percentage decrease in economic loss	Q, i = 0	Q, i = 4	Q, i = 6	Q, i = 8	Q, i = 10
1972	.0268	.0292	.0292	.0292	.0292	.0292
1973	.0375	.0385	.0371	.0363	.0357	.0350
1974	.0485	.0333	.0308	.0296	.0285	.0275
1972-1974	.0377	.0337	.0324	.0318	.0312	.0306

where i denotes the discount rate used.

This sensitivity analysis is useful for the following reason. Since Q is the target percentage reduction in economic loss necessary to break even, the definition of Q could dictate whether or not the ASAP generates a return on investment. In some years, the discount rate is the determining factor. For example, in 1973, a zero rate or discount yields a break-even percentage (Q) of .0385. The actual percentage reduction in economic loss (.0375) does not meet this level, whereas with a four percent discount rate, the actual percentage reduction in loss is greater than the rate of return necessary for the ASAP to break even (.0371). Therefore, in some years, such as 1974 for example, one might want to define a range for Q and observe if the percentage decrease in economic loss is outside of this range. In 1974 with a 0 discount rate, Q equals .0333 and with a 10% discount rate Q equals .0275. The actual decrease in loss is .0485 and this falls outside of the .0275 - .0333 range (on the high side); therefore, the break-even rate is met. By defining realistic ranges, one can possibly place an increased amount of confidence in the results of the analysis.

CHAPTER IX

CONTINGENCY ANALYSIS

The trend analysis used in Chapter VII is one statistical technique which will assist in the ASAP evaluation. However, this technique is applicable only when a sufficient number of baseline observations for one locale are available. A contingency design might be more appropriate for Henrico and Fairfax County accident statistics referring to the baseline and project years.

The null hypothesis (H_0) to be tested is that the probabilities of being killed in an automobile accident are identically distributed between the sample populations (pre-ASAP and ASAP). The appropriate contingency analysis design with one degree of freedom is:[53]

	Pre-ASAP	ASAP	
Fairfax County	a	b	a + b
Henrico County	c	d	c + d
	a + c	b + d	n

where $n = a + b + c + d$ and $k = (a + b)(c + d)(a + c)(b + d)$

$$x^2 = \frac{n(|ad - bc|)^2}{k}$$

In the case of fatalities, if b is less than expected (as defined by comparison with the control site), one possible explanation is that this discrepancy is due to the ASAP. A contingency analysis should be applied only when it can be assumed that the probability of a motorist being involved in a fatal accident is not significantly different between pre-ASAP locales.

If the null hypothesis is rejected, the ASAP may not necessarily be the cause. Only to the extent that the previous assumption is satisfied and documented can the ASAP be supported as the reason for rejecting the null hypothesis. An example application of contingency analysis follows. The pre-ASAP fatality figures were supplied by the Virginia State Police while the ASAP figures are hypothetical.

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[53] Bernard Ostle, Statistics in Research, The Iowa State University Press, Ames, Iowa, 1963, p. 131.

	Pre-ASAP 1969-1971 Fatalities	ASAP 1972-1974 Fatalities	
Fairfax County	221	240	461
Henrico County	69	90	159
	290	330	620

$$X^2 = \frac{620 \ (\ 19890 - 16560\ )^2}{7014714300} = .9801$$

The X^2 value for one degree at a 90% level of confidence = .0158.

From the above results, the H_0 that the probabilities of being killed in an automobile accident are identically distributed before and after ASAP in both areas is rejected. Obviously, this analysis in isolation cannot indicate whether or not the ASAP is an unqualified success. The possible causes of a decrease in the number of Fairfax County fatalities must be identified. For example, new laws requiring more stringent safety standards in automobile construction or a more effective emergency medical service team, or more miles travelled per year, could affect the fatalities. For a complete project evaluation, all clues of ASAP's success should be systematically considered and subjectively weighed by the decision maker.

CHAPTER X

ROADSIDE SURVEY ANALYSIS

The distribution of motorists' blood alcohol contents (BACs) is a useful indicator of the ASAP's effectiveness. A significant shift in the BAC distribution of ASAP area drivers might signify a change in the probability of occurrence of an alcohol-related accident. Such shifts are quite difficult to infer from the results of the previous methods of analysis. Although one cannot assign a dollar figure to a shift in the BAC distribution, any shift must be analyzed and brought to the decision maker's attention.

A. Methodology

Several tests can be performed on the roadside survey data. Initially, the BAC readings should be arrayed into frequency distributions. The first statistical test utilizing roadside survey results asks the question:

> Given an observed difference between the means
> of the positive BAC levels for the baseline and the
> following year, does this observed difference signify
> a real difference between the true BAC means of the
> drinking-driving population in the baseline year and
> the drinking-driving population in the following year?

