To the Graduate Council:

I am submitting herewith a thesis written by Thomas E. Ragland entitled " A Methodology for Evaluating the Effectiveness of Highway Safety Program Standards." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Civil Engineering.

William A. Goodwin, Major Professor

We have read this thesis
and recommend its acceptance:

Accepted for the Council:

Vice Chancellor
Graduate Studies and Research

A METHODOLOGY FOR EVALUATING THE EFFECTIVENESS OF HIGHWAY SAFETY PROGRAM STANDARDS

A Thesis

Presented for the

Master of Science

Degree

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Thomas E. Ragland

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ABSTRACT

This investigation searched for evaluation techniques applicable to the National Highway Traffic Safety Administration's 18 Highway Safety Program Standards. The problem was attacked from the viewpoint that much can be learned from evaluation principles used in other public social action programs.

An extensive review of literature was conducted on the subjects of evaluation, evaluative research, countermeasures, measures of effectiveness, and methodologies of accident prevention to provide a broad base for the selection of evaluation techniques for optimization of highway safety program standards.

Evaluation techniques based upon this review of literature were used to critique the evaluation procedures as set out in the Final Report on Criteria for Program Evaluation--Highway Safety Standards by William A. Goodwin, submitted to the Highway Safety Planning Division, Office of Urban and Federal Affairs, State of Tennessee.

Levels I and II of Goodwin's program review were found to be adequate and feasible. Level III needed a more detailed set of criteria established on more finite measurements of effectiveness. Recommendations were made to expand

this level of evaluation. A general model was proposed for Level III, encompassing four dimensions for establishing criteria of process. Examples of each dimensional model were given to show their application to selected highway safety program standards.

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CHAPTER I

INTRODUCTION

A. STATEMENT OF THE PROBLEM

President Lyndon B. Johnson upon signing the Highway Safety Act of 1966 into law on September 9, 1966 remarked, "Through the Highway Safety Act, we are going to find out more about highway disease--and we are going to find out how to cure it . . . the Highway Safety Act will set up a national framework for the State safety programs" (U.S., Superintendent of Documents, 1966, p. 1255).

Pursuant to this legislation, the National Highway Traffic Safety Administration and the Federal Highway Administration under the auspices of the Department of Transportation issued 18 highway safety program standards (countermeasures) which serve as guidelines for statewide highway safety program implementation. The 1966 Act required that each state develop and submit for review and approval a five-year Comprehensive Plan, implemented through an Annual Work Program, as a planning guide to program development.

This accelerated and badly needed national emphasis on highway safety has created an enlarging expenditure of

governmental funds at all levels. Tennessee's Highway Safety Annual Work Program for fiscal year 1974 shows the disposition of over $5 million from all sources.

As in any Federally-supported program, the public, legislators, and professionals in the related field demand and should expect concrete evidence of sound continuous evaluative procedures. Each standard must "be periodically evaluated by the State for its effectiveness in terms of reductions in accidents and their end results, and the National Highway Safety Bureau shall be provided with an evaluation summary" (See Appendix, p. 69). (Until March 1970, the National Highway Safety Bureau [NHSB] was one of the component agencies of the Federal Highway Administration. In the Highway Safety Act of 1970 the NHSB became the National Highway Traffic Safety Administration [NHTSA]).

In reply to this responsibility, Tennessee has addressed itself to the problem as follows:

> As traffic accidents are the fourth leading cause of death in the state, the countermeasures contained herein must be judged according to their effectiveness in alleviating this problem. Therefore, an evaluation system for the Highway Safety Program will be implemented in FY '74 that will provide feedback concerning program accomplishments which include the status of statewide compliance with the standards, and the effect of these standards on the accident and fatality rate. (State of Tennessee Annual Work Program, Fiscal Year 1974, p. ii)

Highway safety program evaluation contains many problems, most of which are common to evaluation procedures of other systems which are financed principally by public funds to alleviate a social malignancy. Public health, crime prevention and rehabilitation, welfare, and education are such areas which can be successfully explored for an understanding of sound evaluative techniques.

These type programs, however, are often victims of inherent inflationary biases which exist within the current state of the art. In highway safety, traffic fatality reporting is grossly overstated and exaggerated on holiday weekends with no explanation to the public regarding the influence of increased traffic volume. If the effect of traffic volume is recognized, the fatality rate is probably lower than on corresponding non-holidays. Likewise, our national figures on annual traffic fatalities, which are prominently reported in the mass media, are oftentimes uncorrected for vehicle-miles traveled and population increases. Of course, the officials who release such data realize that this pessimistic type of reporting is done. Why? Is it because they feel that "scare" tactics will cause the public to be more aware of the problem and therefore reduce accidents? Not necessarily! Such reporting by

the National Safety Council has been suggested to be due to a sort of "blackmail" by the mass media to obtain such information from other sources. The National Safety Council concedes being suspicious of the reliability of "other sources" (Bauer, 1966, p. 29). A major priority of an evaluator should be to bridge this harmful gap between the mass media and the professionals, because such divergent forces can be the death knell for the measurement of highway safety countermeasure effectiveness.

Another problem pertinent to demonstrating the effectiveness of programs about social improvement is that of human factors. People cannot be considered in the same context as other components of a system. The susceptability of human beings to factors such as overloading and fatigue, coupled with their ability for motivation, emotion, morality, and superstition seemingly defies accurate description and prediction. The environment of the immediate system is largely responsible for man's thoughts and actions, as well as the environment preceding and following his participation in the system. Human factors are also influential in the evaluative process as related to administrators, professionals, and the system participants.

Highway safety evaluation has two major factors which greatly deter its effective implementation. One is the apparent lack of available and useful statistical accident data from which objective evaluations can be ascertained. Necessary baseline data must be identified and its accurate collection and proficient analysis must be insured. The other major limitation is the difficulty in quantifying the relationships in a highly interactive setting. Methodologies must be developed to capture these dynamics. Simplistic approaches should be considered along with those of a highly reactive nature. Each countermeasure must be examined closely as to its stated objectives and desired effects to determine the evaluation methodology that will best serve the program.

The utopian result of such highway safety countermeasures would be a complete elimination of traffic accident fatalities, injuries, and property damage. Since utopian results cannot be achieved in our society, a technically sound, methodical, concerted effort should be reached to minimize the number of traffic accidents and their consequences. This minimization can be classified as a "reduction in ruin."

Evaluation techniques based on sound methodology are essential for the success of a program. Programs and projects must be formulated for an effective manner of highway safety standard implementation. The ongoing progress of a task can be monitored and then tested for its degree of compliance with its objective(s). Administrators need good evaluation formulae for establishing priorities due to the lack of unlimited funds being available. The legislators need good evaluation formulae for justifying their appropriations.

B. PURPOSE

The purpose of this study is to suggest a method for evaluating the overall effectiveness of statewide highway safety programs.

The successful performance of a highway safety program consists of activities to satisfy administrators, legislators, professionals, and the general public by reducing traffic injuries and property damage, investing in humans and institutions as valuable resources, using cost-benefit analysis and sound continuous evaluation as efficiency techniques, acquiring monetary resources, and doing all of this in a manner that conforms with the 18

highway safety countermeasures with desirable, feasible, and consistent rationale.

C. SCOPE

In accomplishing this purpose, an extensive review of literature on the subject of evaluation procedures was made to provide a background for the selection of a workable evaluation technique.

Most scholars in the field of evaluative research will agree that a major stepping stone in an evaluative process is the establishment of criteria for optimization. Tennessee's Highway Safety Annual Work Program suggests a hierarchy of program evaluation: Level I--task (project) performance; Level II--element (standard or countermeasure) compliance; Level III--program effectiveness. (State of Tennessee Annual Work Program, Fiscal Year 1974, p. II-15) Level III is under consideration in this study. The evaluation procedure described herein is aimed at the criteria of process utilizing (1) attributes of the program, (2) the population exposed, (3) situational context, and (4) effects of the program. Examples of each of these methods are given, showing their application to certain specific highway safety program standards. Sound evaluation will utilize criteria against which accomplishments may be effectively judged.

CHAPTER II

REVIEW OF LITERATURE

A. EVALUATION VS. EVALUATIVE RESEARCH

Evaluation and evaluative research are two terms which are oftentimes misunderstood and confused. Simply stated, evaluation refers to process while evaluative research refers to design of process.

