DOCUMENT RESUME

ED 080 716 VT 021 014

TITLE	Transportation Safety Education and Manpower Training.
INSTITUTION	Florida Technological Univ., Orlando. Coll. of Engineering.; Office of the Assistant Secretary for Environment, Safety, and Consumer Affairs (DOT), Washington, D.C.
PUB DATE	Jan 73
NOTE	84p.; Summary Report of a workshop (Florida Technological University, Orlando, Florida, November 13-17, 1972)
AVAILABLE FROM	Transportation Systems Institute, Florida Technological University, Box 25000, Orlando, FL 32816
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	*Accident Prevention; Educational Programs; *Manpower Development; *Safety Education; *Transportation; *Workshops

ABSTRACT

In an effort to aid in the improvement of transportation safety, a workshop involving the efforts of transportation officials, operators, government officials, and educators was instituted to formulate policies for education and manpower training in the area. The proceedings, findings, and recommendations of the workshop team are presented in this document. Part One presents a general overview and summary of the conclusions and recommendations made, and Part Two contains an explanation of workshop proceedings and provides the framework and rationale on which conclusive findings and recommendations were based. The recommendations are grouped under the headings: (1) Problems in Transportation Safety, (2) Skills and Disciplines Required in Transportation Safety, (3) Organizational Considerations for Transportation Safety Programs, (4) Public Education Requirements for Transportation Safety Awareness, and (5) Manpower Development and Training Requirements for Transportation Safety. (Atuhor/SN)

TRANSPORTATION SAFETY
Education & Manpower Training

A WORKSHOP REPORT

U.S. DEPARTMENT OF TRANSPORTATION
Office of Assistant Secretary for
Environment, Safety, and Consumer Affairs
Washington, D.C. 20590 January 1973

SUMMARY REPORT OF A WORKSHOP

ON

TRANSPORTATION SAFETY EDUCATION AND MANPOWER TRAINING

NOVEMBER 13-17, 1972

ORLANDO, FLORIDA

Prepared for the

U.S. Department of Transportation

Office of the Assistant Secretary
for
Environment, Safety, and Consumer Affairs

by

The Transportation Systems Institute
College of Engineering

Florida Technological University

January 1973

ABSTRACT

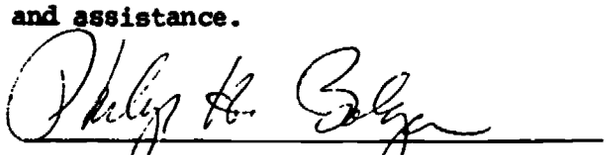
This report summarizes the findings and presents the recommendations of a workshop on Transportation Safety Education and Manpower Training held on November 13-17, 1972, at Florida Technological University, Orlando, Florida. The report's recommendations are presented under the headings: Problems in Transportation Safety; Skills and Disciplines Required in Transportation Safety; Organizational Considerations for Transportation Safety Programs; Public Education Requirements for Transportation Safety Awareness; Manpower Development and Training Requirements for Transportation Safety.

FOREWORD

Continuing widespread interest in improved transportation safety inspired the U.S. Department of Transportation to bring together in a workshop format a multimodal group of transportation managers, operators, government policy makers, and a multidisciplinary group of educators for the purpose of developing recommendations and broad guidelines for education and manpower training in transportation safety. This report presents a synthesis of the deliberations, findings, and recommendations of that workshop.

The report is presented in two parts in order to provide the reader with either a briefing on the workshop recommendations or a more detailed summary of the proceedings of the sessions. Part I provides a general overview and summary of the conclusions and recommendations developed by the workshop participants concerning the various education and manpower training programs appropriate to transportation safety improvement. Part II of the report presents a synthesis of the deliberations in each of the workshop sessions so as to provide the background and rationale for the conclusions and recommendations cited in Part I.

Acknowledgement and appreciation is expressed herewith to General Benjamin O. Davis, Assistant Secretary for Environment, Safety, and Consumer Affairs--U.S. Department of Transportation, for the inspiration and impetus provided by his office in assembling the workshop and publishing this report. Similar acknowledgement and appreciation is conveyed herewith to E. A. Mueller and G. F. Schrader, who served as co-chairmen with me in guiding the development and implementation of the workshop. Appreciation is also extended to the U.S. Office of Education and other agencies for their splendid cooperation and assistance.



Philip H. Bolger, Director
Office of Safety Program Coordination
Office of Assistant Secretary for
Environment, Safety, and Consumer Affairs
U.S. Department of Transportation

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INTRODUCTORY COMMENTS

The Workshop on Transportation Safety Education and Manpower Training was held as an exploratory device in delineating the various problems in transportation safety and developing guidelines for education and manpower training programs for intermodal careers in transportation safety. It is hoped that these preliminary efforts will serve to inspire further cooperation among the transportation industry, government and education for the development of viable programs to insure continued improvements in transportation safety manpower training.

Transportation safety is the end product of many interrelated efforts. Management decisions and operating policies must reflect a new concern for safety. Many occupations must integrate new concepts and new skills. Those engaged in equipment design, safety training, establishing maintenance standards and operating policies, using equipment, inspection and compliance procedures, establishing and enforcing standards and safety regulations, as well as safety managers, government administrators and safety program managers, must all be cognizant of a body of knowledge which includes appropriate safety considerations.

Of critical importance is defining this body of knowledge and integrating it into the education and manpower training taking place at all education levels. A basic problem is that the diverse nature of the groups involved and their adherence to widely different modal habits and professional disciplines complicates the task of developing educational programs which ensure that adequate safety principles and practices are taught at each appropriate level. The variety of modal experiences tends to obscure the modal commonalities, and the variety of professional disciplines tends to compartmentalize education. Needed are guidelines for program and curriculum

development to ensure that each occupation involved in transportation safety has had appropriate safety related instruction.

The U.S. Department of Transportation, having reviewed the transportation safety efforts being made in various governmental and private agencies, felt it would be beneficial to draw various individuals involved in these efforts together in a conference which would address the basic question of how to provide the education and training needed to produce the proper mix of trained people to improve transportation safety.

Important to this task is an understanding of the role and scope of education and training in developing the manpower resources necessary to the achievement of specific transportation safety improvement goals. The terms "education" and "training" are often used synonymously in a lay context. However, in terms of total human development, they are separate but related tasks. They are usually undertaken at different times during the life span and career of an individual, at different institutional locations, and with different objectives. The term "education" usually refers to the process of cultivating and disciplining the mind so as to acquire knowledge and understanding of a broad spectrum of societal activities or within a particular subject area. "Training" usually refers to the process of acquiring the specific skills required to do a particular job.

PURPOSE AND OBJECTIVES OF WORKSHOP

The primary objective of this workshop was to develop requirements for education and manpower development in the transportation safety field and to provide broad guidelines for program development at each educational level. Attention was focused on transportation safety problems in order to develop an understanding of the modal and multimodal aspects of transportation safety. This understanding was then related to the education and manpower training requirements of the occupations and skills which must be involved in improvements in transportation safety.

The workshop also permitted the achievement of several secondary objectives, including:

- - Exchange of information among transportation managers, modal representatives of state and federal departments of transportation, educators, and other conferees concerning safety training problems, programs, solutions, and innovative techniques, particularly in manpower development and training areas
- - Dissemination of background material to the workshop participants, which provided a factual basis for common discussion, understanding and potentially, resolution of some problems of transportation safety training.
- - Delineating critical training gaps and training surplus in transportation safety fields by relating the safety problem to the available training resources
- - Identifying safety related educational requirements for inclusion of safety related material within certification requirements of professional groups involved in transportation
- - Identifying and making recommendations for improvements in transportation safety education and manpower training, and for other required follow-on action.

The primary intended users of these guidelines include:

- - Education institutions providing instruction in transportation related fields
- - - State agencies involved in preparing manpower development and training plans
- - Government agencies developing detailed curriculum guidelines for occupations involved in specific transportation modes and for intermodal transportation systems
- - Transportation associations involved in setting standards, establishing requirements, or training
- - Transportation industries and unions

WORKSHOP PLANNING AND ADMINISTRATION

The Workshop on Transportation Safety Education and Manpower Training was held at Florida Technological University on November 13 - 17, 1972. The U.S. Department of Transportation, the Florida Department of Transportation and Florida Technological University served as cooperative sponsors for the workshop. A steering committee consisting of representatives from those organizations developed the plans and programs for the conduct of the workshop. Mr. Philip H. Bolger of the U.S. Department of Transportation, Mr. Edward A. Mueller of the Florida Department of Transportation, and Dr. George F. Schrader of Florida Technological University served as workshop co-chairmen.

The co-chairmen of the workshop wish to acknowledge the fine contributions made to its success by the workshop coordinator, Mr. Alan J. Warshawer of National Scientific Corporation under contract with the U.S. Department of Transportation, and by Mr. Robert A. Lavette, who served as project coordinator for the Florida Department of Transportation. Also,

special recognition is due Mr. C. Barth Engert of Florida Technological University for his untiring efforts in arranging and scheduling the facilities at FTU to meet the needs of the workshop participants.

WORKSHOP ORGANIZATION AND PROGRAM

A total of fifty-one (51) participants and three (3) recorders attended the workshop sessions. The group included a balanced representation of federal agencies, state agencies, [illegible]portation industry and their associations, and the academic community. A listing of participants and their affiliations is included in the appendix to this report.

On the first day of the workshop all of the participants attended a general briefing session which provided an overview of safety problems in transportation from the viewpoint of industry and modal administration representatives. The purpose of the briefing session was to place the safety problem in perspective and to provide all the participants with a common reference point. An overview of the priority safety problems in air transportation was given by Mr. Charles O. Miller of the National Transportation Safety Board. Dr. William E. Tarrants of the National Highway Traffic Safety administration discussed the major safety problems in highway transportation, and Mr. Mac E. Rogers of the Federal Railroad Administration spoke of problems in rail transportation safety. Captain Vincent J. Mitchell of the U.S. Coast Guard gave an overview of the problems in marine transportation safety. During each of these briefings, emphasis was focused on indices of safety performance in the various modal areas. Of particular concern were the statistics and trends in accidents and fatalities for the major transportation modes. Charts on these statistics are shown in Figures I through VI for all transportation and for each mode discussed during the briefing.

Subsequent to the briefing, the participants were assigned to one of three separate panel groups wherein particular elements of the transportation safety problem and related educational needs were deliberated. Workshop Panel I, chaired by Mr. Charles O. Miller of the National Transportation Safety Board, addressed itself to the identification and examination of the parameters of transportation safety. Panel II, under the chairmanship of Dr. John Grimaldi of New York University, concerned itself with the determination of the skills and disciplines required in the field of transportation safety. The third panel group, under the guidance of Mr. Fletcher N. Platt of the Ford Motor Company, deliberated on the organizational guidelines and career management requirements for transportation safety occupational skill groups. On the third day of the workshop, each of the three panels prepared reports on their findings and recommendations. The participants were then divided into two panels, each of which were assigned the task of integrating the reports of the previous workshops and developing recommendations on broad guidelines for education and training programming.

Panel IV-A, under the chairmanship of Dr. Herold Sherman of the University of Southern California, was concerned with the development of educational program guidelines for occupational skill groups directly involved in transportation safety. Panel IV-B, chaired by Dr. Robert D. Kersten of Florida Technological University, addressed itself to the problem of integrating transportation safety concepts into a broad spectrum of career and professional education programs. The latter group was also concerned with the development of guidelines for public safety awareness.

Each of the panel chairmen presented a report of their findings and recommendations to a general meeting of all the participants on the last day of the workshop. Mr. William Davis, Deputy Assistant Secretary for Administration, responded to those reports for the U.S. Department of Transportation.