The population consists of ASAP area residents who drink and drive during the baseline and following years. If one assumes that these populations are coincident upon the ASAP area and do not change significantly over time, a significant difference between BAC means might indicate a drinking-driving behavior change. However, the exact nature of this change must be examined. It is possible that between two time periods the distribution of positive BAC readings could change while the means remain the same. A conclusion that the ASAP area residents' drinking-driving behavior did not change would not be accurate. The decision maker will have to consider the results of this test as a gross indicator of behavior change. The cause of any drinking-driving behavior change is difficult to identify. It is virtually impossible to link specific ASAP countermeasure efforts (such as an increased media campaign) to reductions in accident statistics.

Nevertheless, tests for the difference in BAC means can be applied to each annual roadside survey. By comparing the BAC means between the first and third years, as well as successive years, the time during which a behavioral change occurs might be identified.

After determining whether the sample means indicate whether or not the true means differ significantly, the analyst, with a specified degree of confidence, can calculate an interval within which both population BAC means lie. This will provide the decision maker with an intuitive range of the expected shift in the mean of the positive BAC readings.

The methodology to be applied follows:

1. The number of survey sample items, n_1 and n_2, will be identified. The sample means ($\overline{X}_1$ and $\overline{X}_2$) and the sample standard deviation (s_1 and s_2) will be calculated.

2. The null hypothesis, H_0, that no difference exists in the average positive BAC levels for the two populations, P_b and P_i, will be constructed.

3. An acceptable percentage by which the difference in sample means could have been caused by chance alone will be chosen.

4. H_0 will be accepted if the calculations yield a figure less than the specified level of significance.

5. If H_0 is rejected, the actual difference in means with a 95% level of confidence will be determined:

   (a) The standard error will be multiplied by the number (1.96) associated with a normal distribution two-tailed test.

   (b) $\overline{X}_1$ and $\overline{X}_2$ will be calculated and a surrounding interval will be defined with the number in (a).

Closely related to the comparison of mean BAC levels is the statistical comparison of BAC distributions. As mentioned previously, a mean BAC figure does not adequately specify the changes in behavior which the evaluation is attempting to identify. By applying the chi-square test to two BAC frequency distributions, one can discern whether the present distribution approximates the baseline distribution. When the results of a chi-square test are used in conjunction with other statistical techniques, useful conclusions can be made. For example, if the mean BAC level drops between periods one and two, and if the distributions are significantly different, then one might conclude a significant change in drinking and driving behavior has occurred. Conversely, if the mean BAC level remains the same over two time periods, a high chi-square value might suggest a change in behavior which would not have been detected by a mere comparison of sample means.

The previous discussion related only to the positive BAC readings. One secondary ASAP objective is to reduce the ASAP area drinking-driving population. Therefore, it is useful to know whether an observed change in the percentage of motorists who drive with positive BAC levels is significant.

During the baseline roadside survey 462 out of 1,578 subjects registered positive BAC readings. With future survey results, it can be determined whether a change in the number of positive readings is significant and not due to chance alone. The previously discussed techniques will be demonstrated in the following examples.

B. An Example

In order to apply the previous techniques, one must construct a hypothetical distribution of BAC levels. It is assumed that the hypothetical data were collected after the first survey. The hypothetical and actual roadside survey BAC frequency distributions (positive readings only) are:

BAC reading interval	First Survey (baseline)	Hypothetical Survey
.01 - .04	293	386
.05 - .09	101	75
.10 - .14	44	20
.15 - .19	18	15
.20 - .24	5	20
.25 +	1	15
n =	462	531

For each survey, the following information is necessary. (The interval midpoints .02, .07, .12, .17, .22, and .27 were used in calculation of the means.)

	First Survey	Hypothetical Survey
Number of respondents	$n_1 = .462$	$n_2 = 531$
Mean	$\overline{X}_1 = .048$	$\overline{X}_2 = .050$
Standard deviation of sample	$S_1 = .046$	$S_2 = .062$
Standard error of the mean	$S_{\overline{X}1} = .0021$	$S_{\overline{X}2} = .0027$

If one wants to test whether there exists a significant difference between the means of these positive readings he can proceed as follows.

The standard error of the difference between the means is

$$S_{\overline{X}1} - S_{\overline{X}2} = \sqrt{(.0021)^2 + (.0027)^2} = .0033$$

and

$$\frac{\overline{X}_1 - \overline{X}_2}{S_{\overline{X}1} - S_{\overline{X}2}} = \frac{.002}{.0033} = .6060 \text{ standard errors}$$

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With this result, one cannot reject the null hypothesis that no difference exists between the mean BAC levels of the two samples. He can estimate, however, that the true difference between the population means lies within the interval:

$$.002 \pm 1.96 \ x \ .0033 = .008 \ and -.004$$

and hold a 95% degree of confidence that this is correct.

However, the means of the positive BAC readings are not the only indicators of a change in drinking and driving behavior that are useful. One must further examine the percentage of the total number of respondents who were not drinking and the BAC levels of those who were drinking.