Definitions of evaluation usually emphasize the positive aspects of the process of measuring values of achievement of goals. This inference is oftentimes unintentional but Riecken's definition clearly equalized this imbalance: "Evaluation is the measurement of desirable and undesirable consequences of an action that has been taken in order to forward some goal that we value [italics not in the original]" (1952, p. 4).

Suchman (1967, pp. 31-32) gave a comprehensive definition as follows:

> Evaluation is the determination (whether based on opinions, records, subjective or objective data) of the results (whether desirable or undesirable; transient or permanent; immediate or delayed) attained by some activity (whether a program, or part of a program, a drug or therapy, an on-going or one-shot approach) designed to accomplish some

> valued goal or objective (whether ultimate, intermediate, or immediate, effort or performance, long or short range) [italics not in the original].

Suchman's four dimensions are underlined above and defined as (1) process--the "determination," (2) criteria--the "results," (3) stimulus--the "activity," and (4) value--the "objective."

Suchman visualized evaluative research as a design of methodology which understandably demonstrates the validity of a stated bypothesis of a causal chain of events. "The verification of this evaluative hypothesis requires the design of a research project which would show that the desired effect was more likely to occur in the presence of the program being evaluated than in its absence" (Suchman, 1967, p. 84). McGlade and Abercrombie (1965, p. 482) believed that basic requirements for sound evaluative research include a specification of the stimuli which actively produce change and cause desired effect (causation research) and the establishment of criteria for the measurement of effectiveness (prevention research). Freeman and Sherwood (1965, p. 24) suggested using accountability, efficiency, and efficacy as primary guidelines in evaluation research.

There is a breach between the scientific community and the administrative community concerning the objectives of evaluation. Each group has a different interest in the evaluation procedure and its outcome. The administrator is usually more interested in a short-term study so he can make a quick decision having no interest in the scientific value which can be gained from a systematically operated evaluation. Naturally, the researcher is more in favor of producing a sound evaluation, with techniques being formulated and tested to further the "state of the art" in evaluative research. This leaves us with a wide avenue for compromise. As stated by Mann (1969, p. 13), "the better the study, the longer it takes, and consequently the less usefulness it may have. The sloppier the procedure, the more likely it is to provide information on questions of interest even though this data will be of doubtful validity." He suggested a narrow path of compromise utilizing the methodological requirements and the administrative limitations of scientific appraisal.

Scriven (1967, pp. 51-71) emphasized the relative importance of evaluative research along with evaluation. He classified the evaluation research role as "intrinsic evaluation" (self-appraisal) and the evaluation role as

"pay-off evaluation." Either role may be "formative" (intermediate) or "summative" (ultimate). Various approaches to the confusing issue of evaluation versus evaluative research were outlined by Johnson (1970, pp. 12-14). Zylman (1971, p.19) felt that the term "research," in this context, creates such a "hangup" that it should be deleted in future proposals and substituted by the term "evaluation."

B. HISTORICAL PERSPECTIVE

Evaluation of Public Service Programs

The growth of evaluation and evaluative research in public service programs has suspectingly paralleled the growth of the public service movement itself. Suchman (1967, pp. 12-14) stated that early public service development was characterized by a dependence upon "benevolent despotism" for its existance. This fact does not preclude the probability that trial-and-error evaluations occurred, however crude. Such evaluations were expectedly swayed in the direction and favor of such benefactors, but there existed a demand, ever so slight, for the public to receive a "success or failure" report. As early as the seventeenth century, public health vital statistics were employed as a basis for

program continuations or cessations. In the United States the concept of comparative ratings of various areas was developed in 1914. The critical demand for such self-appraisals was strongly evident only after World War I.

As far back as 1926, Syndenstricker (pp. 1-35) set forth principles of public service program evaluation, suggesting experimentation and use of "control" groups. One of the earliest examples of this evaluative research technique was Dodd's (1934) experiment of rural hygiene in Syria. He selected two Arab villages of relatively equal economic, historical, educational, and sanitary backgrounds. The inhabitants of only one of the villages were subjected to a two-year program of hygiene education and comparisons were made in the hygienic practices of the two villages.

In the 1930's Chapin was a forerunner in studying three types of experimental design in evaluative research concerning social problems:

> 1. A cross-sectional design which makes controlled observations for a single date.
>
> 2. A projected design of "before" and "after" study, in which an attempt is made to measure the effects at some future date of the social forces set in motion by some method of social treatment or by a social program, thus following through the flow of events from a present date to some future date.

> 3. An ex post facto design in which some present effect is traced backward to an assumed causal complex of factors or forces operating at a prior date, using for this purpose such records as are available, since no new measures of the past can be made in the present. (1955, p. 2)

Lewin (1946) was a social psychologist who attempted to merge the methods of social action and social theory, recognizing the importance of evaluation.

Since World War II, evaluative research has been extensively explored by several areas of social reform. Allport (1950) and Wispe (1951) conducted studies of evaluation of teaching methods. Scriven's (1967) contributions of evaluation theory was quite extensive in his study of curricula evaluation. He developed a classification of evaluative strategies with a suggestion of "mediated" evaluation.

Another field of exhaustive work was that of changing prejudicial attitudes toward minorities. Deutsch and Collins (1951) concentrated on the subject of interracial housing while Festinger and Kelley (1951) examined hostilities between housing project residents and the surrounding community.

Brooks (1965) and Marris and Rein (1967) evaluated "community action programs" as defined by the Economic

Opportunity Act of 1964. Both of these studies are steeped in evaluative research principles. Brooks' four functional reasons for evaluation are noteworthy:

> 1. The accounting function--To inform the funding agent (whether a foundation, the Congress of the United States, or perhaps even the American taxpayer) as to the value being received for dollars spent.
>
> 2. The feedback function--To refine and improve the program being evaluated, through a continuous feedback of its results to the planning process (planning. . .action. . .evaluation. . .planning. . . etc.).
>
> 3. The dissemination function--To make available to other interested communities, whether involved in community action programs or not, the results of the program being evaluated.
>
> 4. The theory-building function--To clarify, validate, disprove, modify or otherwise affect the body of theory from which the hypotheses underlying the program were derived. (p. 34)

The Marris and Rein report emphasized continuous and intermediate evaluation with causality theories.

A study in crime prevention by Powers and Witmer (1951) served as a landmark as stated by Gordon W. Allport in the forword: "The unique feature of this study was its determination from the beginning to measure its own success or failure. Perhaps never before in history has a social agency been created for the purpose of assessing its own goals" (pp. xv-xvi). Riecken's (1952) contribution to the

technique of pyschological evaluation of social action programs suggested nine requirements for the ideal design of a model for scientific evaluation.

The study of Meyer, Borgatta, and Jones (1965) concerned with the social casework service to vocational high school girls with potentially deviant behaviors, serves as a good example of prevention techniques. Suchman (1966) developed an applied evaluative model for the determination of the effectiveness of rehabilitation activities.

The field of evaluative research has been greatly advanced by Caro (1971) in a broad series of readings and references on the subject. Modern society places a strong demand upon public service developers and workers to act through well-planned action based upon sound principles. It expects such a program to serve as a base of knowledge for increased efficiency in future social action programs.

Evaluation of Highway Safety Programs

Expectedly, the evaluation of highway safety countermeasure programs has been explored in detail only since the passage of the Highway Safety Act of 1966. Before this legislation, the techniques of evaluation were based on value judgment rather than on scientific methods. A

cost-benefit analysis approach was applied by Recht (1966). Buxbaum and Colton (1968) compared motor vehicle death rates in states with and without motor vehicle inspection laws.

Hall and O'Day (1971) echoed the use of cost-effectiveness analysis for the project planning stage, but were not hopeful for the success of historical data analysis in evaluations after implementation. They recommended a causal chain approach.

Leininger (1969) suggested that a systematic approach to the evaluation problem be solved by use of a three model system: (1) effectiveness model--relating safety standards to crash incidence, (2) cost-analysis, and (3) allocation model--distributing funds on the basis of measurements of effectiveness and cost-analysis information.

Katz (1971) searched to find a common methodology for traffic safety measurement, drawing information from other areas of accident research, while O'Day (1971) suggested a series of detailed specific experimental designs for the purpose of determining the efficacy of the Federal standards.