Figure I

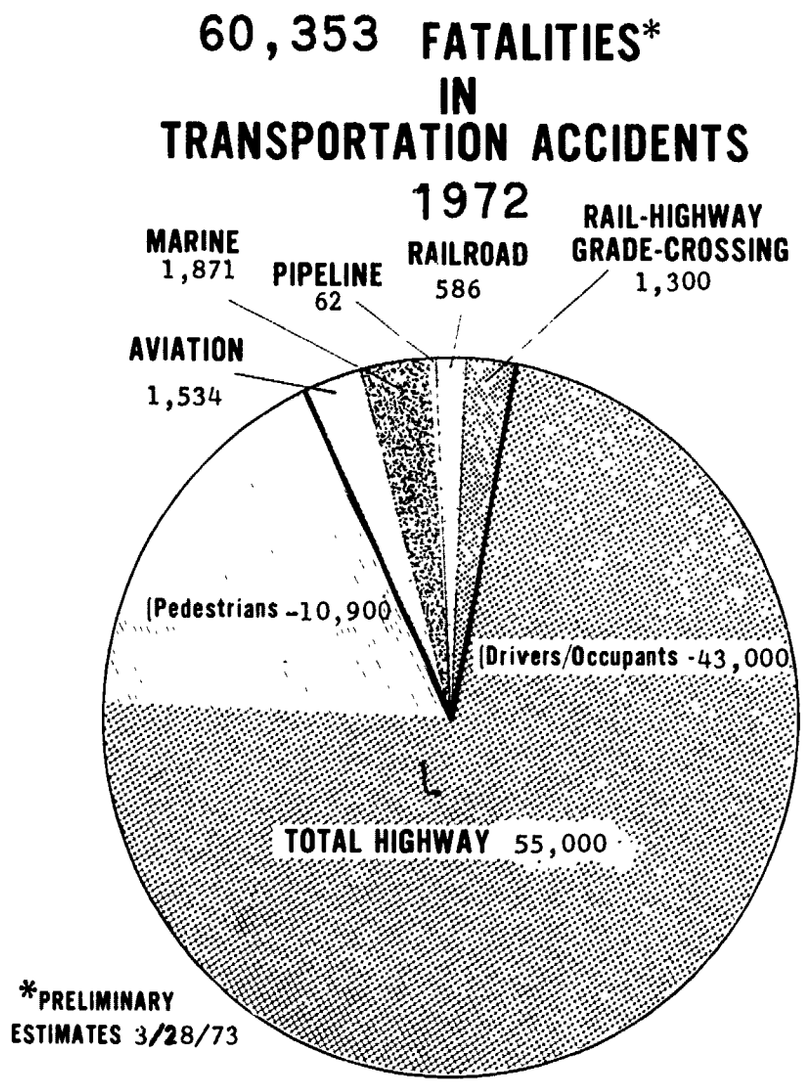
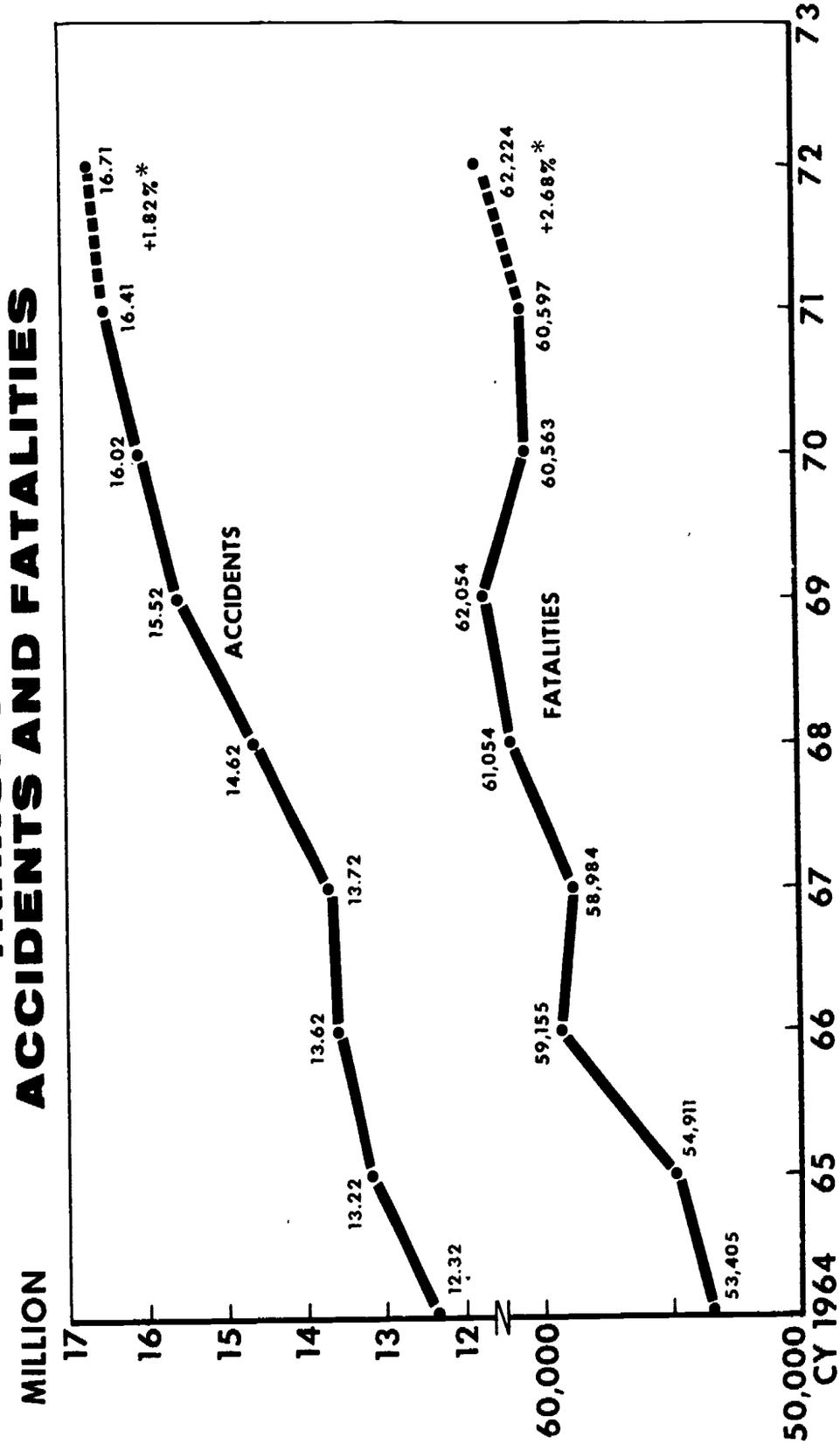

60,353 FATALITIES*
IN
TRANSPORTATION ACCIDENTS
1972
MARINE
1,871
PIPELINE
62
RAILROAD
586
RAIL-HIGHWAY
GRADE-CROSSING
1,300
AVIATION
1,534
(Pedestrians -10,900
(Drivers/Occupants -43,000
TOTAL HIGHWAY 55,000
*PRELIMINARY
ESTIMATES 3/28/73

Figure II


DEPARTMENT OF TRANSPORTATION SAFETY PROGRAM
TRANSPORTATION
ACCIDENTS AND FATALITIES
MILLION
ACCIDENTS
12.32
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13.62
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FATALITIES
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* PERCENTAGE CHANGE PROJECTED 1971 TO 1972