In the first survey, 29% (i.e., 462 of 1,578) persons were drinking. In the hypothetical survey, 24% (i.e., 531 of 2,200) were drinking. So, although the mean BAC level is greater in the hypothetical sample, the percentage of persons drinking is less in the hypothetical sample than in the first survey. Unfortunately, one still cannot make a clear choice as to which behavior is preferred; the lower average positive BAC but higher percentage of motorists drinking, or the higher average positive BAC but lower percentage of drinking drivers.

Intuitively speaking, a comparison of the percentages of motorists stopped who fall within each BAC interval might be useful. If there is a redistribution from lower to higher readings, this might help to decide whether an improvement in drinking and driving behavior has occurred.

Each interval total (denoted as a percentage of the respective survey sample) and the percentage point changes between the first and hypothetical surveys are shown in Table 5.

TABLE 5

HYPOTHESIZED CHANGES IN BAC DISTRIBUTIONS

BAC Reading Interval	First Survey	Hypothetical Survey	Percentage Point Change
.01 – .04	63.4	72.7	+ 9.3
.05 – .09	21.9	14.1	– 7.8
.10 – .14	9.5	3.8	– 5.7
.15 – .19	3.9	2.8	– 1.1
.20 – .24	1.1	3.8	+ 2.7
.25 – Up	0.2	2.8	+ 2.6

The hypothetical readings have polarized over time to the higher and lower levels. If one is attempting to devise a scheme of preferredness between the behaviors reflected in the survey results, a subjective judgment must be made. It is not clear which distribution might be preferred, especially with the knowledge that the percentage of motorists who drink and drive declines (from 29% to 24%).

A chi-square test supports the intuitive conclusion that the distributions are significantly different and not drawn from the same population. This test can always be applied to frequency distributions when any doubt as to the reason for their difference arises (that is, whether or not this difference is due to chance alone).
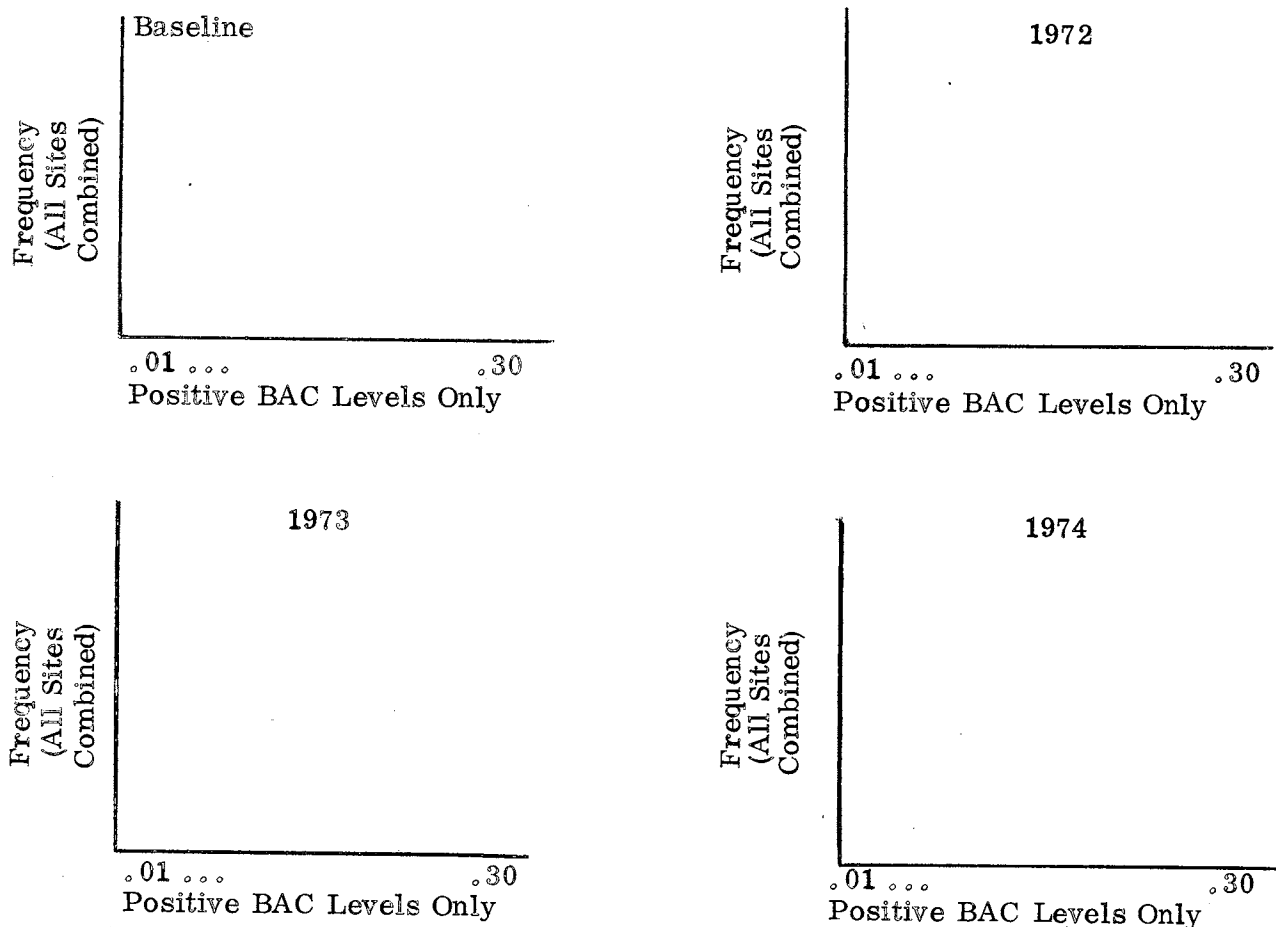
Tables 6 and 7 under the heading following can be completed over the three-year project in order to help conclude whether or not the drinking and driving behavior of ASAP area residents changes.