Hahn (1970) pointed out a few differences in evaluating a "countermeasure intervention" program from other social action programs. One stems from the fact that most

highway safety countermeasure programs rely on error data as an index of performance. This deemphasizes the common yardstick of "more good" for measurement and concentrates on the "less bad" concept. He suggested a second order evaluation to trade off this imbalance. The predominance of error-rate data makes the population "at risk" very critical. Another difference is due to the utilization of readily available data rather than data specifically collected for the program's objectives. Generally speaking, though, the evaluation processes are highly similar.

C. CLASSIFICATION OF COUNTERMEASURES

"When utilized in the injury control or accident-prevention context, a countermeasure is a technique or program designed to reduce the frequency of accidents or the severity of injury if an accident does take place" (Hagen, 1970, p. 23).

The 18 standards of the Highway Safety Act of 1966 are such countermeasures. The selection of countermeasures has oftentimes been made with adequate provisions for their full evaluation (prior to and during implementation). This "common sense" approach has been under fire by several experts in the field of highway safety. (Hagen, 1970,

p. 23; Haddon, et al., 1964, p. 5; Campbell, 1970, p. 7; Heimstra, 1970, p. 7)

Objective evaluation would diminish this danger of sub-optimization of available monies. Many countermeasures employed in the past and selected by the "common sense" approach are very questionable as to their quantifiable positive effectiveness. Such examples are driver licensing examinations, motor vehicle inspection, driver education, etc. Due to misleading statistics and the institutionalized effect of such countermeasures, sound evidence must be produced to show if these standards are producing a pronounced reduction in highway accidents.

The wide variety of countermeasures under scrutiny open several avenues of classification for evaluation studies. The most commonly used breakdown refers to the man-machine-environment triad. Each target has its proponents advocating emphasis. Kearney (1966, pp. 157-159) and Black (1966, pp. 92-94) proposed that the major concern should surround the vehicle, while Skillman (1966, p. 41) suggested that the greatest and quickest payoff would result from concentration on the driver aspects of the problem. This human factors approach gauges the drivers' performance in relation to the other system elements. Shingu (1971)

felt that overemphasis on the "crashworthiness" of a vehicle might lead to overconfidence of the driver, thereby increasing the number of accidents. The 1972 National Highway Needs Report of the 92nd Congress stated its concern as follows: "The payoff in terms of a significant reduction in fatalities seems to lie with major improvements in safety related design standards, improvements in vehicle safety characteristics, and in programs aimed at specific accident-prone locations" (U.S., Congress, p. VI-50). Greenshields' (1973) theory was that the measurement of traffic performance (quality of traffic flow) is of primary importance in the detection of hazardous locations, and emphasis on this theory will produce objective driver testing and design of safer highways. Little (1968, p. 38) pointed out the importance of social factors which fall in the environmental realm. Some of the standards which encompass all three of these areas of concentration might be grouped together as "service countermeasures" (Codes and Laws, Traffic Records, etc.).

Looking from a cost-benefit viewpoint, Wohl (1968) emphasized a distinction between "measures that affect only accident-related costs and measures that affect both costs and benefits," as well as distinguishing between

countermeasures that do and do not affect the amount and character of traveling. (p. 32) How much is a person willing to pay, knowingly and voluntarily, in terms of money, time, and risk for added safety benefits?

Borgatta (1966, p. 184) classified countermeasures as to the types of action, corrective or preventive. Hagen (1970, pp. 24-25) made his division of the standards as to those using environmental modification techniques and those using behavioral modification techniques. A time sequence approach was made by Haddon (1968, pp. 1434-1435) based upon the pre-crash, crash, and post-crash phases of the accident sequence.

The most intricate breakdown of the Federal standards for evaluative purposes emerged from O'Day (1971, p. 20). He formulated these categories to group the countermeasures which could be simultaneously evaluated: (1) road user regulation, (2) information flow, (3) road user preparation, (4) vehicle regulation, (5) system restoration, and (6) highway regulation.

This diversity among the countermeasures is a major factor in the complexity of the problem of establishing sound and objective evaluation procedures.

D. MEASURES OF EFFECTIVENESS

After a countermeasure has been put into effect, a previously established criteria must be implemented for evaluating whether the standard has been effective in achieving program objectives, for determining why the program succeeded or failed, and for providing a method of redefining goals, if necessary. The selection of such measures of effectiveness warrants strict diligence. Goode and Machol (1957, pp. 116-120) listed relevance, comprehensiveness, reliability, and feasibility as basic criteria for judging the merits of measurements, emphasizing the desire "to derive a single measure of effectiveness which includes the effects of all the fundamental criteria" (pp. 125-129). Glennan (1972, p. 215) took an opposite view stating, "There is no need to insist that all program effects be combined into a single measure of program impact." Tarrants (1971) pointed out that most measures of effectiveness indicate the lack of safety rather than the presence of safety. He stated that "a measure of safety performance must help us prevent, not record accidents" (p.11).

Basically, the primary elements of effectiveness in a highway safety program are the reduction of loss of life,

the reduction of loss through injury, and the reduction of property damage. These apparent ultimate measures do not preclude the importance of cost-benefit effectiveness measures. This measure can oftentimes steer us away from the benefits derived and direct our attention only to cost as a cost, (Bauer, 1966, p. 33)

Although ultimate measures of effectiveness are vital, it might be more advantageous to measure intermediate effects, provided they are direct forerunners of the ultimate measures, Hahn (1970, p. 90) raised another question. "Which is the more justifiable index, an absolute measure of system failure, or a relative measure of failure in relation to exposure?" He leaned toward the relative measurement but Baker (1971, p. 47) favored absolute measurement.

The technique of measurement must be just as carefully chosen as the solution of the measurement itself. Tarrants (1971) gave these criteria for the measurement technique situation:

1. Its applicability to a particular situation.
2. The relative costs involved.
3. The criticality of the component or system under study.

4. The desired output.

5. Its compatibility with other programmed activities.

6. Its meaningfulness to administrators and others who are required to use it. (p. 14)

He cited three techniques which show great potential in measuring safety performance: (1) Behavior sampling, based upon statistical inferences drawn from a relatively small sample taken from a large population; (2) Critical incident technique, which provides a means for identifying a potential for injury or accidents before the event occurs; and (3) System safety analysis, a product of the aerospace industry which encompasses model building and cost-effectiveness analysis.

Rockwell (1959) suggested the concept of using "unsafe" behavior as a safety performance criterion. By converting behavior from "unsafe" to "safe," accidents should be reduced, however indirectly. Acts of unsafe behavior on the highways must be established and then the extent of their occurence measured.

According to Paul (1956, p. 1390), "program performance can be assessed according to criteria of effort, effect, or process, or any combination of these." Suchman (1967) took the criterion of effect and broke it down into

three categories giving us his "five categories of criteria according to which the success or failure of a program may be evaluated. These are (1) effort, (2) performance, (3) adequacy of performance, (4) efficiency, and (5) process" (p. 61). The criteria of process "may be made according to four main dimensions dealing with: (1) the attributes of the program itself; (2) the population exposed to the program; (3) the situational context within which the program takes place; and (4) the different kinds of effects produced by the program" (p. 67).

E. METHODOLOGIES OF ACCIDENT PREVENTION

Mankind has always inflicted himself and his environment with accidents and will probably never stop. Since accidents usually produce dire results, it is rational for mankind to exercise a certain amount of precaution to reduce accident occurence. Naturally, it has been theorized that the crux of the problem in accident prevention was the identification of the "responsible causes." This "cause and effect" approach along with newer theories of systems approaches and epidemiological approaches are the three major avenues being used today for accident prevention techniques. (Baker, 1971, p. 67)

Cause and Effect Approach.

Chapin (1947, pp. 52-53) gave a comprehensive definition of causality as follows: "Cause and effect, or causality as a system of ideas, is an explanation of successive events by a set of assumed antecedent-consequent relationships. . . . The concept of cause and effect . . . is used as a shorthand device to represent a kind of association between factors in time sequence which has a determinable probability of occurence." These "assumed antecedent-consequent relationships" must be verified by a research project showing that an improvement was the result of the innovation and not caused by "a general betterment of social chances, or the intervention of fortuitous circumstances" (Marris and Rein, 1967, p. 193).

Suchman (1967, p. 84) advanced his theory of "multiplicity of causes" and "interdependence of events" pointing out the complexity and highly interactive nature of an open system. He also diagramed the system showing the three major intervention points for obtaining desired results. (Fig. 1)

Under this umbrella of causality, the causal chain approach is found. Wold (1964, p. 3) listed this technique as a model for "forcasting by the chain principle."