DEPARTMENT OF TRANSPORTATION SAFETY PROGRAM

AVIATION ACCIDENTS AND FATALITIES

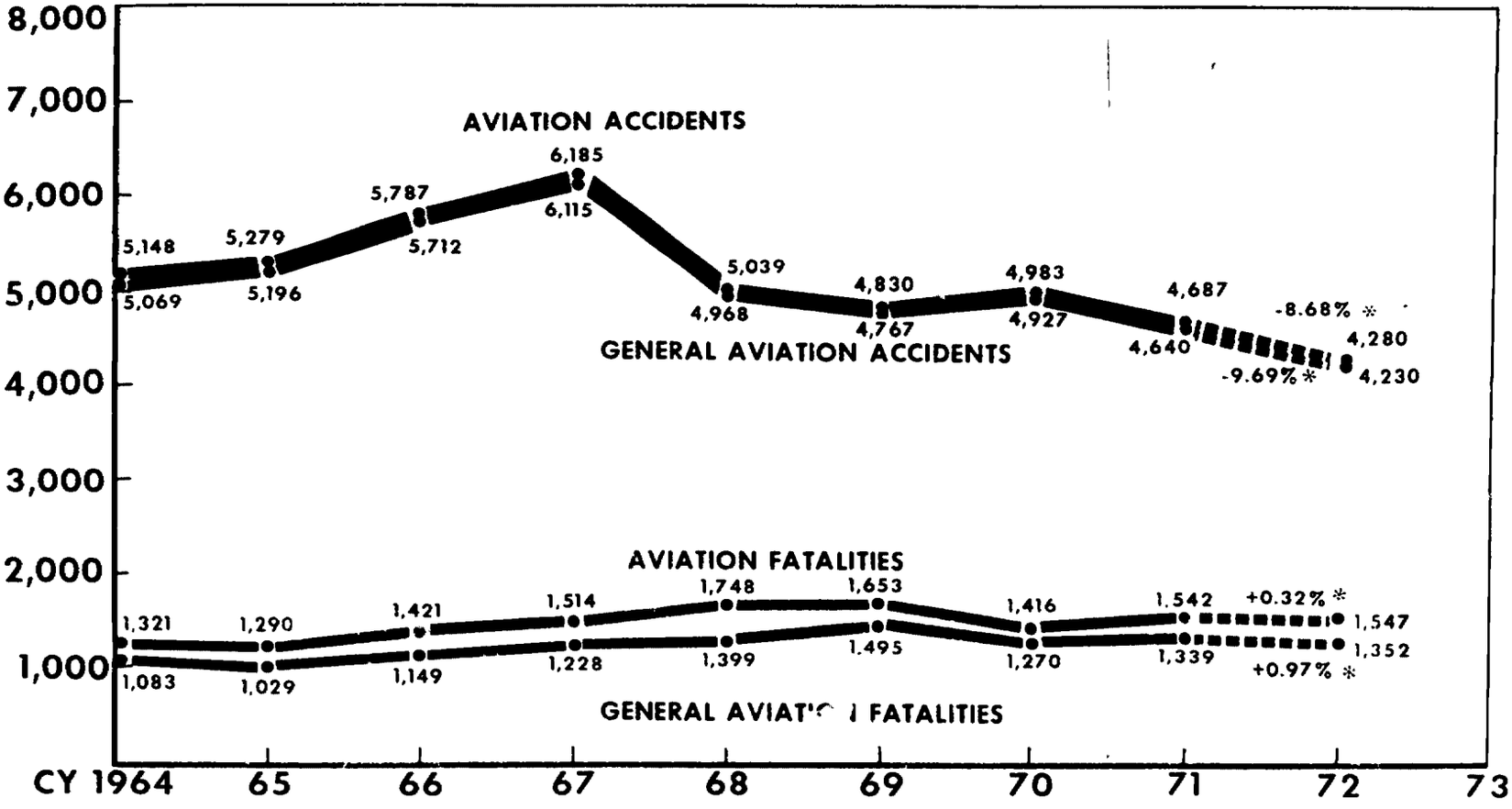

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Figure III

DEPARTMENT OF TRANSPORTATION SAFETY PROGRAM

MOTOR VEHICLE ACCIDENTS AND FATALITIES

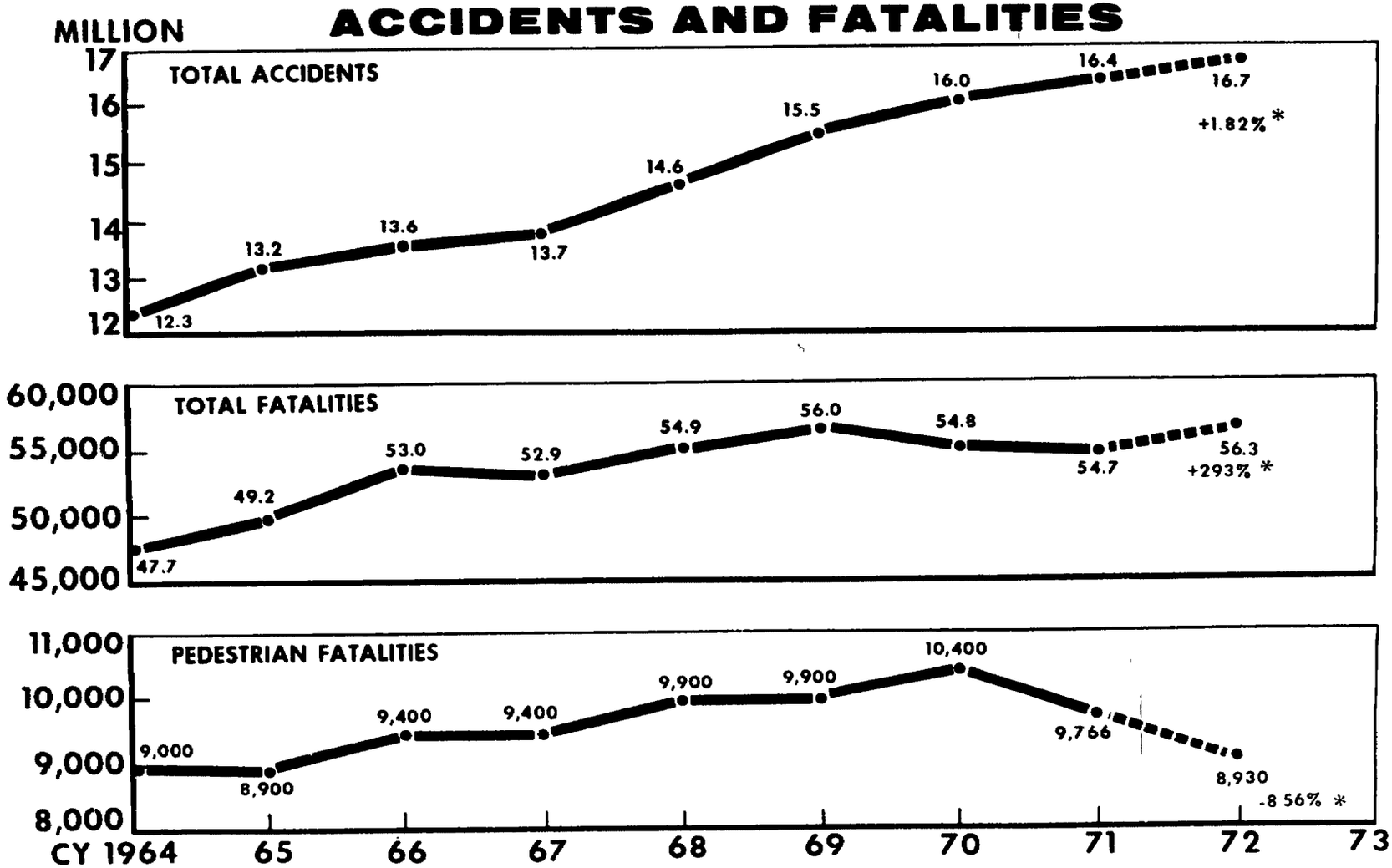

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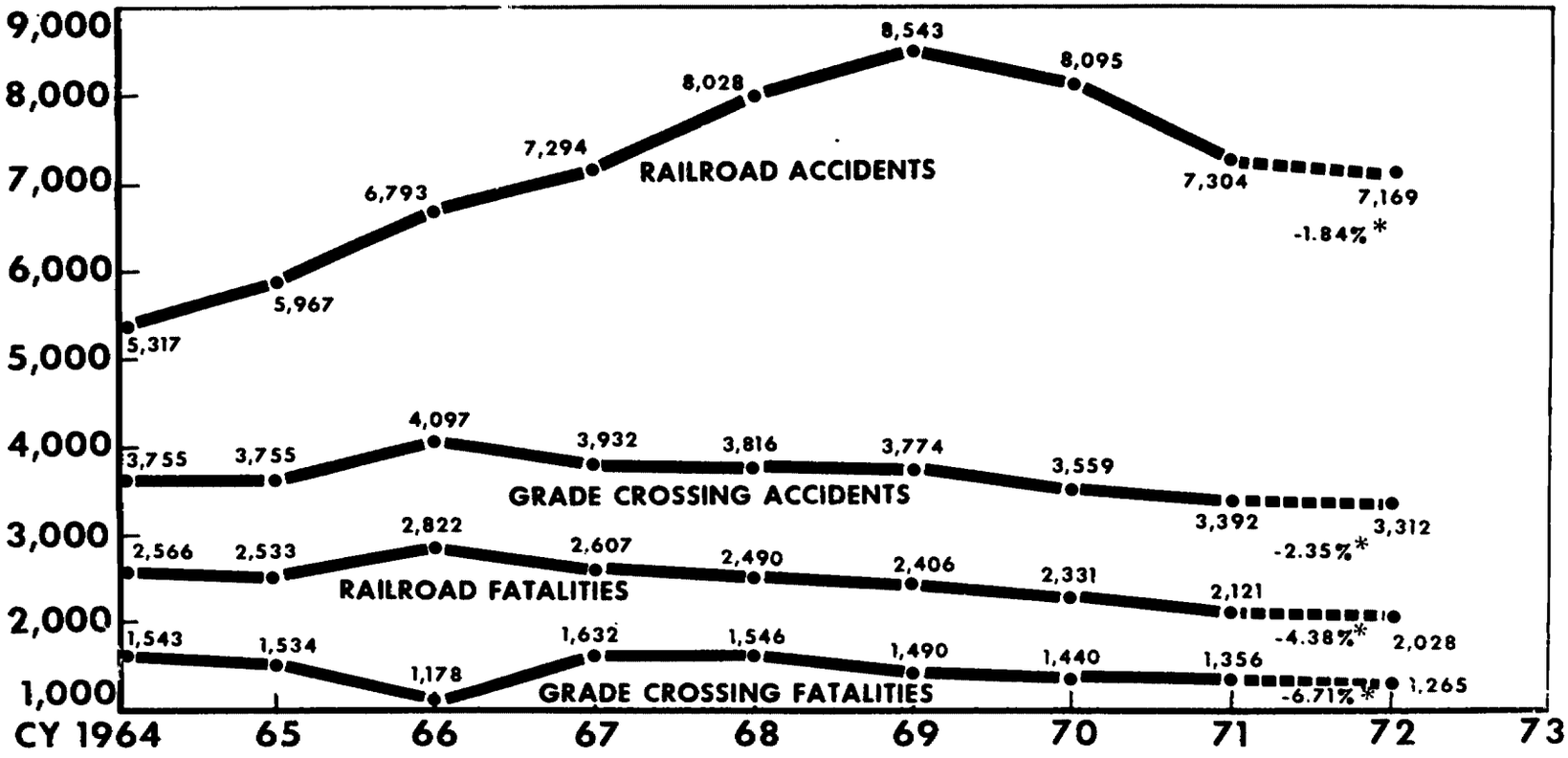
Figure IV

DEPARTMENT OF TRANSPORTATION SAFETY PROGRAM

RAILROAD AND RAIL HIGHWAY GRADE CROSSING ACCIDENTS AND FATALITIES

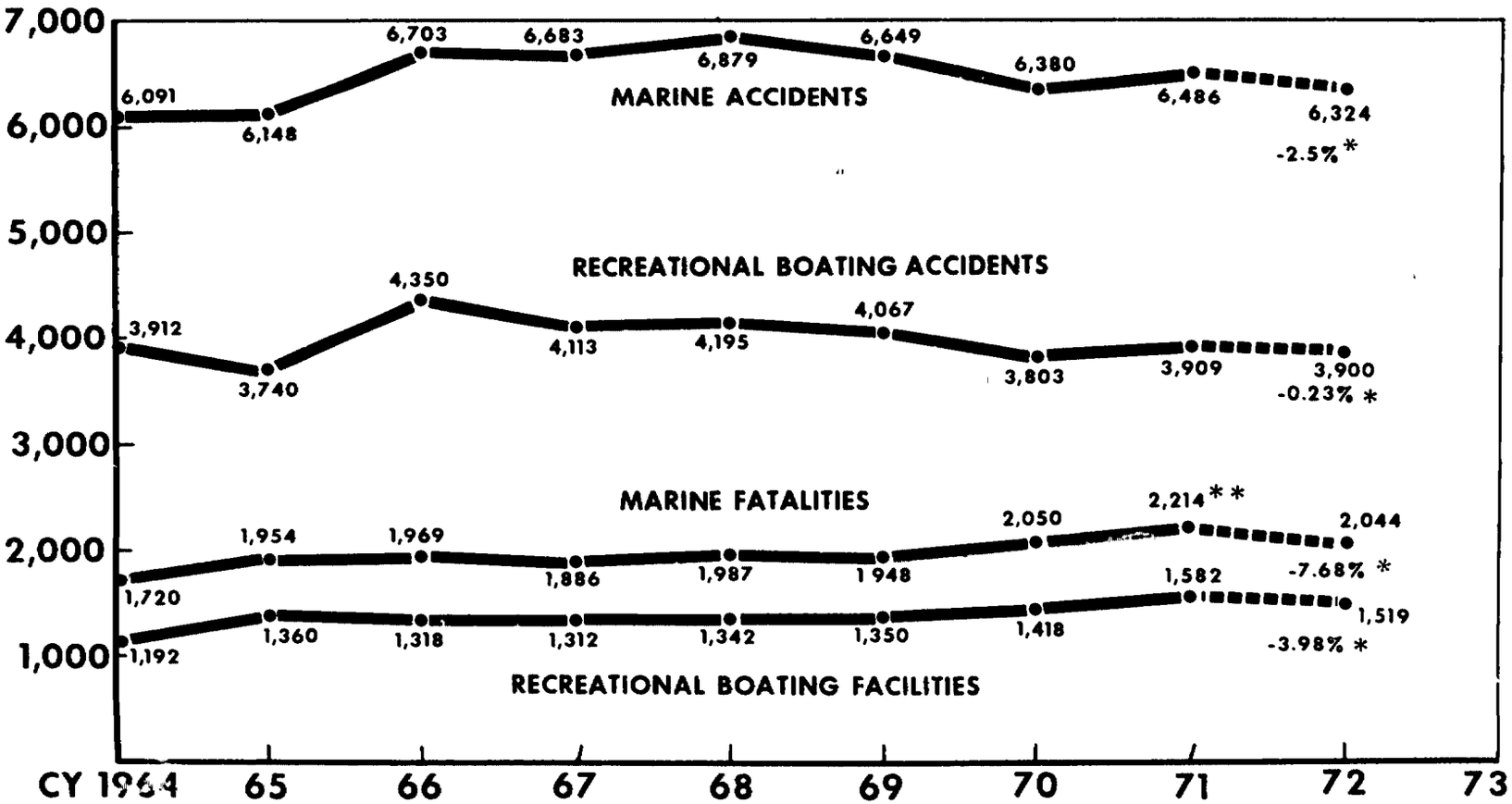


* PERCENTAGE CHANGE PROJECTED 1971 TO 1972

Figure V

DEPARTMENT OF TRANSPORTATION SAFETY PROGRAM

MARINE ACCIDENTS AND FATALITIES



* PERCENTAGE CHANGE PROJECTED 1971 TO 1972

** CHANGE CAUSED BY NEW REPORTING SYSTEM BY STATES

Figure VI

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

A. Problems in Transportation Safety

1. Man - Machine - Environment

During the early phases of the workshop deliberations, attention was focused on the major problems in transportation safety in order to relate those problems to the education and manpower training requirements of personnel to be involved in generating improvements therein. Although each modal representative tended to digress initially on problems inherent to his own system, quite often implying that these problems were different from those of other modal groups, it soon became apparent to all the participants that, for the most part, their problems had a great deal of commonality - - only the dimensions and the framework of references were different. As the discussions progressed, the issues became more and more identifiable under a common set of classification characteristics, and an understanding of the inter-modal mutuality of these problems developed. In essence, the general conclusion was drawn that most, if not all, of the transportation safety problems result from the actions, or interactions, of the man - machine - environment framework within which this nation's transportation systems must operate and that these problems have broad social, economic, political and environmental implications.