C. Roadside Survey Tables

TABLE 6

ROADSIDE SURVEY POSITIVE MEAN BAC LEVELS

Baseline

Frequency (All Sites Combined)

.01 ... .30
Positive BAC Levels Only

1972

Frequency (All Sites Combined)

.01 ... .30
Positive BAC Levels Only

1973

Frequency (All Sites Combined)

.01 ... .30
Positive BAC Levels Only

1974

Frequency (All Sites Combined)

.01 ... .30
Positive BAC Levels Only

Analysis Results

Surveys Analyzed	H_0 Rejected?
Baseline X 1972	
Baseline X 1973	
Baseline X 1974	

Note: The time interval during which the drinking-driving behavior changes will be identified. For example, if H_0 is accepted for Baseline X 1972 and Baseline X 1973, but rejected for Baseline X 1974, then 1972 X 1974 and 1973 X 1974 will be tested. The point at which H_0 is rejected might indicate a change in the behavior of those who drink and drive.

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TABLE 7

OBSERVED BACS OF ROADSIDE SURVEY SUBJECTS

Observed Percentage of Roadside Survey Subjects With a Positive BAC Reading

	Sample Size	Number .15% BAC	% of Sample Size	95% Confidence Interval Boundaries	Increase in % BAC	Decrease in % BAC	Is Change Significant ?
Baseline							
1972							
1972 x Baseline							
1973							
1973 x Baseline							
1973 x 1972							
1974							
1974 x Baseline							
1974 x 1972							
1974 x 1973							

Observed Percentage of Subjects With a BAC Reading $> .15\%$ (or $.10\%$)

	Sample Size	Number .15% BAC	% of Sample Size	95% Confidence Interval Boundaries	Increase in % BAC	Decrease in % BAC	Is Change Significant?
Baseline							
1972							
1972 x Baseline							
1973							
1973 x Baseline							
1973 x 1972							
1974							
1974 x Baseline							
1974 x 1972							
1974 x 1973							

CHAPTER XI

ATTITUDE SURVEY ANALYSIS

Responses to selected questions on the attitude (household) surveys are possible indicators of the effectiveness of the ASAP media campaigns and public education efforts. Shifts in the frequency distributions of these responses between two time periods might signify a change in public opinion. By comparing the answers of ASAP area citizens to the answers of the non-ASAP exposed Henrico County control group, one can further investigate the possibility of changes in public attitudes. Furthermore, differences in the response frequency distribution of annual and baseline surveys in Fairfax County are expected. As with other research methods used throughout this study, observed shifts in frequency distributions do not necessarily denote a significant shift in public attitude. Additionally, significant attitude changes cannot always be attributed solely to the ASAP. Nevertheless, these attitude changes must be identified and examined.

A. Methodology

A chi-square test of significance will be applied to the response frequency distributions of ten questions. For each question, the answer distributions from two surveys will be compared. These surveys may be either successive ASAP area surveys or surveys completed in Fairfax and Henrico Counties during the same time periods. With a specified degree of confidence, this test will answer the question:

Are the response distributions significantly different, and is this observed difference not due to chance alone?

If a significant difference exists, then the centralization of answers to the target (desired or correct) answer will be observed. For some questions, although the two answer distributions might differ significantly, a tendency toward the target answer might not occur. Consequently, the target answer, the percentage point change, and the direction of this change (increase or decrease) will be noted. By recording these changes for successive time periods, it may be possible to roughly indicate the magnitude of the attitude change, and the time periods within which the change occurs. However, as discussed previously, it is difficult to price these attitude changes and, consequently, they will have to be subjectively weighed by the decision maker.

One chi-square test requirement is that the expected number of observations in each cell exceed five. Those cells which do not meet this requirement will be either excluded from the analysis or combined with other cells. Implicit in this restraint is the assumption that a category in the first survey with less than five responses is not the target (desired or correct) answer, and that this category frequency will not increase in the future to the point that it alone determines the difference between two frequency distributions.

The ten questions, a discussion of their importance, and the target category follow. A sample of the survey questionnaire follows this discussion.