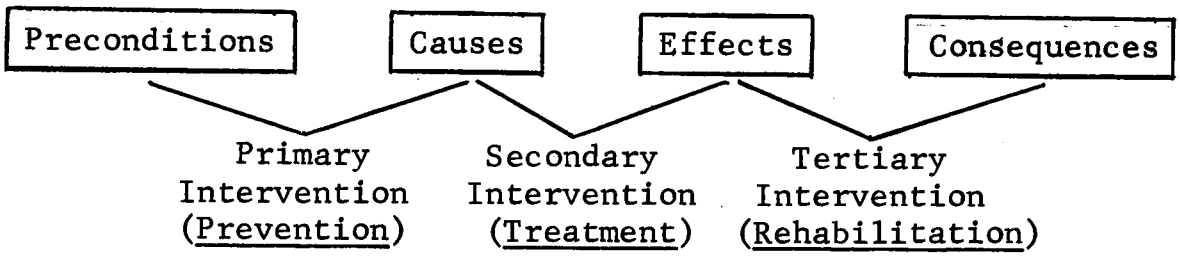


Figure 1. Applications of intervening variable model. (Suchman, 1967, p. 173)

Lipps (1972) defined this approach as relating intermediate effects to the ultimate goal by systematically analyzing the logical order of events occuring between the countermeasure implementation and the ultimate effect.

An excellent example of the use of this approach is by Hall and O'Day (1971). They resorted to this technique of evaluation of highway safety countermeasures due to the difficulty of relating intermediate events to the ultimate goal.

The general structure of their countermeasure causal chain is shown in Fig. 2, where E_n is the ultimate measure of social loss. They recognized certain pitfalls in this approach, namely, the possibility of a "break" in the chain causing intermediate changes not relating to the ultimate goal, and the political danger of extremely gratifying intermediate results creating a demand for a cessation of the program's expansion before it makes its full social improvement level. (p. 15)

Little (1970, p. 31) completely refuted the causality concept in traffic accident control, preferring to accept the systems approach, because of the high degree of improbability in defining the significant factors.

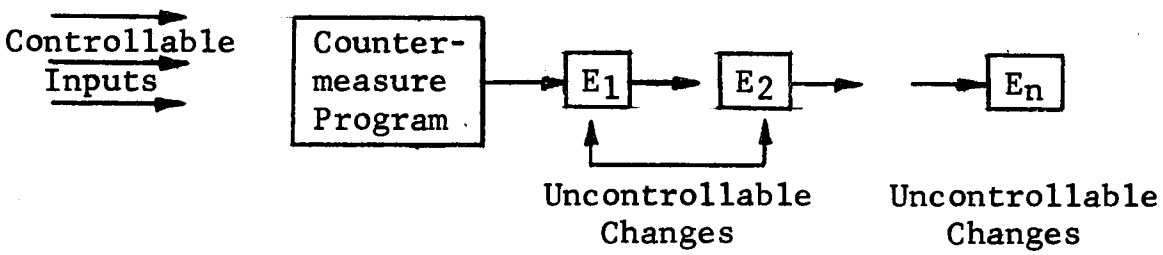


Figure 2. The countermeasure causal chain. (Hall and O'Day, 1971, p. 15)

Systems Approach

The systems approach of traffic safety for any driver or pedestrian which is legally using such facilities is rapidly gaining many followers. Haddon, Suchman, and Klein (1964, p. 366) were forerunners in this broad view of accident phenomena. Michaels (1964, pp. 372-373), August (1970, p. 76), Little (1970, p. 31), and Baker (1971, p. 16) agreed that the systems approach held more promise than concentration on a specific defect. This technique strove to equate the mismatch between man and machine in a cost-effective manner. Baker (1971, p. 16) stressed an important guideline derived from such an approach: "The objective of safety actions is not perfect vehicles, perfect highways, perfect drivers, or perfect administration or law enforcement. The objective is the combination of components with characteristics that produce the safest conditions (least risk) for the mobility desired and the resources available [italics in the original]."

Roer (1973) proposed a "comprehensive framework" systems approach to traffic safety, placing emphasis on external factors maybe not directly identifiable with any functional component of the road transportation system. Expenditures might be directed toward non-transportation fields through non-traditional approaches for viable

solutions. Such "far-out" aspects as basic risk factor comparisons (disease, suicide, etc.), lunar influence, and electronic highways were suggested for more extensive exploration.

Katz (1971, p. 32) suggested the systems analysis approach in evaluating complex countermeasures. August's (1970, pp. 76-77) four steps in a systems approach are:

> The systems approach discussed here, then, is one of (1) qualitatively defining elements of the highway crash problem and their interactions, (2) hypothesizing solutions to the problem, (3) developing mathematical models for use in estimating the potential effectiveness of various alternative solutions and their associated costs, and (4) decision making based on cost-effectiveness tradeoffs.

Haddon, Suchman, and Klein (1964, p. 373) felt that too much emphasis was placed on traffic flow and psychological variables, therefore, other nonpsychological variables should receive more attention.

Epidemiological Approach

In its conception, epidemiology, the study of medical ecology, was related to three sources, all combining to create causation of communicable diseases. They are the host (usually man), the agent, and the environment. The expansion of this epidemiological approach from the field of

disease to the field of injuries was set forth by Gordon (1949). In trying to develop a theory of accident origination, he suggested, "first a recognition of the agents involved, second a determination of the mechanisms by which that agents comes into play, and thirdly a definition of cause in terms of combined effect originating from host, agent, and environment" (p. 514).

MacFarland (1958, p. 666) applied this approach to the transportation safety scene stating, "a basic step in the application of the epidemiological approach is determining the fundamental physical, physiological, and psychological characteristics of the host." These characteristics may range from age of driver to the degree of driver training or from personal attitudes of drivers to efficiency impairment by temporary conditions such as fatigue, weather, alcohol, etc.

After these factors are determined, then the host-agent and host-environment relationships are studied for their interactions and possible remedies, as shown by Alexander and Lunenfeld (1972). They developed the "basic driving task" consisting of three activities or subtasks: (1) control, (2) guidance, and (3) navigation. The control task is the relationship which develops between the host and

the agent. How well does the driver control his vehicle as determined by feedback from vehicle response? Similarly, the guidance task alludes to the host-environment interrelation. How well does the driver respond to the relative positions of other vehicles and to the highway itself? The third subtask, navigation, is a mental task pertaining to the driver's ability to execute the journey from origin to destination.

Haddon (1968) utilized the host-agent-environment concept in his "three phases of social concern" in traffic safety. This concept gives an overview of traffic accident phenomena as follows:

> The first phase involves, from a countermeasure standpoint, the prevention of the etiologic agent from reaching the susceptible host. In the highway field, this involves an array of measures which in essence, are designed to prevent mechanical forces above injury thresholds from reaching vehicles and people.
>
> A second phase in the interactions which lead up to the end results of social concern, involves the interaction of the etiologic agents and the susceptible structures. In the case of highway phenomena, it begins when mechanical forces, in excess of those the vehicle, occupants, pedestrians, and cyclists can tolerate, begin to exert themselves on vehicles and people. Here, too, are many opportunities for the elimination or reduction of the end results of injury and death. In fact, as far as vehicle occupants are concerned, the knowledge, both theoretical and applied, is already available. During the next few years, this will

> make it entirely feasible to design vehicles whose occupants need not sustain either any injuries at all or, at worst, no very serious injuries at crash speeds under at least 60 mph, a range in which the overwhelming bulk of occupant injuries and deaths now occur.
>
> A third phase of the sequences, which lead up to the end results of concern, involves maximizing salvage, once damage has been doen to the susceptible structures. The problem is to reduce the liklihood of death, once the accident has occurred, and to provide the necessary emergency, medical, intermediate, and rehabilitative care. (pp. 1434-1435)

Summary of Methodologies

Suchman (1969, p. 203) encompassed all three approaches to the problem by listing four factors comprising accident phenomena:

> 1. Predisposing characteristics, including susceptible host (driver), hazardous environment, and injury-producing agent (vehicle).
>
> 2. Situational characteristics, involving risk-taking, appraisal of hazard, and margin of error.
>
> 3. Accident conditions which are unexpected, unavoidable, and unintentional.
>
> 4. Accident effects, such as injury or damage.