2. Human Behavior - A common concern

Throughout the workshop sessions, there was observed to exist, both within and among the modal groups represented, a common concern for the human dimension and its impact on the transportation safety equation. Perhaps more than any other single factor,

human behavior, as manifested by human error in the design of equipment, management decision process, manufacture, operation and maintenance of transportation systems and individual equipment items, was concluded to be the key to the general improvement of performance in transportation safety.

3. How safe or how unsafe?

Lord Kelvin once said, "When you can measure what you are talking about, you know something about it." Perhaps Lord Kelvin could have extended that truism to include, "and given this knowledge, you have the basis for controlling the phenomenon in question." Measurement is fundamental to any scientific progress and constitutes the real difference between a work of art and a scientific endeavor. Suffice to say, the magnitude of the transportation losses is reasonably appreciated, but the precise dimensions are not a matter of clear record, nor are they readily measurable. Thus, the conclusion is reached that the advancement of the "science" of transportation safety will require continued improvement and standardization of the measurement bases of the characteristics of the transportation system.

4. In order for educational programs and manpower training and development to be effective, the goals and objectives of the transportation program must be made clear. In order for the goals to be made clear, transportation managers must decide what problems they are seeking solutions for. Objectives, hence training requirements, will differ if the problem is viewed in terms of preventing all fatalities, or in terms of preventing damages, or in terms of avoiding catastrophic accidents.

Additionally, the economic impact must be assessed and organizational elements of the transportation system should become aware of and responsible for those safety programs that fall within their purview. Questions in this regard include;

- - Should transportation companies be responsible for training manpower to engage in research and development for solutions to rare catastrophic accidents? Or is this the role of government?
- - What is the place of inspection and what is the place of employee safety training? Should each transportation company be free to establish this trade-off? Should the resulting instruction be up to the individual company, industry associations, government regulation, or educational institutions?
- - Should each transportation safety hazard be considered an engineering problem with the objective of making these situations safe in spite of human failures? Or, should these be viewed as a matter which can be taken care of by more training or more highly skilled employees? If equal "contributions" to safety are available through either approach, where does economics enter into the picture, and where are the decisions made as to the approach?

These were the types of questions which were aired and deliberated upon during the workshop. The answers to these questions generates many implications relative to the kind of manpower training needed and the conduct of such training.

Recommendations:

1. Develop standardized definitions for fatalities, injuries, damages, etc., and implement more uniform exposure and loss

d standards throughout the transportation industry.

2. Undertake research in the measurement of safety effectiveness:
   a. Improvement for those variables that can be quantified.
   b. Seek solutions regarding factors that appear immeasurable.
3. Codify or otherwise study existing approaches to priority assessment for possible development of a national policy in this regard to be used as a guide to education and training priorities.
4. Social benefits and social indicators as well as economic benefits should be coupled to the safety program.

B. Skills and Disciplines Required in Transportation Safety.

1. It appears that the nature and content of many of the transportation safety tasks have not been defined well enough heretofore to enable a clear understanding of which of these tasks should be engaged to meet the hazard control optimization objective.
2. There seems to be no question that one phase of the means for developing transportation safety manpower is the wise use of educational and training approaches.
3. It is evident that the transportation modes have mutual training inputs which enable cross transference of skills and common instructional opportunities.
4. Skill requirements for transportation safety positions have not been completely described at this time but they are capable of being described if sufficient effort and emphasis is placed on the task.
5. In planning the development of transportation safety education programs, it would be helpful to be able to quantify pertinent general education levels, as well as the occupational skill

groups in the transportation field.

6. Examination of transportation safety skill groups and other occupational safety positions in different transportation modes frequently indicates a strong similarity in many of the elements of the same levels of jobs.

Recommendations:

1. Transportation safety career training opportunities exist at the high school and two-year collegiate levels of instruction and should be further developed.
2. Work experience should be an integral part of the preparation of practitioners in transportation safety. Mere classroom instruction cannot provide the knowledge required for making sound judgements in the field.
3. Employment data and job opportunity projections, which enable meaningful inferences, are essential to planning the course of educational and training development programs for transportation safety specialists but is not now available. Every effort should be made to provide this intelligence as rapidly as possible.
4. Exploration of the most important subject, with which this workshop was concerned, should be continued. Due to time constraints, the objectives of the workshop could not be fulfilled. The Department of Transportation is urged, therefore, to reconvene the workshop as soon as possible to renew its cooperative analysis of the problem and to refine further the developments from this meeting just ended.

C. Organizational Considerations for Transportation Safety Programs.

1. In establishing a structure for transportation safety, it is

generally agreed that no single method is optimum for all modes and organization sizes.

2. The quantity and quality of manpower required for effecting improvements in transportation safety are generally uncertain.
3. Although there have been no definitive studies in this area, some representatives contend that there is a significant intermodal commonality of safety tasks and skills within the transportation industry, but the same level of organizational commonality does not exist.
4. Career management (advancement opportunity) in transportation safety is rather vague in many sectors of the transportation industry at this time.
5. Industry - government coordination in career management would be useful.

Recommendations:

1. Transportation agencies and organizations should develop and emphasize commonality and transferability of skills among safety programs.
2. A study should be made on how federal standards can encourage improvement in safety practices.
3. Programs should be planned and implemented to make young people aware of career opportunities in safety.
4. A study should be made of the impact of federal government reorganization on safety programs and practices at all levels.
5. Motivational research should be accomplished to determine how the public can be more effectively influenced toward safe practices in transportation.

6. Better techniques should be developed for predicting future requirements for manpower and education.

7. A study should be made to determine means of upgrading the status of safety specialists and safety managers.

8. Safety training should, at the generalist level, include study of comparative organization of safety to produce understanding of the varieties of organization and the conditions which produce them and to develop organizational planning capability. Study of the politics of transportation safety should be encouraged at the generalist level.

D. Public Education Requirements for Transportation Safety Awareness

1. Since human behavior is the key to the general improvement of performance in transportation safety, the objectives of any effective transportation safety program must include emphasis on communication with all sectors of the general public if significant changes in attitude, motivation and subsequent performance are to be realized.

2. There is a need in elementary education to improve, expand or develop a participatory learning and educational process which relates transportation safety to such items as orderly habits, respect for authority, property, and the right of others, recognition of hazards and proper utilization of time.

3. In our secondary education programs there is a need to develop an understanding of and an involvement in transportation safety achieved by instruction which imparts an awareness of equipment limitation, operator variables, personal limitations, personal responsibility and involvement, and the relative impact of safety and benefits on society.

4. At the post high school or junior college level, there is a need to develop an awareness of the social and economic costs of transportation accidents to society as a whole and to the individual, to develop a knowledge of transportation accident causes and preventive measures, and to develop an understanding of the roles of government, industry, and the individual in transportation safety.

5. There is a need in higher education to develop an appreciation for and an ability to understand and apply physical principles to risk situations, with emphasis on transportation safety. Students should be informed concerning safety principles, accident causes and statistics, human factors involved, corrective measures, preferable behavior, and the laws, rules, regulations and programs applicable to transportation safety. They should also develop familiarity with and ability to use sources of safety information.

6. In the various professional programs in higher education, there is a need to develop programs which enable the student to recognize and demonstrate an awareness of professional responsibility for safety in the design, development and operation of transportation systems within the framework of the professional field of activity.

7. In continuing education programs there is a need to focus attention on and inspire public awareness of critical areas of transportation safety as a societal/political vehicle and motivational tool for enabling and forcing improvements in those areas.

8. In our various public information programs there is a need to inform and influence the public such that they modify their behavior and follow safe practices routinely.

Recommendations:

1. Provide separate general transportation safety educational programming at secondary school level so as not to further dilute the driver education program.
2. Establish a clearing-house and/or depository for information concerning transportation safety.
3. Establish special projects to develop educational materials on transportation safety for elementary and secondary school programs.
4. Encourage the development of research programs concerned with motivation and attitude reconciliation for transportation safety.
5. Set up a continuing program for identifying professional/ technical skill classifications and assessing manpower needs in those areas of concern in transportation safety.
6. Initiate funding to encourage the development and support of educational programs in transportation safety.
7. Establish "centers for excellence" in transportation safety in each DOT Region.
8. General recommendations on public awareness activities.
   a. Develop and arrange for education programs for media personnel.
   b. Develop and arrange for TV advertisements and skits for public education.
   c. Encourage reduction in automobile insurance premiums for safe driving and publicize the impact of these savings.
   d. Actively create and promote public awareness campaigns such as the "Arrive Alive" campaign in Florida.

e. Inventory the clubs of the U.S. and develop programs, materials, and implementation plans to make maximum use of club opportunities for public education on safety.

f. Institute several research grants around the U.S. with diverse groups to develop creative ideas for furthering public education on safety.

E. Manpower Development and Training Requirements for Transportation Safety Occupational Skills

1. In order to satisfy the needs of transportation safety, it will be necessary to provide a supply of professional and technical manpower whose education and training background is explicity directed to the field of transportation safety.

2. Because of the diversity of tasks, it is difficult to provide explicit activity descriptions for transportation safety job family areas which are completely applicable to all modes.

3. It is concluded that the following nine job family groups are appropriate manpower elements in transportation safety organizational programming:

- Safety administration
- Safety training
- System safety engineering
- Operational safety program planning
- Safety analysis
- Accident investigation
- Safety security
- Safety inspection and compliance
- Emergency safety services.

PART II

WORKSHOP SESSIONS

SUMMARY

PARAMETERS OF TRANSPORTATION SAFETY

Workshop Panel I

Charles O. Miller, Chairman

A. The Transportation Safety Enigma

The changing demands of modern society created by the use of technology have resulted in increased urbanization and caused many problems. One of the more complex of these, in terms of its harmful effects, may be the transportation safety enigma. The question of how to move increasing amounts of goods and numbers of people over short, as well as very long distances, as rapidly as desired without endangering the travelers or the environments through which they pass has been difficult to answer.

Broadly speaking, transportation safety can be represented by the traditional man-machine-environment factors as either amplified or inhibited by an institutional or management factor. That is, detailed problem areas can be classified under one or a combination of these factors. This sort of classification matrix becomes a fundamental point of reference for both program and manpower development.

Perhaps more than any one single factor, human behavior, as manifested by human error in the design of equipment, management decision process, manufacture, operation and maintenance of transportation systems and individual equipment items, is concluded to be the most complex factor or variable in the transportation safety equation within all modes of operation. Because they are generally easier to identify and cope with, many of our transportation safety countermeasures are concentrated on the machine/environmental factors rather than the human behavior factors.

Although the framework of reference may be different, there are many detailed, transportation safety problem areas common to all modes. Among those problem areas that share this commonality are:

- Identification of level of safety required by or acceptable to the public.
- Safety education effectiveness.
- Measurability of the level of safety.
- Management and labor commitment to safety principles.
- Design for human performance.
- Crash survivability.
- Requirement for better exposure data.
- Safety communication with "constituents."
- Transporting of hazardous materials.
- The role of the safety professional.
- Measurability of safety or lack thereof.
- Personnel staffing; quantity and quality.
- Vandalism.
- Personnel motivation - safety awareness.
- Configuration of an intermodal transportation safety system.
- Identification and documentation of hazards.
- Bystander/pedestrian safety.
- Rail-Highway grade crossings.
- Accident investigation processes (notification, reporting, training, technologies, legalities, jurisdictions, etc.) are fragmented and often cumbersome in most modes but particularly in the highway field.