Question Number	Discussion
1	Recognition of the problem. Expect target category five to increase.
2	Type of drinker who contributes most to the problem. Expect category two to increase.
3	The extent of the problem. Expect categories four, five and six to increase. Because of the small number of responses within each category, the eleven answer categories might have to be combined and reduced to five or six.
4	Consequences of illegal behavior. Expect category one to increase.
6	Legal definition of illegal behavior. Expect category four to increase. (This question will be difficult to analyze because the presumptive level of intoxication was lowered in July 1972.)
9	Awareness of the ASAP. Expect category one to increase.
12	Desirability of behavior change methods. Since each category has three possible answers, values could be assigned to each answer so as to assign one number to each category.
26	Change in drinking-driving behavior. Expect categories one through four to increase.
29 (a)	Reasons for refusal to drive. Expect category two to increase.
30 (b)	Perception of illegal behavior detection. Expect categories one, two, and three to increase.

An example of the chi-square test follows. Sample B is a hypothetical frequency distribution.

B. An Example

For attitude survey question number one, the answer frequency distributions for two surveys are:

Answer Category (Question 1)	Sample A Baseline Frequency	Sample B Hypothetical Frequency
1	13	10
4	107	90
5	147	170
6	142	60
0	72	20

Answer category 5 is the target answer. It is expected to change in the positive direction (increase).

	Answer Categories					Row Totals (R)
	1	4	5	6	0	
Sample A	13	107	147	142	72	481
Sample B	10	90	170	60	20	350
Column Totals (C)	23	197	317	202	92	831 = N

Category Frequencies (O)	$\dfrac{R \times C}{N} = E$	$O - E = D$	D^2	$\dfrac{D^2}{E}$
13	13.31	.31	.096	.007
107	114.02	7.02	49.280	.432
147	183.48	36.48	1,330.790	7.253
142	116.92	25.08	629.006	5.379
72	53.25	18.75	351.562	5.602
10	9.68	.32	.102	.010
90	82.97	7.03	49.420	.595
170	132.51	36.49	1,331.504	9.973
60	85.07	25.07	628.504	7.388
20	38.74	18.74	351.187	9.065

$$X^2 = 46.704$$

Degrees of freedom (DOF) = 4.

For this example, the table at the end of this chapter would read:

Surveys Compared	Significant Difference at 95% Level	Degrees of Freedom	Expected Direction of Target Category Change	Direction of and Percentage Points Change in Target Category
Baseline x Hypothetical	Yes	4	+	+% = 48.5 − 30.5 = 18

where 48.5 and 30.5 are the number of answer category 5 responses divided by the total number of responses to question number one in the hypothetical and baseline surveys respectively.

Given a change in the answer frequency distributions, the decision maker must:

1. Decide what percentage change in the target category signifies a significant change.

2. Decide how much of this change is possibly attributable to the ASAP.

3. Subjectively value the public attitude change.

Other evaluation materials and information must be used in making the above three decisions. For example, where single answer categories of the Fairfax and Henrico answer distributions are being compared, a contingency analysis design might be appropriate.

C. Sample Survey Questionnaire

ASAP HOUSEHOLD ATTITUDE SURVEY
(selected questions)

1. Which one of these do you feel causes the greatest number of automobile accidents ? Just read me the number. (Hand respondent card A with following answers.)

    1. Unsafe highways or streets
    2. Failure to enforce laws
    3. Poor traffic laws
    4. Driving too fast
TARGET→5. Driving under the influence of alcohol

6. Disregard for traffic regulations by drivers
7. Disregard for traffic regulations by pedestrians
8. Drivers and pedestrians who don't know the traffic regulations
9. Something wrong with cars
0. Drivers who handle a car poorly

2. Would you guess that more fatal accidents are caused by the many social drinkers (people that occasionally drink too much) or by the smaller number of problem drinkers (people who frequently drink a great deal) ?

1. SOCIAL DRINKERS
TARGET→2. PROBLEM DRINKERS
3. OTHER (specify) _____
4. NO OPINION

3. Out of every 10 traffic deaths, how many would you say are caused by drinking drivers ?

01 ONE	07 SEVEN
02 TWO	08 EIGHT
03 THREE	09 NINE
04 FOUR	10 TEN
TARGET→ 05 FIVE	11 NO OPINION
06 SIX	

4. As you understand it, what is the penalty for this state for driving while intoxicated ?

TARGET→1. PENALTY STATED CORRECT
2. PENALTY LESS SEVERE
3. PENALTY MORE SEVERE THAN ACTUAL PENALTY

6. The Blood Alcohol Concentration is based on a chemical test, such as a breath test, and is used to determine if a person is legally drunk or intoxicated. Which of these do you understand is the legal definition of being drunk in this state? (Hand respondent card B with following answers.)