It is the human factor aspect of this phenomena which creates a large portion of the complexity of the problem. MacFarland's (1968, p. 666) approach, as mentioned earlier, first concentrated on the driver. Black (1966)

felt very strongly about the importance of the host and made a strong point with his example of the "unconscious mind":

> There is much to suggest that this unconscious mind of ours is but the mind of a child: It is muddled, greedy, filled with strange symbols of association, confused as to time and place, uninfluenced by tradition and experience. It is unquestionably the mind of our dreams. And above all, it is filled with wild aggression. If therefore anyone doubts the validity of our findings with regard to unconscious motivation on the roads, we suggest the following experiment. The subjects are three boys below the age of three years. The apparatus is a low table at which these children can stand in comfort. Each child is then provided with a toy motor car . . . These three boys are then instructed to play with the cars on the table top, pushing them around as if on roads and making the appropriate noises--of which "brumm.....brumm" appears to provide a satisfactory illusion. The experimenter should then start a stop watch and note the time taken for the following events to occur: The first <u>accidental</u> collision, the first <u>deliberate</u> collision, and the first <u>tears</u>. He will not have long to wait [italics in the original]. (p. 351)

CHAPTER III

METHOD AND PROCEDURE

The evaluation procedure as set out in the Final Report on Criteria for Program Evaluation-Highway Safety Standards for the State of Tennessee (Goodwin, 1973, pp. 5-6) is based upon three levels of Program review: (1) Level I--task accomplishment, (2) Level II--element compliance, and (3) Level III--effectiveness, (Figs. 3-5). Level III evaluation, which is under consideration here, appears to be based on the ultimate criteria of reduction in death, injuries, and accidents (property damage) measured by the percent of compliance to the 18 highway safety standards. A much more detailed set of criteria must be established on more finite measurements of effectiveness. These three levels of review must be tested for the various categories of criteria, to properly evaluate them.

The criterion of effort, or activity, has already been established by the creation of the standards by Congress. There is some question as to whether the approach taken was the best one. Naturally, these standards might not be the most effective ones, but this is a primary reason for good evaluation procedures.

Program Evaluation - Level I - Task Accomplishment

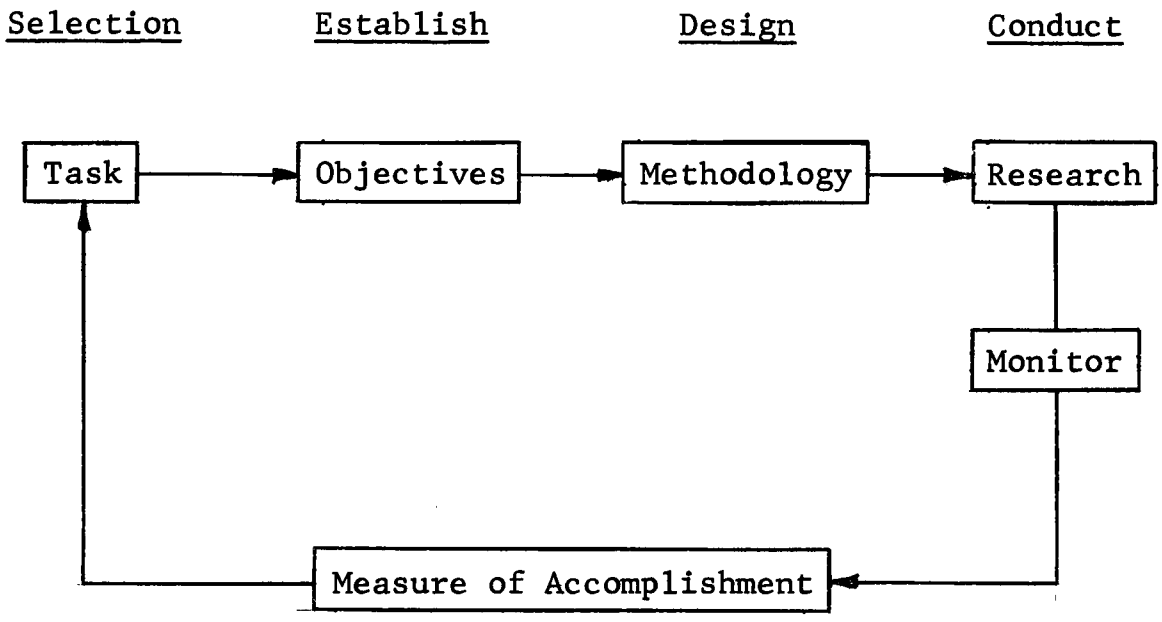


Figure 3. Level I of program evaluation. (Goodwin, 1973, p. 10)

Program Evaluation - Level II - Element Compliance

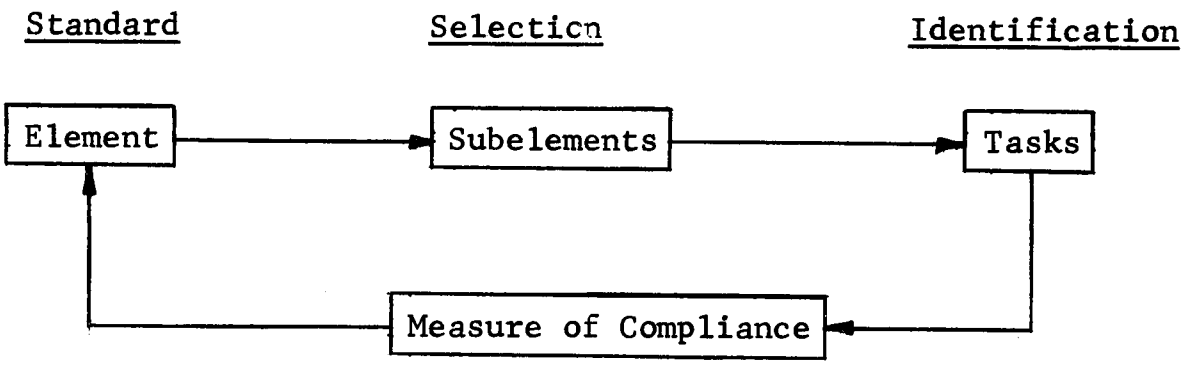


Figure 4. Level II of program evaluation. (Goodwin, 1973, p, 11)

Program Evaluation - Level III - Effectiveness

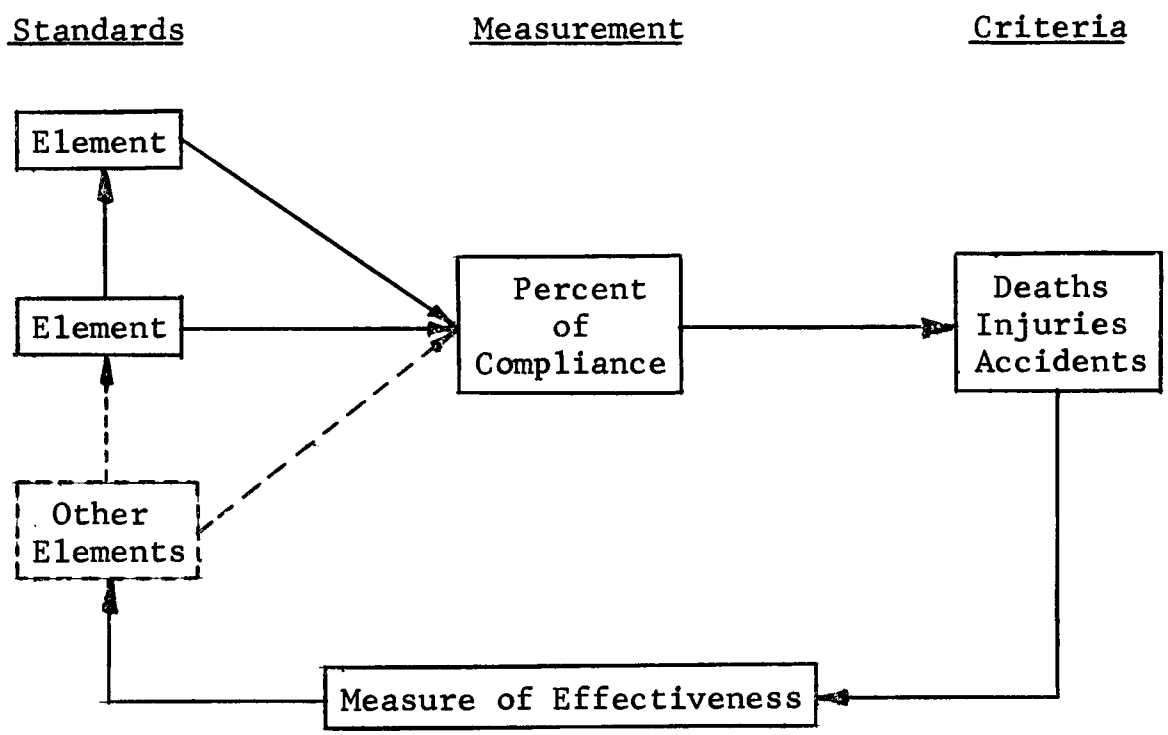


Figure 5. Level III of program evaluation. (Goodwin, 1973, p. 12)

The criterion of performance, or accomplishment, is based upon a sound statement of the objective. Did a change occur? Was it good or bad? Did the standard produce the change? This criterion may be evaluated at several levels and major assumptions must be made regarding the reliability and validity of the criteria of effectiveness. Goodwin (1973) has successfully applied this criterion of performance in the Level I determination of task accomplishment effectiveness by establishing objectives and conducting research to answer the aforementioned questions, provided that the reliability and validity of such measures are carefully scrutinized.