B. Criteria in Transportation Safety Analysis

The policy underlying the U.S. Department of Transportation's safety program is:

> "To provide for the protection and security of the people, property and environment associated with or exposed to the nation's transportation system . . . "

This presupposes the public's requirement for an effective transportation system, one that can only be degraded by accidents or the lack of safety.

Such degradation will ensue anytime losses are incurred. Such losses can be reflected in any one or combination of the following:

1. Loss of life, or serious injuries.
2. Significant economic loss.
3. Serious compromise to the transportation mission.
4. Marked decrease in public confidence.
5. Impediments to traffic flow.

Basically then, these five degradation aspects constitute the criteria for assessing the overall safety status of a transportation system. There are problems, however, in the specification, acquisition, and maintenance of appropriate and consistent measurements for representing these criteria on an intermodal scale.

Statistical records are available to assess the magnitude of the death/personal injury loss factor to some degree. Limited economic loss information is similarly available somewhat. Even with these two relatively basic parameters in transportation safety, however, very serious shortcomings

exist when viewing the situation on an intermodal basis. For example, even the definition of a "fatality" varies from mode to mode as a function of time beyond the accident at which death might occur. Similarly, with respect to property damage the same differences of definition occur. The reporting requirements differ markedly for each mode and vary according to the governmental administration levying the requirement. Rail accident reporting differs substantially from other modes. All industrial accidents sustained in shop or plant operations are included in rail accident transportation statistics. This is not the case in any other modes.

Although there has been increased study in the economic loss field in recent years, there has been no coordinated effort to examine economic loss information on a common baseline for all modes of transportation.

Assessment of the significance of accident occurrence or the imposition of accident avoidance or loss avoidance measures on the success of a given mode of transportation in the mission sense continues to be a subjective matter. It can be shown, for example, that accidents in the past have severely curtailed, if not eliminated, helicopter commuter service in the Greater Los Angeles area. It is reasonable to assume that if high speed trains encounter catastrophic accidents during their introduction to widespread passenger use, the very concept could be threatened as a needed mode of transportation.

Public confidence in the government's ability to provide "protection and security" is severely undermined any time a seemingly preventable accident of a newsworthy nature occurs. More often than not, this would entail multiple casualties, but it could also result from the death of a single, well-known personality. Once again, however, a precise measurement technique does not exist for this type of loss, which. whether people care

to admit it or not, provides a major input to the public's assessment as to how safe transportation really is.

Suffice to say, the magnitude of the transportation losses is reasonably appreciated; but the impact of those losses are not a matter of clear record nor are they readily measurable. This is particularly critical since these losses must be measurable if they are to be truly controllable.

C. Goals and Priorities in Transportation Safety Programming

To ensure that a transportation safety effort actually achieves maximal results commensurate with expected performance, cost, and mission requirements necessitates a conscientious, effective, sustained, and integrated program. To be comprehensive this program must address itself to the total framework of the man-machine-environment system and the institutional or management factors which determine the goals, plans, and operating policies relative to that system.

While goals provide direction to the planning process, they are also part of it; goals cannot be established without reference to the availability of resources and a time frame for achieving the goal. Goals are established in many ways ranging from rational calculation deliberately chosen from the best available objective data and explicit assumptions to those which may be authoritatively imposed without appropriate explanation, or those developed from reaction or over-reaction to a specific crisis situation.

Safety goals which are established from rational processes and organized around a priority system are more likely in the long run to produce more effective safety programs. As a practical matter, program goals and objectives will continue to be influenced by crisis judgments of legislators and

administrators, popular pressures, self interest promotion, improperly diagnosed problems, inadequate information analysis and the ability to acquire resources. It is probable that these influences usually dominate. Rational processes can usually be brought to bear in influencing goal development and in determining priorities. An understanding of decision making and the use of priority systems will assist in articulation of the rational process and offer greater opportunity to be influential.

There are many forms of priority systems. All forms seek to place sets of values in ranked order. All forms imply trade-offs and resultion of value conflicts.

a. The "Fine" technique[1]- rate variables - mathematical formula.

b. Frequency distribution - worst cases first (OSHA).

c. Long run vs. short run payoff.

d. Political/managerial decision.

e. Test of goals/program against seriousness, urgency, growth, susceptibility to solution for ranking purposes.

D. Manpower Ramifications

Implicit to comprehensive transportation safety programming is the realization that a total program for accident prevention and loss control requires a multi-disciplinary approach. This can, and often is, achieved by a team approach whether this be done before-the-fact such as during a hazard analysis or after-the-fact such as in an accident investigation. It can also be accomplished to a degree by an individual safety specialist who is sufficiently informed in all facets of the safety process to enable him to call for help when he needs it.

The multi-disciplinary nature of accident prevention-loss control efforts requires certain approaches to the education and training of those

[1]William T. Fine, "The Fine Technique," Journal of Safety Research, National Safety Council, Vol. 3, No. 4, December, 1971

who become involved in safety problems and their solutions. Beyond the safety specialist noted above, there is first a need for safety knowledge by the first line organization engineer, operator maintenance man, and others responsible for an organization's operations. They need sufficient understanding not only of the detail safety ramifications of their job but perhaps how their work relates to others.

E. Implications of a System Safety Approach

In a contemporary sense, the philosophy of system safety embraces all conceivable interactions of the man-machine-environment elements which are used together as an entity and are capable of performing and/or supporting a transportation role. System safety goes beyond the transportation vehicle and its associated operating characteristics and procedures. Its scope includes attitudes and motivations of design, production, test, and operation, as well as possible consideration of a large spectrum of social, economic and political interactions which affect the total spectrum performance and the level of risk desired.

In a simplistic sense, system safety can also be considered as a marriage of the "systems approach" with safety orientation. There are eight characteristics considered to be essential to the system approach concept, and these may also be basic to system safety. This approach involves a methodical, objective, quantitative or measurable, analytical, subsystem dependent, elemental analysis in parallel rather than series, input/output specification, and self-containment treatment of the system in a very explicit and hierarchical fashion.

By means of analysis, the system safety approach proposes to permit optimization of the management decision process. Unfortunately, any system safety analysis can only be as accurate as the information and

model on which the analysis is based. Thus, in its application to transportation, the system safety approach is likely to be incomplete until the state of knowledge of hazard possibilities and probabilities is fully developed.

TRANSPORTATION SAFETY MANPOWER TASKS

Workshop Panel II

Dr. John Grimaldi, Chairman

A. Identification of Transportation Safety Manpower Tasks

Safety as an objective probably is as old as mankind. Its systematic pursuit, however, is a relatively recent development in the course of human progress. Within only a little more than 60 years has there been a significant growth in safety techniques, the body of knowledge required to implement them, and safety technicians, the occupations required to meet society's safety needs. At this time, however, it appears that the nature and content of many of the transportation safety tasks have not yet been defined well enough to enable a clear understanding of that which should be performed to meet the hazard control optimization objective. Due as much to the inadequate descriptions, generally, of the specific safety functions to be served, as well as to the frequent overlaps in assignments that stem therefrom, there is inefficiency in the use of safety manpower in the development of the transportation safety job pool. There is a clear need, therefore, to have discussion, leading to agreement among the transportation safety organizations and employees as to what the individual hazard control assignments might be and how each is constituted. This seems to be a major problem to be solved if manpower utilization in transportation safety is to proceed with maximum capability for contributing to the hazard control objective.

B. Role of Education

There seems to be no question that one phase of the means for effecting transportation safety is the wise use of educational and training approaches. It is evident, for example, that structured programs

which teach a broad appreciation of the advantages in following safety precepts are a precursor to effective application of hazard control skills in all transportation skill assignments. Therefore, it is considered important that a basic safety training approach be integrated into every transportation skill preparation program. This cross fertilization of transportation assignments, with needed safety knowledge, in a sense links all transportation tasks in the move toward greater transportation safety.

C. Requirements for Transportation Safety Education

Education requirements for transportation safety positions have not been described accurately at this time. However, it is obvious that different levels of education and training are required for the performance of the various transportation safety jobs. In general, these may be considered as follows:

1. A high school education prepares a graduate to perform certain entry level jobs, with further training provided by the transportation industry, government, or unions.
2. A post high school, special, technical education provides entry at the transportation safety technician level.
3. Lateral transfer of transportation workers into "safety areas" may come about through in-house training or through technical education courses.
4. Various baccalaureate programs prepare graduates for entry level professional and/or supervisory positions, -- particularly in safety engineering, safety administration, and safety training.
5. Certain post-baccalaureate programs provide specialized training for entry levels in safety program planning, development, analysis and management.

In planning the development of transportation safety education, it would be helpful to be able to quantify pertinent general education levels as well as the occupational skill groups in the transportation field. Unfortunately, there is a dearth of data from which meaningful inferences can be drawn. Thus, there is a critical need for the development of employment data and job opportunity projections for transportation safety assignments. In general, it must be emphasized that the elements of the many transportation safety skill levels and the educational requirements for their attainment are still obscure, thus hindering the development of viable training programs.

D. Modal Commonality in Transportation Safety Occupational Skill Groups

Examination of transportation safety skill groups and other occupational safety positions frequently indicates a strong similarity in many of the elements of the same levels of jobs. For example, the administrator of the transportation safety program requires much the same training and skill as the director of an occupational safety program. Likewise, the investigator of transportation accidents needs the same analytical, interviewing, reporting and evidence gathering skills and tact as the accident investigator in industry or another functional area. A safety analyst, planner, trainer or other specialist requires basically the same preparation irrespective of whether he performs in transportation related assignments or in industry, for example. Therefore, it is seen that considerable opportunity exists for cross transferance of skills and training.

It is considered generally that the safety director is the superior hazard control position. An incumbent must have a substantial understand-

ing of the skills required to complete the tasks for each of the safety specialist positions he will direct toward the fulfillment of his hazard control responsibilities. His work is largely concerned with planning, organizing, coordinating and measuring the program he is responsible for implementing. The supporting safety specialties such as trainer, accident investigator, inspector, etc. then are the building blocks which will form the safety achievement structure.

It is probable that the level of training acquired by the incumbents has a bearing on the accident reduction effectiveness of the roles they play. In a study some years ago by the American Society of Safety Engineers, it is recalled that the best disabling injury frequency rates were achieved by those specialists who had received the higher level of training (i.e. baccalaureate or higher degree). They occupied positions which reported closest to top management - - a factor which probably increased their overall effectiveness. It must be pointed out, however, that until recently there was little or no safety training available for specialists in the field. Most of the practitioners were trained in an allied discipline, e.g. engineering, business management, education, etc., and found their way into safety assignments by one means or another.

E. Requirements for Change in the Educational Structure

The complexity of technology has created a new relationship between man, his education and his work in the transportation system. The educational requiements for all levels and skills are complex and constantly changing. This change calls for a massive response by the total educational community at every level of activity, both in the classroom and in a variety of school-community situations.

According to the U.S. Office of Education, nearly 2,450,000 students dropped out of school during the 1970-71 school year. For these young people, the educational community had failed its fundamental purpose, to prepare them to live a productive and rewarding life by providing basic education relevant to today's real world and to provide basic job entry skills.

At the elementary and secondary levels of school, students complain of dull and irrelevant curriculum - that upon graduation they are not ready to enter the labor market. Education and the business community must join forces to insure each student that he will have a job entry skill of some degree or his education will enable him to enter a post-secondary course of instruction. The academic and vocational curriculum must be married, and cooperative educational programs msut be expanded to allow "hands-on" exploration so that the student can make intelligent career choices and enter into skill training.