1. ANY TRACE
2. .05%
3. .08%
TARGET 4. .10%
5. .12%
→6. .15%
7. .20%
8. DON'T KNOW

9. Have you read or heard of a campaign or program that would reduce alcohol-related traffic deaths?

TARGET→1. YES
2. NO (if NO, skip to Question 12)

12. How effective do you think each of the following methods would be in reducing the drinking-driving problem? Just give me the number on this card. (Hand respondent card D with effectiveness ratings.)

    a. Greater police enforcement of drunk driving laws   _____

    b. A large-scale public information and education campaign.   _____

    c. Improved treatment services for problem drinkers   _____

    d. More severe penalties for convicted drunken drivers   _____

    e. Having convicted drunken drivers use a pill which causes them to be sick if they drink alcohol   _____

    f. Special alcohol-education courses for convicted drunken drivers   _____

    g. Police using random road checks to find drivers who have been drinking   _____

26. How much is the most you will drink and continue to drive?

TARGET →
1. ONE DRINK
2. TWO DRINKS
3. THREE DRINKS
4. FOUR DRINKS
5. FIVE DRINKS
6. SIX DRINKS
7. SEVEN DRINKS
8. EIGHT DRINKS
9. NINE DRINKS
0. TEN OR MORE DRINKS

29a. If the answer to Question 29 was YES, was the refusal to drive because of:

1. Knowledge of laws
2. Fear of arrest
3. Fear of accident

30b. If you drive after drinking too much, what are your chances of being stopped by the police?

TARGET →
1. VERY HIGH
2. HIGH
3. ABOUT EVEN (50-50)
4. LOW
5. VERY LOW
6. DON'T KNOW

D. Attitude Survey Data and Tables

The target question response frequencies for the Fairfax County baseline attitude survey are listed in Table 8. By completing Tables 8 and 9, the decision maker might be better able to detect those areas in which significant attitude changes have occurred.

TABLE 8

TARGET QUESTION RESPONSE FREQUENCIES

Question	Answer Category	Response Frequency
1	1	13
	2	7
	3	3
	*4	107
	*5	147 ◄——————— Target
	*6	142
	7	1
	8	4
	9	1
	*0	72

*Might compare only these categories

2	1	285
	2	179 ◄——————— Target
	3	18
	4	18

3	1	16
	2	27
	3	72
	4	80 ⎫
	5	128 ⎬ ◄——————— Target
	6	64 ⎭
	7	41
	8	28
	*9	4
	*0	1
	X	39

*Might exclude these categories

4	1	41 ◄——————— Target
	2	300
	3	53

TABLE 8 (continued)

Question	Answer Category	Response Frequency
6	1	9
	2	83
	3	76
	4	69 ⟵ Target after July, 1972
	5	48
	6	58
	7	13
	8	144
9	1	236 ⟵ Target
	2	262
12	a	257-200-41-2
	b	184-224-90-2
	c	209-200-89-2
	d	287-149-62-2
	e	96- 92-300-2
	f	152-254-92-2
	g	145-221-132-2
	h	258-111-129-2
26	1	31 } ⟵ Target
	2	49
	3	50
	4	28
	5	24
	6	10
	7	2
	8	3
	9	2
	0	9
29 (a)	1	10
	2	6 Target
	3	111
30 (b)	1	42 } ⟵ Target
	2	101
	3	166
	4	94
	5	63
	6	34

(Source: Tom Smith)

For each question's answer distribution Table 9 will be completed.
This table where the percentage change is weighed by the respective total sample
sizes, can also be used for a comparison of Henrico and Fairfax County surveys.

TABLE 9

CHANGES IN TARGET CATEGORY RESPONSES

Surveys Compared	Significant Difference at 95% Level?	Degrees of Freedom	Expected Direction of Target Category Change	Direction of and Percentage Points Change in Target Category
Baseline x 1972				
Baseline x 1973				
Baseline x 1974				
1972 x 1973				
1972 x 1974				
1973 x 1974				

Key: + = increase, - = decrease

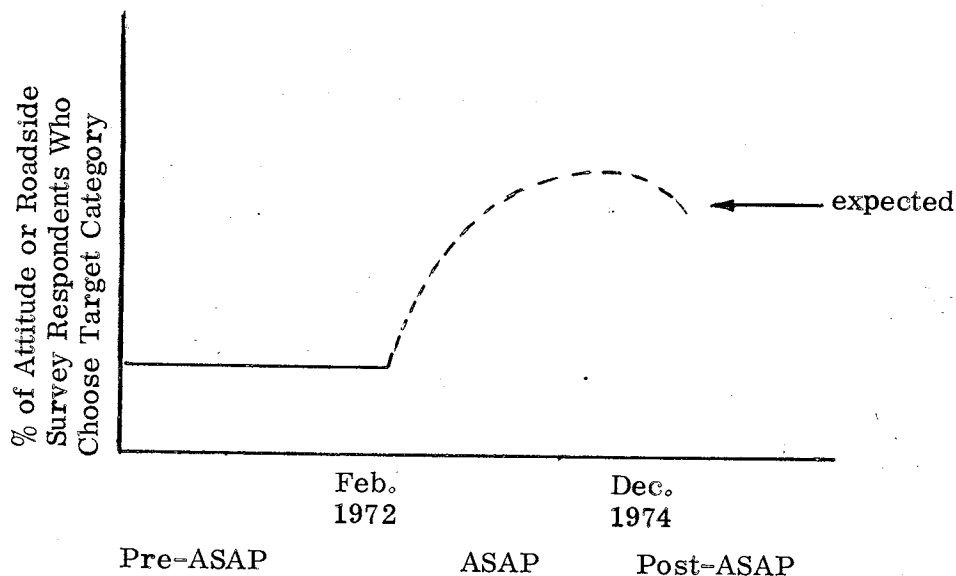Figure 1 will be completed for each core question target category.