The criterion of adequacy of performance, or impact, is utilized by Goodwin (1973) in Level II evaluation in which the percent of compliance to a standard is documented. Using a less ambitious goal than the ultimate one as a measurement of impact, is an excellent selection.

Efficiency, or cost-benefit analysis as a criterion for program success or failure is understandably important, but extremely difficult to quantify in monetary terms for deaths and injuries. A standard might produce the desired changes as outlined in the objective, but it might be too expensive for the returns that are reaped.

The criterion of process, or specification of conditions of effectiveness, is not considered to be an inherent part of evaluative research, but how else can improvements be made in a program of public service if the "why's" and "wherefor's" for success or failure are not scrutinized. (Suchman, 1967, p. 66) These are the questions to be answered in Level III evaluation. This can be best done by selecting criteria of process in terms of attributes, recipients, environment, or direct effects. A recommended general model for Level III evaluation will be presented along with specific examples of how it may be applied to Highway Safety Program Standard Nos. 307, 314/614, 612, and 609. (See Appendix, pp. 62-71).

CHAPTER IV

RECOMMENDATIONS AND EXAMPLES

Level III evaluation as stated by Goodwin (1973, p. 6) is "concerned with measuring the total effectiveness of the Program by relating the percent of compliance with the indicated criteria as shown" in Fig. 5. This highest level of review must encompass all of the categories of evaluation criteria mentioned earlier. The objectives at Level III are not the same as those for Levels I and II. They are broader, but this is where the more specific task objectives must be expanded to the ultimate objectives for each element. The end result criteria of "reduction in deaths, injuries, and accidents" (Goodwin, 1973, p. 5) is not sufficient for all standards. Basing the highest level of review only on a measurement of percent of compliance does not satisfy the principle of sound evaluative research techniques. Just because you obtain 100 percent compliance with the minimum standards required by statute, this does not assure a gainful approach to the ultimate goals.

A recommended general model for Level III of the evaluation procedure is shown in Fig. 6. The ultimate objectives for each standard are stated in respective volumes

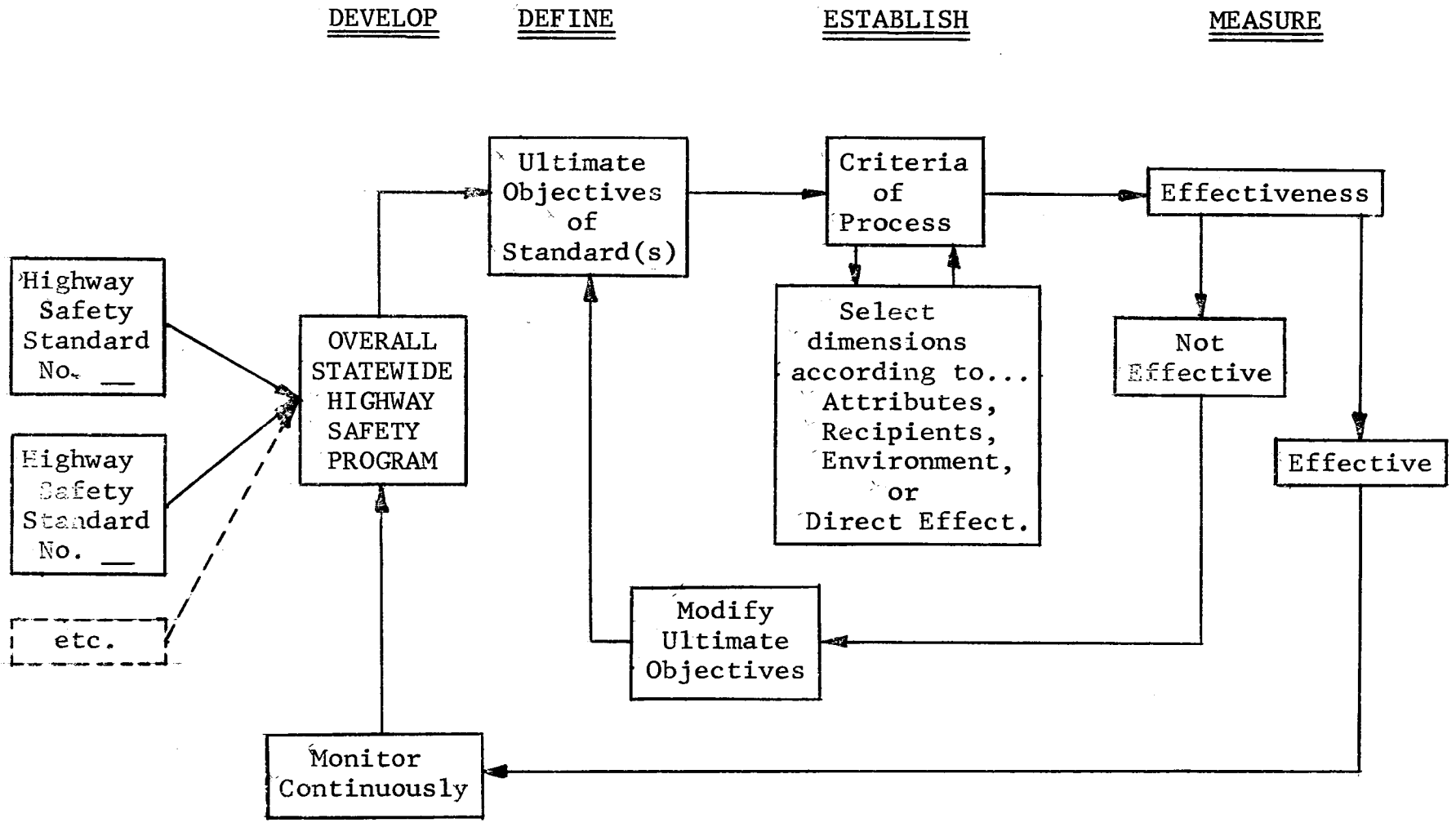


Figure 6. Proposed general model for Level III evaluation.

of the Highway Safety Program Manual. The terminology used in the Manual for ultimate objective is "purpose," whereas, specific objectives (immediate and intermediate) are separately stated. The criteria of process must be established according to one of the dimensions shown in Fig, 6. Selecting these criteria with a responsible awareness of their reliability and validity should result in viable measures of effectiveness for evaluation. Four of the Highway Safety Program Standards have been selected to illustrate each of the dimensions used in establishing the criteria of process.

A. ATTRIBUTES MODEL

Referring to Fig. 6 and using Highway Safety Program Standard No. 307, Traffic Courts, the following evaluative model would evolve:

Ultimate Objective--"To provide prompt impartial adjudication of proceedings involving motor vehicle laws" (Highway Safety Program Manual, Vol. 7, 1969, p. A-1).

Criteria of Process--The effectiveness of this type of standard may be judged by a criteria of process employing the attributes of the program as prescribed in the standard. The most important aspect of this type standard is its

internal components which are not appreciably affected by external forces such as the population. For example, the format of traffic court procedures, i.e., are they basically uniform, just, and expeditious, or otherwise? Other internal components important to this standard are the governmental level at which traffic cases are being tried and the adequacy of traffic court facilities and staffing. By addressing such internal components as these, the weaknesses and strong points of existing traffic court systems may be determined and the criteria of process may be soundly established.