Post-secondary programs must touch down at the elementary-secondary level and evaluate the program choices and offerings in terms of the student needs at the post-secondary level, be it technical school, junior college, or higher degree granting institutions.

Yet, threaded throughout all levels of education, we must see greater involvment of business and industry in planning, operating and evaluating educational offerings in terms of the student's total needs to fulfill his career goals.

ORGANIZATIONAL CONSIDERATIONS FOR TRANSPORTATION SAFETY PROGRAMS

Workshop Panel III

Fletcher N. Platt, Chairman

A. Organization Base For Transportation Safety

The effective transportation executive knows the value of organization. He realizes fully that no objective can be achieved, whether it be for operation, maintenance, marketing, or safety improvement does not come about unless all levels of the organization are motivated toward that objective.

In delineating the organizational principles and career management requirements for transportation safety occupational skill groups, consideration must be given to the organizational environment within which these groups will operate. This includes evaluating the impact of different organizational structures on both career patterns and education and training requirement, indicating multi-modal commonalities, developing organizing principles, and identifying requirements for entry and mid-career education and training.

To attack this task it is necessarcy to consider the ramifications of transportation safety. In a broad sense this includes four major areas of concern:

1. Passenger Safety
2. Employee Safety
3. Public Safety
4. Product Acceptance

Passenger Safety involves the concept of public responsibility for people (and by extension, property) entrusted to the care of a common carrier.

The responsibility of the private company is a public trust. It is subject to public regulatory actions and to a public decision as to concepts of accepted safety. Safety concepts may be fostered by public education and awareness campaigns as well as by requirements for specific employee training, certifications, and other manpower development activities.

Employee Safety involves a different concept of responsibility. The employer has the responsibility to provide for the occupational safety of the employees. Safety training, whether for-the-job or on-the-job, is the responsibility of the employer (or in some cases the union). Commercial and governmental decisions affect the degree of consideration to be given to the equipment redesign needed to eliminate potential hazards and the training required to instruct employees on how to operate equipment safely.

Public Safety involves a third concept of responsibility. The public is an element of the environment through which a transportation system must operate. People walk on roads and are injured; tank cars explode, airplanes fall on houses, and other similar incidents involve those who are only indirectly involved with transportation and transportation safety problems. In this regard, transportation organizations must consider their activities as "environmental hazards" and be prepared to assume responsibility for those events which cause harm to others. They must also weigh the cost of protective and enforcement measures to keep others (vandals, tresspassers, etc.) from being in a position to harm themselves, the transportation firm, or others. Public Safety involves an additional concept if transportation safety is considered as a function of the casual user instead of a function of the industry. More deaths and injuries occur in private automobiles than in public busses and trucks; among private aircraft than in passenger airlines; and in pleasure boats than in commercial boats.

Product Acceptance forces private industry to balance safety considerations with the ability to sell its products. Smoking may be a health hazard but millions still smoke; people have accidents in automobiles but they still drive. Occasionally, however, specific modes of transportation are considered as "too hazardous" and their use declines. Organizations must bring new training resources to bear in modifying their product lines so as to improve their acceptance by the public.

B. Structure for Safety

The structure for safety must be founded on a base. This base rests on establishment of policy as a first step. Safety, by policy within the U.S. Department of Transportation, is of top priority. Its policy is to be preventive primarily, reactive secondarily. Programs support the policy, based on plans, and involve man-machine-environment interactions. Programs relate all elements required to do the job regardless of mode. In addition to programs, goals are necessary to have targets for the future and measuring sticks for accomplishment. The organization, as a structured group of persons and resources, prosecutes the programs of transportation safety. Both line and staff efforts are involved, as well as informal and interdepartmental activities.

In establishing a structure for transportation safety it is generally agreed that no single optimum method is possible because of diverse needs even with common goals. The optimum methods for various agencies, federal, state or commercial, will be different. For example, with an industry it involves both a specific safety organization and participation of many disciplines such as engineering, to produce a safe product.

Certain facets will be common, however. Standards, procedures, planning analysis, reporting, training, compliance, certification, are some of the terms entering the programs of the different organizations. Beyond these will be specialized needs such as the education of foreign customers with attendant language and metric system difficulties. The organization must be modified, by addition, subtraction, or change in function to accomplish the objectives of an optimum safety program.

In the case of a state department of transportation, all or only a few modes may be involved. These organizations are usually modal rather than functional, though there are commonalities. In the U.S. Department of Transportation, safety is handled by modes with high level coordinators. The organizational structure in any case will depend on agency objectives, authority and instruments provided, and be subject to constraints or pressures, such as political considerations. Any organizational structure is optimum only at the present instant, and each organization must be subject to continual review and alteration to meet changing conditions. Additionally, the politics of the situation will influence governmental organizations.

An important part of the organizational task, particularly for the governmental agencies, is to set up procedures to look ahead many years and to make adequate planning. Both federal and state agencies should do this.

Another segment is manpower development, education, and training. All agencies must adequately attack these problems to insure an adequate safety approach, quantitatively and qualitatively.

C. Manpower Implications of the Safety Structure

Many different types of personnel are involved in transportation safety. These include those who are specifically educated or trained for employment in a safety position. A safety engineer is an example. Others might be engineers who would receive additional on-the-job or short-course training in safety. The safety system also includes others such as the teacher, industrial hygienist, operator, behavioral scientist, licensing agent, accident investigator, emergency medical technicians, traffic enforcement officers, etc.

In order to adequately attack the transportation safety problem and plan for future manpower needs, there must be an identification of task and skill requirements, quantity requirements, and a projection of these for the future. The level of committment to a safety program will greatly influence the manpower needs in any given safety organization.

Manpower needs can be used to establish education and training requirements in addition to staffing. Since automation will be entering more phases of vehicle operation and control, data collection and analysis, evolutionary changes in the nature of manpower may be expected in many areas. Thus, more numbers, but with different characteristics, may be needed. If greater safety needs to be designed into a product, more engineers may be needed. At the same time, fewer accident investigators and attorneys might be required. The personnel involved in establishing and operating an advanced, automated, safe system would need to be more highly qualified than in the past. Thus the numbers and specific expertise would change. This must be recognized in future planning for recruitment, education, and training, as well as organization structure.

In any safety structure of this type both specialists and generalists will be needed. In examining modal needs it appears that at the higher levels a well educated or trained generalist should be able to apply principles across modes. Some intermodal expertise also may be required. In any case, studies of safety manpower requirements should look at the total system using competent manpower, realizing that the loosely controlled systems, such as automobiles, may be difficult to analyze. However, the analysis should examine parts of the system, including the operator and other personnel involved. In developing better systems there should be a study of human behavior, including motivation of people involved in the development, construction, operation, and use of the system.

D. Skill Transference

Specialists and generalists exist in the transportation safety effort. It is suggested that specialty training is needed for lower level personnel, more general training at higher levels of management. Considering modal variations, there may be significant degree of commonality. Hence higher level employees should be able to move among modes and apply their managerial skills. Techniques of analysis are probably basic and hence transferable and applicable. Similarly, management skills are transferable among agencies. Thus a person may move between education, industry and government with some additional training being required. Commonality then, exists in tasks and skills at certain levels not in organization. Admittedly, specialists may not fit, and some people will choose to become restricted specialists. Some specialists always will be needed.

It is recommended that further study be made for ways to develop and emphasize commonality and transferability. This would assist in promoting maximum flexibility of effort and should improve the overall expertise of the individual. Transfers of people between organizations should be encouraged.

E. Career Management

The transportation safety effort is very diverse. It involves many agencies from large governmental to small commercial units. No standardization of organization, functions, or personnel tasks and skills has developed across the entire spectrum. Hence this is a loosely structured system where career opportunity can occur but career management may not be possible in many cases. In a large organization such as the federal government, career ladders may be possible. In small organizations the safety branch may be one man, and the position or positions available may be dead-end unless movement to some other type occupation is possible. Hence career management may be difficult. This compounds the recruitment and employment problem for the young since advancement opportunities may not be explicitly visible.

Education for entry into the professional positions available may involve a baccalaureate degree in occupational safety and health as but one example. This is given at only a few schools in this country. Others may enter with limited safety education and may need training after entry. Mid-level or continuing education will be a necessity. These education and training efforts may be one way to establish a career ladder.

Continuing education, a responsibility of management, is a way to promote staffing since it offers opportunity for personal improvement. It should be set up so as to minimize the chance of being permanently placed in a dead-end job. An education and training program is an essential part of the organized effort. Note that certification may go along with this. Certification identifies skills and people. It does not establish a career ladder.

Career management includes recruitment. Consideration should be given to making young people in the elementary and secondary grades aware of career opportunities and what safety personnel do. Perhaps by this means input can be improved over the long term.

In order to induce more qualified applicants to enter the safety field, a study should be made to determine means of upgrading the status of safety specialists and safety managers. This should include the development of minimum educational requirements and ethical standards similar to other recognized professions and sub-professions.

F. Role of Agencies in Developing Transportation Safety

The federal government must assume a leading role in developing the basis for safety improvement. This includes manpower needs and education projections. Public safety is a governmental responsibility. This requires support of the education and training programs.

State governments, through state departments of transportation and supporting agencies such as the police, play an active role in providing the public with safe operating systems. These governments must be heavily involved in day to day operational safety associated with highways, public carriers and similar transportation modes. The federal regulations will establish constraints on their operations to improve standards or to set minimum levels of safety performance. The two governmental structures must have a close working relation because of the rules, regulations, standards, and economic and political interactions.

Many other agencies are also involved. They include the manufacturer, consulting engineer, trade associations, professional engineers, and the educational institutions. The manufacturer is subject to governmental regulations plus any self imposed constraints. Educational institutions

provide support in offering entry level or continuing education programs depending on need, opportunity, and support. Educational institutions also provide research support for both government and industry. All agencies must fit into some reasonable pattern in the overall national transportation safety effort.

EDUCATIONAL PROGRAM GUIDELINES FOR TRANSPORTATION SAFETY OCCUPATIONAL SKILL GROUPS

Workshop Panel IV-A

Dr. Harold Sherman, Chairman

A. Introduction

In order to satisfy the safety improvement needs of the transportation industry, it will be necessary to provide a supply of professional and technical manpower whose education and training background is explicitly directed to the field of transportation safety. The following are broad guidelines for educational program development for occupational skill groups involved directly in transportation safety. The purpose of these guidelines is to assist educational institutions at all levels, industrial safety managers, government safety program managers, and transportation associations in meeting requirements for educating and training persons in the field of transportation safety and in aiding states in fulfilling requirements of comprehensive manpower training plans.

B. Manpower Classifications

The U. S. Office of Education defines an "occupational group" as a number of jobs, job families or both groups together on the basis of goods or services produced. Twelve occupational groups have been designated within the transportation career educational field. These are: Data Management, Distribution, Environmental, Maintenance, Management, Marketing, Passenger, Regulatory, Safety and Security, Systems Planning, Vehicle Operation, and Vehicle Support. It is recommended here that "Safety and Security" be designated as separate occupational groups. In addition, many safety occupations are identified with the public service career field at various levels of government.

A "Job Family", as defined by the U. S. Department of Education, consists of a number of jobs grouped together on the basis of their related skills and knowledge, or their inherent interdependence upon each other. Under this definition, the workshop participants identified nine job families within the transportation safety occupational group. They are: Safety Administration, Safety Training, Safety Engineering, Operational Safety Program Planning, Safety Analysis, Accident Investigation, Safety Security, Safety Inspection and Compliance, and Emergency Safety Services.