Figure 1. Plot of respondents choosing target category.

CHAPTER XII

MOBILE VAN ANALYSIS

As mentioned previously, the internal efficiency of the ASAP is <u>not</u> a criterion that will be used for program success. It is quite possible that an unsuccessful program could be efficient. However, if the ASAP is not deemed to be an overall success, certain portions of the project might be worth funding in the future. The mobile breath and blood testing vans are an example.

A rough estimation of the priceable costs and benefits arising from the use of the mobile van is one indicator of internal project efficiency which is of interest to the decision maker. In the absence of an ASAP program, the mobile blood testing vans may still be useful. Consequently, a break-even driving while under the influence (DWI) arrest analysis will be performed. This analysis should suggest the approximate number of monthly DWI arrests necessary for the van to be "paying for itself."

However, this analysis is limited for the following reasons. First, the priceable benefits consist only of the officer's time savings. Those benefits accruing to the public from reducing the drunken driving population are not taken into account. Such benefits must be subjectively considered since they cannot be priced. Second, the method of analysis will have to be altered when the purchased vans are put into use on the project. The rent per month is now the best estimate available for the monthly cost of the van. Break-even arrest rates will be calculated for the vans under the present rental system and for the future use of ASAP-purchased vans.

Furthermore, this analysis assumes that:

1. There exist non-priceable van use benefits, such as an increased inclination by the police to arrest drunken drivers, or an increased public security attributable to more surveillance hours.

2. Blood test costs are excluded from this design since the test is administered in all DWI cases where the defendant does not refuse. That is, in the absence of an ASAP, this cost would still be incurred by the police department.

3. The three-year ASAP time horizon will not be extended.

4. The mobile vans are sold after three years for fifty percent of their original cost.

5. The observed difference in DWI arrest time between pre- and present ASAP is attributable to a decrease in transport, paperwork, and waiting time.

6.   One policeman handles each DWI case.

7.   Two mobile breath and blood testing vans are used.

8.   One medical technician is assigned to each van.

A.   Present Mobile Van Operating Costs

For the first quarter of 1972 (February and March only), this priceable cost is easily estimated by the following procedure:

2 vans x $1,125 van rental fee x 2 months + 7.5 cents maintenance per mile x 8,124 miles + 2 medical technicians x $4 per hour x 9 hours per day x 59 days + 2 months x $100 intoximeter rental per month x 2 machines = $9,758

The $9,758 total is the operating cost of two vans for two months.

The February and March mileage for the two vans was as shown in Table 10.

TABLE 10

FEBRUARY AND MARCH MILEAGE FOR VANS

Month and Day		Mileage (2 Vans)
February	1 – 13	1,600 (estimate)
	14 – 20	937
	21 – 27	1,050
March	28 – 5	979
	6 – 12	844
	13 – 19	965
	20 – 26	834
April	27 – 2	915
		8,124 (Total)

B.   Benefits per DWI Arrest

The priceable benefits accruing to the ASAP project per van-use DWI arrest consist solely of police time savings. For each use of the van, the benefits (time savings) can be roughly estimated as:

4 hours (DWI arrest time without van) x $5.50 per hour (non-ASAP officer wage rate) x 1 officer – (1 hour mobile van arrest time x $5.50 per hour non-ASAP officer wage rate) x .65 (the percentage of arrests by non-ASAP officers) x 1 officer + 1 hour mobile van arrest time x $6.50 per hour (ASAP officer wage rate) x .35 x 1 officer) = $16.16.

C. Number of Van Use Arrests Necessary to Break Even

In order for the mobile van to "pay for itself" in the business vernacular, the two-month operating cost of the van divided by the benefit per arrest yields the break-even number of arrests.

For the Febraury-March period, this break-even level is approximately:

$$\frac{\$\ 9,758}{\$16.16} = 604 \text{ for 2 months}$$

This is roughly 302 uses of each van per month. During the first quarter, the van was used 160 times in February and 253 times in March. The value of the police time saving arising from these DWI arrests was:

$$(253 + 160) \times \$16.16 = \$6,674$$

In the first quarter, the priceable costs of the van exceed the priceable benefits by:

$$\$9,758 - \$6,674 = \$3,084$$

However, one should not conclude that the mobile vans have not been worthwhile. Numberous non-priceable or intangible benefits can arise from the use of these vans and when the newly purchased vans are delivered, the cost of the van per month will be less than the present rental fee of $1,125. The monthly cost of the new vans will now be traced.