Examples of Measures of Effectiveness:

Format--To determine the effectiveness of the format of traffic courtroom procedures one may establish a subjective scale of say, 1 to 5, that would range from non-uniformity (1) to uniformity (5), as described in the Highway Safety Program Manual.

Governmental Level--The increase or decrease in percent of traffic courts falling under the State judicial system rather than under local authority may serve as a measure of effectiveness for this standard.

Facilities and Staffing--A subjective scale of say, 1 to 5, may be established, ranging from non-adequacy of judicial facilities and court personnel (1) to adequacy of

same (5), based upon qualifications as set forth by the Comprehensive Traffic Courts Plan described in the Highway Safety Program Manual.

B. RECIPIENTS MODEL

Referring to Fig. 6 and using Highway Safety Program Standard No. 314/614, Pedestrian Safety, the following evaluative model would evolve:

Ultimate Objective--"To emphasize the need to recognize pedestrian safety as an integral, constant, and important element in community planning and all aspects of highway transportation, and to insure a continuing program to improve such safety by each State and its political subdivisions" (Highway Safety Program Manual, Vol. 14, 1969, p. A-1).

Criteria of Process--This standard strikes a solid blow at the recipient of the program in terms of criteria of process establishment, as it is aimed at the driver and the pedestrian; but how much influence can the program have on others, such as land use planners and persons responsible for providing safe student crossings? Maybe you can best reach the driver who will more strongly influence the reduction of potential vehicle-pedestrian conflicts, than a

direct approach to the pedestrian. Do you attack the problem on an individual, group, or public basis? This complex problem can best be served by establishing criteria of process aimed at the population.

Examples of Measures of Effectiveness:

Education of Recipient--The adequacy of driver and pedestrian education in pedestrian safety information programs as prescribed in the Highway Safety Program Manual may be constituted on a subjective scale of say, 1 to 5, with a higher rating for larger percentages of the general population actively participating in such programs.

Vehicle-Pedestrian Conflicts--The reduction of vehicle-pedestrian conflicts with the use of pedestrian signs, signals, islands, crosswalks, etc., may be used as a measure of effectiveness for this standard.

Child Pedestrians--An effective measurement of the protection for this age group of recipients may be realized by establishing a subjective scale of say, 1 to 5, that would range from the inadequacy of planners in providing for child safety at residential play and in transit to and from school (1) to adequacy of same (5), as set forth in the Highway Safety Program Manual.

Enforcement--This aspect of pedestrian safety may be measured by recording the increase in school safety patrol locations.

All of the aforementioned measures of effectiveness will serve as intermediate evaluative measures for the ultimate goal of a decrease in pedestrian fatalities and injuries.

C. ENVIRONMENT MODEL

Referring to Fig. 6 and using Highway Safety Program Standard No. 612, Highway Design, Construction and Maintenance, the following evaluative model would evolve;

Ultimate Objective--"To assure: (a) that existing streets and highways are maintained in a condition that promotes safety, (b) that capital improvements either to modernize existing roads or to provide new facilities meet approved safety standards, and (c) that appropriate precautions are taken to protect passing motorists as well as highway workers from accident involvement at highway construction sites" (Highway Safety Program Manual, Vol. 12, 1971, p. A-1).

Criteria of Process--This standard appears to have its basic chances of success or failure hinging on the

driving environment. This multi-faceted program encompasses geometric design, pavement design and construction, pavement treatment, roadway lighting, crash survivability, emergency response, maintenance, work-site safety, rail-highway grade crossings, land development, etc. With such a wide range of factors involved, jurisdiction by the State and local highway and transportation officials is very critical for effective implementation. Hopefully, acceptable design safety standards will be employed by all jurisdictions for the sake of uniformity. Are these design, construction, and maintenance safety criteria equally applicable to all local jurisdictions? Is there a highly successful local program in highway design, construction, or maintenance? If so, are there any unusual features about the program? Are responsible personnel in supervisory positions adequately trained in safety related procedures? By specifying the situational context of a program on a local level, the criteria of process for this standard may be better established.

Examples of Measures of Effectiveness:

Maintenance--A subjective scale of say, 1 to 5, may be derived, ranging from a low level of desirability of maintenance procedures (1) to a high level (5), based upon the requirements of the Highway Safety Program Manual.

Design Standards--The increase or decrease in the number of design areas (geometric, pavement, lighting, rail-highway grade crossings, etc.) which are governed by professionally acceptable national uniform design standards may be an effective measurement for this program.

Work-Site Safety--The number of highway related personnel, both governmental employees and private contractors, supervisory and non-supervisory, who have completed an adequate educational program in work-site safety should serve as an excellent measure of effectiveness.

D. DIRECT EFFECT MODEL

Referring to Fig. 6 and using Highway Safety Program Standard No. 609, Identification and Surveillance of Accident Locations, the following evaluative model would evolve:

Ultimate Objective--"To identify specific locations or sections of streets and highways which have high or potentially high accident experience, as a basis for establishing priorities for improvement, selective enforcement, or other operational practices that will eliminate or reduce the hazards at the location so identified" (Highway Safety Program Manual, Vol. 9, 1969, p. A-1).

Criteria of Process--This standard has a direct effect on the ultimate objective of reduction of accidents and the inherent deaths, injuries, and property damage. The different effects produced by the program are foremost in the selection of the criteria of process, Programs of this type reduce the probability of utilizing intermediate objectives as a measure of effectiveness. Are the effects of the program single or multiple? What effect does the improvement of a high accident location have on adjacent locations? In other words, was the problem solved or merely shifted? How long is the accident reduction program going to be effective? If improvements are made in highway design features, or traffic operation controls, the effects are surely quite long in duration. If selective enforcement is a primary utilization for accident reduction, the effects may well be short-lived. The duration of effectiveness must be heavily considered in selecting a method of high accident location improvement. For standards of this type, which are direct actions at accident reduction, the effects of the program must be carefully examined.

Example of Measure of Effectiveness--The increase or decrease in accidents and their inherent deaths, injuries, and property damage at selected high accident locations

provide a measure of effectiveness directly serving the ultimate goal of the Overall Statewide Highway Safety Program.

E. SUMMARY

The four aforementioned examples depicting each of the dimensions in selecting the criteria of process may be expanded to include each of the 18 highway safety standards. (See Appendix, p. 72) Although, the criteria of process might be selected by more than one dimension, the following is a suggested selection of models for each of the remaining 14 highway safety standards:

Attributes Model--Motor Vehicle Registration, Codes and Laws, Traffic Records, and Accident Investigation.

Recipients Model--Driver Education, Driver Licensing, Alcohol in Relation to Highway Safety, and Pupil Transportation.

Environment Model--Traffic Engineering Service, Police Traffic Services, and Debris Hazard Control and Cleanup.

Direct Effect Model--Periodic Motor Vehicle Inspection, Motorcycle Safety, and Emergency Medical Services.

It is hopefully anticipated that the selection of criteria of process according to one of the dimensions as

shown in the general model in Fig. 6 will result in highly successful evaluation procedures for Overall Statewide Highway Safety Programs.

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APPENDIX

HIGHWAY SAFETY PROGRAM STANDARD NO. 307

TRAFFIC COURTS

Purpose

To provide prompt impartial adjudication of proceedings involving motor vehicle laws.

Standard

Each State in cooperation with its political subdivisions shall have a program to assure that all traffic courts in it complement and support local and Statewide traffic safety objectives. The program shall provide at least that:

I. All convictions for moving traffic violations shall be reported to the State traffic records system.

II. Program Recommendations: In addition the State should take appropriate steps to meet the following recommended conditions:

A. All individuals charged with moving hazardous traffic violations are required to appear in court.

B. Traffic courts are financially independent of any fee system, fines, costs, or other revenue such as posting or forfeiture of bail or other collateral resulting from processing violations of motor vehicle laws.

C. Operating procedures, assignment of judges, staff, and quarters ensure reasonable availability of court services for alleged traffic offenders.

D. There is a uniform accounting system regarding traffic violation notices, collection of fines, fees, and costs.

E. There are uniform rules governing court procedures in traffic cases.

F. There are current manuals and guides for administration, court procedures, and accounting. (Highway Safety Program Manual, Vol. 7, 1969, p. A-1)

HIGHWAY SAFETY PROGRAM STANDARD NO. 314/614

PEDESTRIAN SAFETY

Purpose

To emphasize the need to recognize pedestrian safety as an integral, constant and important element in community planning and all aspects of highway transportation, and to insure a continuing program to improve such safety by each State and its political subdivisions.