C. Transportation Safety Job Family General Activity Guidelines

Because of the diversity of tasks, it is difficult to provide explicit activity descriptions for transportation safety job family areas which are completely applicable to all modes. After reviewing and cross-referencing a variety of modal activity elements, however, it becomes apparent that there are many similar activities that do relate quite well with the aforementioned nine transportation safety job family groups. Some preliminary activity guidelines in that regard are listed as follows:

1. Safety Administration

   Develops the safety policy and works for its adoption by top management; implements safety policy; disseminates knowledge of applicable standard operating procedures; initiates effective training and safety education programs; plans, organizes, coordinates, and implements safety programs, including hazard control and emergency aid functions; applies reliable and valid measures of the performance of the safety operation.

2. Safety Training

   Assesses training needs; identifies and evaluates existing training resources; develops needed training resources and programs and obtains management support for their implementation; conducts

the approved program; evaluates the training program in terms of the pre-determined goals for the training program.

3. Safety Engineering

Designs safety systems and sub-systems for transport equipment and facilities; tests and evaluates safety characteristics of transportation equipment, products and facilities; develops criteria for minimizing the hazards of the man-task-equipment-environment and facilities systems.

4. Operational Safety Program Planning

Delineates necessary safety tasks for the operation; develops contingencies; plans and identifies the individuals best able to implement them; makes recommendations leading to the safe operation and design of equipment. Improves the safety aspects of the work environment.

5. Safety Analysis

Establishes evaluative criteria for appraising safety effectiveness; collects, evaluates and disseminates data; conducts analyses and makes recommendations therefrom.

6. Accident Investigation

Investigates unscheduled, unwanted events which cause or have a potential for causing death, injury or property loss; determines causal relationships; prepares required reports and records relative to these events; and identifies suggested correction needs.

7. Safety Security

Develops and implements regulations and procedures for preventing illegal acts that cause loss of life, injury, economic loss, disruption of mission and loss of public confidence which affect passengers, personnel, material or equipment. Enforces traffic

laws and regulations.

8. Safety Inspection and Compliance

   Applies authoritative safety standards to determine the level of compliance; recommends corrective action within the constraints of the applicable standards; conducts follow-up inspection of compliance effectiveness.

9. Emergency Safety Services

   Recognizes, prevents, corrects, and assists in the solution of potential emergency conditions and reduces the impact of an accident or a potential accident.

D. Modal Job Family/Job Title Comparisons

In order to test the consistency of the "job family" ordering, the various safety positions for a sample of five safety organizations were assigned to the nine job family service areas. Listings of these five organizations are shown in Appendix II of this report.

As would be expected, considerable comparability exists in safety position assignments within the larger organizations, while in the smaller agencies or firms one position title must of necessity serve in several capacities.

E. Transportation Safety Position Descriptions

In order to further the intermodal adaptation of the job family hierarchical concept, job position descriptions must be developed within the various job family groups. As an experiment in this direction, three different job families were defined. The positions defined are Safety Administrator, Safety Engineer, and Accident Investigator. These definitions, along with a listing of tasks and skills incident to each position, are included in Appendix III of this report.

F. Educational Program Guidelines

After the skill requirements for the various transportation safety positions have been developed and specified, the identification of educational program guidelines necessary to the acquisition of those skills becomes a relatively easy task. Educational program guidelines for the three previously described safety positions are included in Appendix III along with the position descriptions.

This step of allocating training and education components by discipline (or skill) then makes possible the next step in the process of building to an inter-modal, transferrable training and education program.

The accumulation of disciplines and skills required in the mode can be combined into a matrix cell which will show the commonality of training at the basic skill and technique level and also the management principles and techniques.

EDUCATIONAL PROGRAM GUIDELINES-GENERAL

WORKSHOP PANEL IV-B

Dr. Robert D. Kersten, Chairman

A. Introduction

There exists today a significant concern for transportation safety in all of its many facets. Perhaps more than any one single factor, human behavior, as manifested by human error in the design of equipment, management decision process, manufacture, operation, maintenance, as well as user practice, is the key to the general improvement of performance in transportation safety. Therefore, the elements of any effective transportation safety program must employ vectors which are dedicated to providing a basis for controlling and/or correcting the error function in those processes. Since many of these processes operate outside the sphere of direct influence of the transportation safety specialist or professional, it is necessary to employ other mechanisms wherein the knowledge and motivation for safety is promulgated. A viable program of safety education, directed to a broad spectrum of professional and technician career areas, and to the general public, would constitute one of the primary mechanisms in this regard.

The following pages delineates the general objectives and some preliminary guidelines to the broader aspects of educational programming related to transportation safety as a part of (1) a safety awareness program, (2) a general education program, or (3) as elements within disciplines which may cross not only transportation but other career lines.

General instructional guideline objectives are given for the major sectors of the educational system (other than specific transportation safety career fields which are discussed in an earlier section of this report).

Several specific program element guidelines are cited for each sector to exemplify the instructional areas to be covered.

B. Elementary Education

Program Objectives

To improve, expand or develop a participatory learning and educational process which addresses itself to such items as the creation of orderly habits, respect for authority, property, and the right of others, recognition of hazards and proper utilization of time, as it affects transportation systems.

Program Guidelines

- Identify features of transportation modes designed to improve safety to users, employees, and the public. Supplement instruction by examining transportation modes on field trips. Require recognition of safety features for each mode of transportation.
- Relate problems of safety to trespassing, vandalism and loss through theft. Show how these acts create an increase in accidents as well as how the protective measures employed by companies can themselves be accident causes.
- Relate principles of transportation safety to the lifespace of each child. At the elementary level, discuss identification of hazards; caution in the use of machinery which is "unforgiving" of carelessness; use of safety devices as a probabilistic safety concept. (i.e., while a single non-use of a seat belt may not lead to death, those who

use seat belts may live longer); and courtesy to others and adherence to rules as a factor in safety. Relate these to bicycles and other transportation vehicles used by children.

- Ensure understanding and familiarity with traffic signs and symbols. Describe importance of everyone having the same understanding and doing the same things. Illustrate the impact of training on forming habits which will prevent accidents in emergency situations.

C. Secondary Education (High School)

Program Objectives

To develop an understanding of and involvement in transportation safety achieved by instruction which imparts an awareness of equipment limitation, characteristics of hazardous materials, operator variables, personal limitations, personal responsibility and involvement, and the relative impact of safety costs and benefits on society.

Program Guidelines

- Demonstrate equipment limitations, e.g., stopping distance at 30 mph and 60 mph
- Illustrate the impact on transportation systems of hazardous materials, e.g., flammable and toxic materials.
- Point out the influence of operator variables on the safe operation of vehicles, e.g., influence of inattention,

fatigue, alcohol, drugs, medication after illness, variable eyesight, degrees of physical strength, emotional factors.

- Explain personal limitations, e.g., experience, actual measurement of judgment and reaction times.
- Emphasize personal responsibility and involvement, e.g., importance of courtesy and responsible attitudes, need for practical (simulator) training, compliance with rules and procedures.
- Explain the relative impact of safety costs and benefits on society, e.g., (a long range aspect of the program). How much will it cost the state to eliminate all highway accidents? How much does society benefit from a given reduction in the number of accidents? Insurance rates and accidents, etc.

D. Post High School or Junior College

Program Objectives

To develop an awareness of the social and economic costs of transportation accidents to society as a whole and to the individual; to develop a knowledge of transportation accident causes and preventive measures; to develop an understanding of the roles of government, industry, and the individual in transportation safety.

Program Guidelines

- Cite comparative statistics on human and economic losses attributable to transportation accidents and losses attributable to other causes, such as crime, war, and disease.

- Cite economic cost to the individual in terms of insurance premiums, taxes, lost wages, etc.
- Identify the various causes of accidents (e.g., alcohol, drugs, fatigue, environmental) and their interactions.
- Demonstrate the ability to recognize potentially hazardous situations or conditions (in an actual or simulated setting) and take proper precautionary actions.
- Explain the reasons underlying each of the traffic regulations of the state.
- Explain the cause or causes and cite any violations of traffic regulations, given a physical description of an accident.
- Describe the responsibility of Federal, State, and local governments with regard to transportation safety.
- Describe the responsibilities of the components of transportation industry.

E. Higher Education - General

Program Objectives

To develop an appreciation for and an ability to understand and apply physical principles to risk situations, with emphasis on transportation safety. To inform the students on safety principles, accident causes and statistics, human factors involved, corrective measures, preferable behavior, and the laws, rules, regulations and programs applicable to transportation safety. To develop familiarity with and ability to use sources of safety information.

Program Guidelines

- Introduce physical concepts, e.g., forces involved in moving vehicles, skid resistance, falls of persons and why these cause injuries.
- Introduce concepts of risk structures, e.g., recognition that all activities involve some risk and that individuals can exercise some control over these risks.
- Explain environmental variables and human limitations, e.g., the importance of systems analysis and design considerations involving environmental variables and human limitations.
- Explain control by regulation, e.g., regulatory standards as they address specific accident causal factors.
- Explain control by motivation, e.g., psychology of accident prevention, personal motivation processes.
- Integrate safety into transportation as a cost factor in the system. Introduce system safety concepts. Demonstrate trade-offs between safety and other system costs.

F. Higher Education - Professional

Program Objectives

To recognize and demonstrate an awareness of professional responsibility for safety in the design, development and operation of transportation systems within the framework of the various professional fields of activity.

Program Guidelines

- Develop the body of knowledge appropriate to understanding transportation safety principles and practices in a particular professional field.

- Emphasize the importance of observing the principles and practices of transportation safety in a particular professional field.
- Stress the importance of recognizing the risks of not observing these principles and practices in terms of economics and human losses.
- Interpret general regulations pertaining to transportation safety in a particular professional field.
- Develop a recognition of the efficiency or inefficiency of the activities within a professional field as they relate to transportation safety.
- Develop an awareness of the potential hazardous interactions of hardware components, personnel components, procedural elements, and the environment in a operating transportation system; and the need to consider this potential in the decision making and selection process of system development (any professional group).
- Develop an awareness of the analytical concepts and practices used to verify the safety level of a system design (professional engineering groups)
- Develop an awareness of the potential benefit of a preventive safety program rather than a reactive safety program for a transportation system (primarily in terms of cost) (professional management groups)
- Develop an awareness of the safety standards and regulations governing the development and operation of a transportation system (any professional groups)

- Develop an awareness of the need for management attention to and support for safety functions and tasks during system development and operation (any professional groups)
- Develop an awareness of the need to establish and maintain safety goals for the development and operation of a transportation system (any professional group)
- Develop an awareness of the management techniques used to verify acceptable organizational activities toward achieving safety goals (professional management groups)
- Develop an awareness of the interested participants in the legal decision process by which safety laws, regulations, and codes are formalized. Consider public, private power structure, technical specialists and users in this process, (any professional groups).

G. Public Information

Program Objectives

To inform and influence the public such that they modify their behavior and follow safe practices routinely.

Program Guidelines

- Include in toy manufacturing advertising, primarily television films, advice as to proper safety use of toy vehicles.
- Add to material used by science museums simulation demonstrations which illustrate transportation safety principles.
- Develop positive and systematic transportation safety programs within children's organizations, e.g., Explorers, Boy Scouts, Girl Scouts, Cub Scouts, Brownies, Future Farmers of America, Four-H Clubs, et al.

- Develop experiments and prototype programs offering safe driving incentives, e.g., insurance rate reduction, special license plates, safe driver awards, et al.
- Develop experiments and prototype programs on negative incentives or punitive requirements for poor driving performance.
- Develop and arrange for education programs for media personnel.
- Develop and arrange positive programs for television and demonstrations for public education.

