H = hazard index or expected number of fatal plus non-fatal injury accidents per year;
V = vehicle exposure;
PE = probability of encroachment;
PCE = probability of a collision, given an encroachment; and
PIC = probability of an injury (fatal or non-fatal), given a collision.

Glennon then calculates the cost-effectiveness ratio defined as the annualized cost for the reduction of one fatal or non-fatal injury accident. Here, data are needed for all the probability terms, because much of this work is based on theory. Indeed, the probability of encroachment is based on the old work by Hutchinson and Kennedy (6).

In models like this, site layout considerations come into play. For example, a pole (breakaway or non-breakaway) is more likely to be struck if closer to the edge of pavement. The same would be true for median barrier placement. Barriers placed close to the pavement yield more hits at shallower angles, while more severe, higher-angle collisions result when distance from the pavement edge is greater. And while such considerations about site layout and impact conditions are important, what we are trying to focus on here are the inherent capabilities or limitations of the appurtenance and the relative severity of the collision.

CONCLUSION

It should be stated that some excellent work has been performed in developing or reviewing procedures for ranking alternatives by the Texas Transportation Institute (7) for FHWA. These methods include incremental benefit/cost techniques with improved algorithm, dynamic programming and inter programming--techniques that lead to optimal budget packages. However, one problem here is that much of the work has focused on fairly meticulous cost calculations (i.e., costs of accidents for various roadway and traffic situations). The accompanying knowledge about treatment effectiveness (frequency or severity reduction) can be stated with nowhere near the same precision. Indeed, the effectiveness factors could be orders of magnitude different.

Thus, we have a good handle on the economic techniques for ranking programs. It is time to develop research methodologies that will produce the needed estimates of effectiveness for our design hardware.

REFERENCES

1. Council, F. M. and Hunter, W. W. Implementation of Proven Technology in Making the Highway Environment Safe. Chapel Hill: University of North Carolina Highway Safety Research Center, August 1975. (Report prepared for the Motor Vehicle Manufacturers Association of the United States, Inc.)
2. Hunter, W. W., Council, F. M. and Dutt, A. K. Project Selection for Roadside Hazards Elimination, Volume I, Final Report. Chapal Hill: University of North Carolina Highway Safety Research Center, April 1977.
3. Fleischer, G. A. The Significance of Benefit-Cost and Cost-Effectiveness Ratios in Traffic Safety Program/Project Analysis. Washington, D.C.: Transportation Research Board, 1977.
4. American Association of State Highway and Transportation Officials. Guide for Selecting, Locating, and Designing Traffic Barriers. Washington, D.C.: AASHTO, 1977.
5. Glennon, J. C. Roadside Safety Improvement Programs for Freeways--A Cost-Effectiveness Priority Approach. Washington, D.C.: Transportation Research Board, National Cooperative Highway Research Program Report 148, 1974.
6. Hutchinson, J. W. and Kennedy, T. W. Medians of Divided Highway--Frequency and Nature of Vehicle Encroachments. Urbana: University of Illinois Engineering Experiment Station, Bulletin No. 487, 1966.
7. McFarland, W. F., Griffin, L. I., Rollins, J. B., Stockton, W. R., Phillips, D. T. and Dudek, C. L. Assessment of Techniques for Cost-Effectiveness of Highway Accident Countermeasures. College Station: Texas Transportation Institute, Report No. FHWA-RD-79-53, January 1979.

Part 2: Session 1, Physical Testing and Analysis

Jarvis D. Michie, Southwest Research Institute, Moderator

This session was devoted to seven aspects of roadside hardware development, principally the design, laboratory and crash test evaluation and assessment of the hardware potential. The presenters were asked to critically evaluate a specific area with respect to generating data needed in the benefit/cost analysis procedure. As it was felt that the positive features of the seven areas have been emphasized in previous meetings and in the literature, the presenters were asked to concentrate on limitations. Accordingly, the reader is advised that the following purposely stresses the negative and should not be viewed as a balanced appraisal of highway safety technology.

BASELINE DATA NEEDS

Hayes E. Ross, Jr., Texas Transportation Institute, Texas A&M University

Benefit/cost analyses of roadside safety programs generally involve (a) an estimate of accident frequency and (b) an estimate of the severity of the predicted accidents. In most such analyses these estimates, through no fault of the analyst, are crude and statistically unsound. Data on which reliable predictions can be based are sparse. Numerous variables influence accident frequency and severity, further complicating data needs.

Attempts have been made to develop accident prediction models based on regression techniques utilizing accident data. These have met with little success for the reasons given above. In the absence of accident data bases, researchers have formulated probabilistic models based on observed and/or assumed vehicle encroachment data. Although widely used, the latter technique has relied on very limited encroachment data, and the results obtained are generally suspect.