Standard

Every State in cooperation with its political subdivisions shall develop and implement a program to insure the safety of pedestrians of all ages. The program shall provide as a minimum, that:

I. There is a continuing Statewide inventory of pedestrian-motor vehicle accidents, identifying specifically:

A. The locations and times of all such accidents.

B. The age of all of the pedestrians injured or killed.

C. Where feasible to determine, whether the exterior features of the vehicle produced or aggravated an injury.

D. The color and shade of clothing worn by pedestrians when injured or killed, and the visibility conditions which prevailed at the time.

E. The extent to which alcohol is present in the blood of fatally injured pedestrians 16 years of age and older.

F. Where possible to determine, the extent to which pedestrians involved in accidents have physical or mental disabilities.

II. There are established Statewide operational procedures for improving the protection of pedestrians through reduction of potential conflicts with vehicles:

A. By application of traffic engineering practices including pedestrian signals, signs, markings, parking regulations and other pedestrian and vehicle traffic control devices,

B. By land use planning in new and redevelopment areas for safe pedestrian movement.

C. By provision of pedestrian bridges, barriers, sidewalks and other means of physically separating pedestrian and vehicle pathways.

D. By provision of environmental illumination at high pedestrian volume and/or potentially hazardous pedestrian crossings.

III. There is established a Statewide program for familiarizing drivers with the pedestrian problem and with ways to avoid pedestrian collisions.

A. The program content shall include emphasis on:

(1) Behavior characteristics of the three types of pedestrians most commonly involved in accidents with vehicles: 1) children; 2) persons under the influence of alcohol; and 3) the elderly.

(2) Accident avoidance techniques that take into account the hazardous conditions and behavior characteristics displayed by each of the three high risk pedestrian groups listed in subparagraph (1).

B. Emphasis on this program content shall be included in:

(1) All driver education and training courses.

(2) Driver improvement courses.

(3) Driver license examinations.

IV. There are Statewide programs for training and educating all members of the public as to safe pedestrian behavior on or near streets and highways.

A. For children, yourhs, and adults enrolled in schools, beginning at the earliest possible age.

B. For the general population via the public media.

V. There is a Statewide program for the protection of children walking to and from school, entering and leaving schoolbuses, and in neighborhood play.

VI. There is a Statewide program for establishment and enforcement of traffic regulations designed to achieve orderly pedestrian and vehicle movement and to reduce vehicle-pedestrian conflicts.

VII. This program shall be periodically evaluated by the States, and the National Highway Safety Bureau shall be provided with an evaluation summary. (Highway Safety Program Manual, Vol. 14, 1969, pp. A-1 thru A-3)

HIGHWAY SAFETY PROGRAM STANDARD NO. 612

HIGHWAY DESIGN, CONSTRUCTION, AND MAINTENANCE

Purpose

To assure: (a) that existing streets and highways are maintained in a condition that promotes safety, (b) that capital improvements either to modernize existing roads or to provide new facilities meet approved safety standards, and (c) that appropriate precautions are taken to protect passing motorists as well as highway workers from accident involvement at highway construction sites.

Standard

Every State, in cooperation with county and local governments, shall have a program of highway design, construction, and maintenance to improve highway safety.

I. The program shall provide, as a minimum that:

A. There are design standards relating to safety features such as sight distance, horizontal and vertical curvature, spacing of decision points, width of lanes, etc., for all new construction or reconstruction, at least on expressways, major streets and highways, and through streets and highways.

B. Street systems are designed to provide a safe traffic environment for pedestrians and motorists when subdivisions and residential areas are developed or redeveloped.

C. Roadway lighting is provided or upgraded on a priority basis at the following locations:

1. Expressways and other major arteries in urbanized areas,

2. Junctions of major highways in rural areas.

3. Locations or sections of streets and highways having high ratios of night-to-day motor vehicle and/or pedestrian accidents.

4. Tunnels and long underpasses.

D. There are standards for pavement design and construction with specific provisions for high skid resistance qualities.

E. There is a program for resurfacing or other surface treatment with emphasis on correction of locations or sections of streets and highways with low skid resistance and high or potentially high accident rates susceptible to reduction by providing improved surfaces.

F. There is guidance, warning, and regulation of traffic approaching and traveling over construction or repair sites and detours.

G. There is a systematic identification and tabulation of all rail-highway grade crossings and a program for the elimination of hazards and dangerous crossings.

H. Roadways and the roadsides are maintained consistent with the design standards which are followed in construction to provide safe and efficient movement of traffic.

I. Hazards within the highway right-of-way are identified and corrected.

J. There are highway design and construction features wherever possible for accident prevention and survivability including at least the following:

1. Roadside clear of obstacles, with clear distance being determined on the basis of traffic volumes, prevailing speeds, and the nature of development along the street or highway.

2. Supports for traffic control devices and lighting that are designed to yield or break away under impact wherever appropriate.

3. Protective devices that afford maximum protection to the occupants of vehicles wherever fixed objects cannot reasonably be removed or designed to yield.

4. Bridge railings and parapets which are designed to minimize severity of impact, to retain the vehicle, to redirect the vehicle so that it will move parallel to the roadway, and to minimize danger to traffic below.

5, Guardrails, and other design features which protect people from out-of-control vehicles at locations of special hazard, such as playgrounds, schoolyards, and commercial areas.

K. There is a postcrash program which includes at least the following:

1. Signs at freeway interchanges directing motorists to hospitals having emergency care capabilities,

2. Maintenance personnel trained in procedure for summoning aid, protecting others from hazards at accident sites, and removing debris.

3. Provisions for access and egress for emergency vehicles to freeway sections where this would significantly reduce travel time without reducing the safety benefits of access control.

II. This program shall be periodically evaluated by the State for its effectiveness in terms of reductions in accidents and their end results, and the National Highway Safety Bureau shall be provided with an evaluation summary. (Highway Safety Program Manual, Vol. 12, 1971, pp. A-1 thru A-3)

HIGHWAY SAFETY PROGRAM STANDARD NO. 609

IDENTIFICATION AND SURVEILLANCE OF ACCIDENT LOCATIONS

Purpose

To identify specific locations or sections of streets and highways which have high or potentially high accident experience, as a basis for establishing priorities for improvement, selective enforcement, or other operational practices that will eliminate or reduce the hazards at the location so identified.

Standard

Each State, in cooperation with county and other local governments, shall have a program for identifying accident locations and for maintaining surveillance of those locations having high accident rates or losses.

I. The program shall provide, as a minimum, that:

A. There is a procedure for accurate identification of accident locations on all roads and streets:

(1) To identify accident experience and losses on any specific sections of the road and street system.

(2) To produce an inventory of:

(a) High accident locations.

(b) Locations where accidents are increasing sharply.

(c) Design and operating features with which high accident frequencies or severities are associated.

(3) To take appropriate measures for reducing accidents.

(4) To evaluate the effectiveness of safety improvements on any specific section of the road and street system.

B. There is a systematically organized program:

(1) To maintain continuing surveillance of the roadway network for potentially high accident locations.

(2) To develop methods for their correction.

II. The program shall be periodically evaluated by the State and the National Highway Safety Bureau shall be provided with an evaluation summary. (Highway Safety Program Manual, Vol. 9, 1969, pp. A-1 thru A-2)

HIGHWAY SAFETY PROGRAM STANDARDS

301	Periodic Motor Vehicle Inspection
302	Motor Vehicle Registration
303	Motorcycle Safety
304	Driver Education
305	Driver Licensing
306	Codes and Laws
307	Traffic Courts
308	Alcohol in Relation to Highway Safety
609	Identification and Surveillance of Accident Locations
310	Traffic Records
311	Emergency Medical Services
612	Highway Design, Construction, and Maintenance
613	Traffic Engineering Service
314/614	Pedestrian Safety
315	Police Traffic Services
316	Debris Hazard Control and Cleanup
317	Pupil Transportation
318	Accident Investigation

VITA

Thomas E Ragland was born in Lebanon, Tennessee on May 27, 1941. He attended elementary school in Wilson County, Tennessee and was graduated from Lebanon High School, Lebanon, Tennessee in 1958.

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