CONCLUSION

The participants in the Workshop were generally optimistic about the potential impact that their deliberations can make on the myriad problems of transportation safety. There was strong conviction that, through education, there can be a marked improvement in the efficiency and awareness of those involved in transportation and those who use it. In concert with that conviction, the following conclusions are drawn:

1. Continued improvement in transportation safety is the goal of the U. S. Department of Transportation.
2. In order to accomplish that goal, a base of trained manpower must be built to achieve user safety, public safety and occupational safety within the transportation industry.
3. In order to properly train this manpower base, the problems of transportation safety must be explicitly defined and categorized in such a way that each hazard can be immediately translated into a remedial action requiring the efforts of man.
4. Explicit identification of the transportation safety problem often permits alternative solutions to the problem. Basically, these alternatives are:
   - -- Improve the equipment/facilities so that loss is impossible or highly improbable.
   - -- Train the operator/user to use the existing equipment safely.
   - -- Effect some combination of these two approaches based on cost effectiveness and/or system safety criteria.

5. The decision with regard to the alternative establishes a need for certain types and quantities of manpower.
6. This manpower must have appropriate technical and/or professional educational background.
7. This manpower must be trained in the specific skills required.
8. This manpower must be appropriately organized so as to effectively utilize their skills in attacking the transportation safety problem.
9. Evaluation measures must be employed which will indicate the degree of effectiveness achieved in the various transportation safety improvement efforts.
10. Industry, government and education must actively fulfill its role if the entire transportation safety improvement cycle is to be effective.
    -- Industry and government must clearly articulate the problem.
    -- Government must establish requirements and set standards.
    -- Education must synthesize the appropriate body of knowledge and develop courses of study to meet the requirements.
11. Plans and mechanisms must be established to coordinate and articulate manpower requirements with the manpower development efforts at the state and federal levels.
12. Plans and mechanisms must be established for the development of transportation safety data collection systems, information exchange and centers of excellence.

APPENDIX I

TRANSPORTATION SAFETY WORKSHOP PARTICIPANTS

WORKSHOP PARTICIPANTS

1. Allen Harold - - Professor, Management Department, College of Business, University of South Florida, Tampa, Florida 33620

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WORKSHOP RECORDERS

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McLellon, Dr. Waldron L. -- Professor of Engineering and Chairman, Civil Engineering and Environmental Sciences, Florida Technological University, Orlando, Florida

APPENDIX II

MODAL JOB FAMILY/JOB TITLE LISTINGS

JOB FAMILY	NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION JOB TITLES	TYPICAL TRUCKING CO JOB TITLES
1. Safety Administration	Governor's Highway Safety Program Director Highway Safety Public Information Office Driver Education Supervisor	Safety Director
2. Safety Training	Driver Training Program Specialist Driver Education Teacher Driver Retraining Instructor School Bus Driver Training Officer	Safety Director (Policy ning) Driver Trainer (Drivers) Line Supervisor (Other C
3. Safety Engineering Traffic Engineer Engineering Aide - Traffic Traffic Control Device Technician Systems Safety	System Safety Engineer Highway Engineer - Safety Engineering Aide - Safety Highway Safety Site Officer	Safety Director
4. Operational Safety Program Planning	Pedestrian Safety Program Specialist Police Traffic Services Program Specialist School Bus Program Specialist	Safety Director
5. Safety Analysis	Highway Safety Program Analyst Traffic Records Program Analyst Traffic Records Systems Analyst	Safety Director
6. Accident Investigation	Accident Site Investigator Accident Site Investigator - Aide	Safety Supervisor
7. Safety Security	Police Traffic Services Officer Police Traffic Services Patrolman	Safety Supervisor
8. Safety Inspection and Compliance	Motor Vehicle Inspector Motor Vehicle Station Inspector Driver License Examiner Alcohol Technical Specialist Breath Examiner Specialist Driver License Hearing Officer Traffic Court Program Specialist Codes and Laws Program Specialist	Safety Supervisor
9. Emergency Safety Services	State Wrecker Operator Emergency Medical Services Programs Specialist Emergency Medical Services Field Representative State Wrecker Field Representative	Safety Supervisor

MODAL JOB FAMILY/JOB TITLE LISTINGS

TYPICAL TRUCKING COMPANY JOB TITLES	RAILROAD JOB TITLES	FEDERAL RAILROAD ADMINISTRA JOB TITLES
Safety Director	Superintendent of Safety	Associate Administrator Deputy Associate Administrato
Safety Director (Policy and Planning) Driver Trainer (Drivers) Line Supervisor (Other Occupations)	Assistant Manager of Personnel - Training District Training Officers Rules Examiners Educational and Development Specialist	Training Officer Transportation Specialist - Training
Safety Director	Assistant Superintendent of Safety Environmental Protection	Chief - Standards Division Engineering Staff
Safety Director	Superintendent of Safety Assistant Superintendent of Safety	Chief - Program Evaluation Ui Staff
Safety Director	Superintendent of Safety Assistant Superintendent of Safety Statistician	Chief - Reports and Analysis Also Other Division Staff
Safety Supervisor	Superintendent of Safety Assistant Superintendent of Safety Line Officers	Chief - Accident Investigati Chief Accident Investigator Safety Inspectors - (LOCO.,
Safety Supervisor	Chief Special Agent Assistant Chief Special Agent Police Officers	None at this time
Safety Supervisor	Superintendent of Safety Assistant Superintendent of Safety Line Officers Fire Department/Police Department	Chief - Compliance Division Regional Directors Safety Supervisors Safety Inspectors
Safety Supervisor	Superintendent of Safety Assistant Superintendent of Safety Line Officers Fire Department Police Department	

	FEDERAL RAILROAD ADMINISTRATION	FLORIDA DEPARTMENT OF TRANSPORTATION
	JOB TITLES	JOB TITLES
ety	Associate Administrator Deputy Associate Administrator	Engineer of Safety Transportation Safety Engineer Industrial Safety Officer
Personnel - icers opment Special-	Training Officer Transportation Specialist - Training	Safety Instructor
ent of Safety ion	Chief - Standards Division Engineering Staff	Highway Safety Engineer Railroad Safety Engineer Mass Transit Safety Engineer
ety ent of Safety	Chief - Program Evaluation Unit & Staff	Work done by Transportation Safety Engineer and Industrial Safety Officer in Item #1.
ety ent of Safety	Chief - Reports and Analysis Division Also Other Division Staff	Engineer of Accident Analysis and Staff Accident and Records Research Engineer & Staff Statistician
ety ent of Safety	Chief - Accident Investigation Branch Chief Accident Investigator Safety Inspectors - (LOCO., SIGS, OPNS)	District Safety Representatives
al Agent	None at this time	None
ety ent of Safety e Department	Chief - Compliance Division Regional Directors Safety Supervisors Safety Inspectors	District Safety Representatives
ety ent of Safety		None

APPENDIX III

EXAMPLE TRANSPORTATION SAFETY POSITION DESCRIPTION

EXAMPLE TRANSPORTATION SAFETY POSITION EDUCATIONAL PROGRAM GUIDELINES

POSITION DESCRIPTION

SAFETY DIRECTOR

Develops and recommends safety policy; disseminates knowledge of applicable safety standards; develops internal standard operating procedures; initiates effective training and safety education program; plans, organizes, coordinates and implements safety programs, including hazard control and emergency aid functions; applies reliable and valid measures of the performance of the safety operation.

Educational Requisites

Baccalaureate degree in engineering or science

Graduate education preferred

Tasks

1. Recognizes safety problems.
2. Develops safety policy
3. Reviews and evaluates training needs and programs.
4. Reviews and evaluates safety data.
5. Establishes goals and objectives
6. Develops standards and procedures.
7. Plans, develops, organizes and implements safety programs.
8. Establishes yardsticks to measure results of program.
9. Develops safety standards.
10. Plans and reviews budget safety programs.
11. Suggests legislative changes.

Skills

1. Highly oriented in system safety
2. Ability to communicate
3. Ability to motivate others
4. Ability to cooperate with others involved.
5. Ability to persuade to management.

EDUCATIONAL PROGRAM GUIDELINES

SAFETY DIRECTOR

The Safety Administrator program is designed to meet the needs of the transportation industry and government (State and Federal).

This program is a multi-modal approach to safety of man, machine, and environment. The development of a scientific approach and method of study will predominate.

In addition to the study of investigation and prevention techniques, the theme will be represented by the fields of Engineering, Management, Mathematics, Physiology, Psychology, and Law.

Student research in areas of safety will be a basic obligation. Research may be selected in the areas of: human factors, accident prevention, or accident investigation. The potential of needed research in all modes of transportation and fields of safety is essentially unlimited.

The required courses will include:

Philosophical basis for accident prevention

Investigation of Accidents

Human Factors in Accident Causation

Quantitative Methods of Safety Analysis

Experimental Design and Safety Research

Management of Accident Prevention Programs

Fundamentals of System Safety

Legal Aspects of Safety plus safety technology in specialized areas.

POSITION DESCRIPTION

SAFETY ENGINEER

Designs safety sub-systems for transport equipment; tests and evaluates safety characteristics of transportation equipment products; develops criteria for maximizing the safeness of the man-task-equipment systems.

Educational Requisites

Educational Minimum Baccalaureate Degree in Engineering

Task

Applies scientific and engineering principles for the timely identification of hazards and initiates those actions necessary to prevent or control hazards.

Skills

Ability to apply analytical processes in identifying and controlling potential hazards.

Ability to develop engineering or procedural solutions to accident problems.

Ability to measure potential and actual results of system failures.

Ability to synthesize estimates of necessity of hazard correction based upon system reliability and consequences of failure information.

Ability to detect and correct potential failures at the man-task interface.

Ability to design or restablish requirements for fail-safe systems.

Ability to eliminate or control work environment hazards.

Ability to develop effective standards.

Must be people oriented, of an inquisitive nature, be methodical in approach; and must persevere complex problems to full solution.

EDUCATIONAL PROGRAM GUIDELINES

SAFETY ENGINEER

Safety engineering is the optimum degree of hazard elimination and/or control within the constraints of operational effectiveness, time and cost through the specific application of management, scientific and engineering principles throughout all phases of a system life cycle.

The predominant role of the safety engineer will be in the design, development and test phase of the system's program, but the safety engineer will also function during the operational phase in the analysis and correction of hazards revealed by system use.

Prerequisites for education in this field include an undergraduate degree in engineering and an appreciation for all disciplines which interface with engineering to achieve accident prevention and loss control.

POSITION DESCRIPTION

ACCIDENT INVESTIGATOR TECHNICIAN

Investigates unwanted events which cause or have a potential for causing injury and property loss; determines causal relationships; prepares required reports and records relative to the unwanted events: identifies suggested correction needs.

Education Requisites

High School Minimum

Associate Degree Desirable

Tasks

1. Investigates unscheduled, unwanted events which cause or have a potential to cause loss of life, injury, property damage; to provide data for use in determining casual relationships.
2. Determines causal relationships
3. Prepares required reports and records relative to these events.

Skills

Ability to collect and record facts evident at accident scene.

Ability to recognize casual relationships at the accident site.

Ability to identify contributing causal factors beyond the accident site.

Ability to report and record accident information.

Ability to procure legal evidence, i.e., interviewing.

Sketching and photography ability.

Measurement ability.

EDUCATIONAL PROGRAM GUIDELINES

ACCIDENT INVESTIGATION TECHNICIAN

The Accident Investigation Technician course should be designed to train entry level accident investigators to conduct on and off site accident investigations. In this program the human, equipment, environmental factors should be considered in relation to the pre-accident, accident and post-accident elements with emphasis given to both cause and injury determination.

Classroom and field exercises should provide the methodology for identifying man-machine interfaces, psychology and physiological interfaces, equipment defects or malfunctions and acquisition of information from occupants and witnesses. Causal factors relative to both nature and extent of the injuries should be included. The accident investigator technician concentrates on the collection of data which defines these causal factors. The accident investigator technician is concerned with the accident scene including various environmental influences which are involved. Investigative techniques which influence the investigator technician work require knowledge of the tools utilized to collect evidence and report the accident. Instruction should be given in investigative methodology, the format and preparation of the accident report. Field demonstrations and participation in actual or simulated accidents should be conducted.