D. Mobile Van Operating Costs (New Vans)

With the exception of two cost components, the operating costs of a new van are the same as for a rented van. Instead of a $1,125 per month per van rental fee, one must now consider the total cost of a new van and equipment and allocate this cost over the three-year project. An intoximeter will now be bought rather than rented. Assuming a 50 percent depreciation over the life of the project, the cost of two vans per month is:

2 vans x $29,500 van cost + $5,150 removable equipment[54]
- $29,500 van cost x (1 - .50) (depreciation rate) divided by
36 months = $1,106

or $2,212 for two vans for two months. Now one must add the other unchanged components of operating costs. These are $610 maintenance and $4,248 wages for medical technicians. The two-months operating cost for two vans is $7,070.

54/ This includes a $2,750 intoximeter, a $200 typewriter, a $2,000 camera and
    video set, and a $200 table.

E. Number of Van Use Arrests Necessary to Break Even

If the Fairfax ASAP had owned mobile vans during the first quarter of the project, the priceable costs would have exceeded the priceable benefits by:

$$\$7,070 - \$6,674 = \$396$$

In the future, the break-even number of uses of the van per month should be:

$$\frac{\$\ 7,070}{\$16.16\ x\ \ 2\ months} = 219\ arrests\ per\ month.$$

During the first four months of the project, this figure (219) was exceeded once:

Month	Arrests Using Either Van
February	160
March	253
April	190
May	210

F. Summary

This analysis suggests that in terms of priceable costs and benefits, the mobile vans will be paying for themselves if they are used more than 219 times per month. The average for the March-April-May period was 217.6. Given the uncertainties of some of these estimates, the van would have been paying for itself over the last three months if it had been owned by ASAP. However, this assumes that the vans will depreciate 50 percent in three years. Furthermore, this analysis does not account for the time cost of money, the tax savings on different methods of depreciation, or the non-priceable benefits. The priceable benefits arise from the time savings of police man-hours.

A sensitivity analysis follows. By changing certain assumptions, one can possibly approximate a more realistic break-even rate of arrests per month.

G. Sensitivity of Break-Even DWI Arrest Rate to Assumption Changes

1. Assume that the mobile vans depreciate .25 rather than .50 over the three-year project. Then:

Benefits = $16.16 per arrest
Cost   = $3,125 (2 vans, 1 month)

Break-even arrest rate = 193 per month for 2 vans.

2. Assume that all officers are paid at the rate of $6.50 per hour, rather than non-ASAP officers at $5.50 per hour and ASAP officers at $6.50 per hour. Then:

Benefits = $19.50 per arrest
Costs = $3,535 (2 vans, 1 month)

Break-even arrest rate = 181 per month for 2 vans.

3. Combine changes outlined in 1 and 2.

Benefits = $19.50 per arrest
Costs = $3,125 (2 vans, 1 month)

Break-even arrest rate = 160 per month for 2 vans.

This analysis seems to incorporate the most realistic assumptions. The changes in arrest rates with changes in assumptions are given in Table 11.

TABLE 11

CHANGES IN ARREST RATES CORRESPONDING TO ASSUMPTIONS CHANGES

Assumption Change	Original Rate	New Rate	% Decrease in Break-Even Rate
1	219	193	12
2	219	181	18
3	219	160	27

Obviously, the depreciation rate used over the three-year project and the policemen's wages are variables which significantly affect the break-even DWI arrest rate. Again, there are major uncertainties in many of these estimates and, therefore, special care should be used in applying these estimates to project decisions.

CHAPTER XIII

CONCLUSION

This cost-benefit study has attempted to systematically identify and value, wherever possible, the inputs and outputs of the Fairfax Alcohol Safety Action Project. This task has been extremely difficult because one can only speculate as to the human behavior that has been altered as a result of the project. Furthermore, the numerical estimates and prices assigned to this change are quite uncertain. These uncertainties must be realistically considered in an appraisal of the entire project. Nevertheless, a systematic approach to the evaluation of the project's costs and benefits is an improvement over previous efforts. Perhaps this study's main influence will be to force the consideration of intangible and non-priceable costs and benefits.

Gross indicators or clues as to whether the ASAP is functioning properly are, in many cases, the best tools available for project evaluation. Economic analysis is not a refined discipline that can unequivocally detect and value changes in human behavior. Therefore, an engineering approach rather than economic approach was used in the second half of this study. To assist the decision maker, the author has offered examples of applications of these engineering techniques.

Finally, intuition and common sense have been helpful in the construction of these evaluation methods. These methods are, however, only one tool for evaluating the ASAP. Due to the limitations of cost-benefit analysis and the uncertainties of the estimates used, subjective judgment tempered by the decision maker's firsthand observation of the project's functioning may be the key to a realistic appraisal of the Fairfax Alcohol Safety Action Project.

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