

The Ohio State University TARGET Program

A Program for the Training of Graduate Students as Researchers in the Transportation Accident Prevention Problem Area

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The Ohio State University TARGET Program is designed to train researchers at a graduate level in the methodologies and techniques applicable to transportation accident research. In addition to their normal graduate course work, each trainee participates in a quarterly seminar which reviews the state of the art in various facets of land and air transportation systems and discusses applicable models and research methodologies from the various disciplines. The seminars also present new analytic techniques and statistical methods, discuss the psychological and physiological capabilities and limitations of man as related to transportation systems, and review current related University-supported research. The modus operandi of these courses includes selected lecturers drawn from the University community, invited guest speakers from the research community at large, trips to major research facilities across the nation, and active participation by the trainees in ongoing transportation accident research.

•WITH the rapidly increasing national awareness of the problems of transportation system safety, and both a federal and local government commitment to resolve these problems, the need for qualified research personnel has become very great. This paper discusses one attempt to meet these needs: The Ohio State University TARGET Program (TARGET—Transportation Accident Research, Graduate Education and Training) supported by the Division of Accident Prevention of the U.S. Public Health Service. Although several specialized but related training programs have been in existence in this area for years, such as those in the traffic engineering field, the TARGET Program incorporates many features that are rarely combined. These include:

1. In-depth training in accident problems of both the airborne and highway based transportation systems;
2. An effective dialogue between the disciplines dealing with various facets of this program;
3. Introducing the students to the many methodologies from the various disciplines that may be applied in the transportation safety context;
4. Exposing the students to the most current research through a distinguished guest lecture program;
5. On-site tours of nationally prominent research facilities; and
6. Practical experience through participation in ongoing University research in accident prevention.

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This program is a logical outgrowth of a common interest held by the Departments of Civil Engineering, Industrial Engineering, and Preventive Medicine in the general problem area of transportation safety. Each of these departments has a history of active research in this area dating back a decade or so, and within the past four years, several research projects have been conducted in which the departments have cooperated. During the course of these research programs, it became apparent that interdisciplinary research of this nature requires an improved mutual understanding of each discipline's technical vocabulary, methodologies, data base, and scientific attitudes. A formal classroom program in which students from each department and related disciplines could participate appeared to be the logical framework to meet these needs.

In January 1966, application was made for five-year support from the Department of Health, Education and Welfare. This support was subsequently granted with an initial funding date of October 1, 1966.

The basic structure of the program, as stated in the proposal, is that graduate students from each of the participating departments (or nonparticipating departments with adviser approval) will participate in the TARGET Program while pursuing the standard degree program offered by their department. In effect, the training program is supplementary to the student's regular graduate program. Each quarter, the student is required to enroll in the TARGET seminar, to participate in evening discussions with guest speakers, and to attend all field trips. Each student is expected to fulfill the normal academic requirements for the degree he is seeking. Generally, each department's degree program is flexible enough that the TARGET seminars may be used in fulfilling that department's degree requirements as technical electives. Additionally, the students are generally able to enroll for a limited number of relevant courses in the other participating department's graduate programs.

This program provides basic financial support for the trainees in order that they may devote a full-time effort to participating in the program and completing their graduate education. This support takes the form of a nontaxable traineeship based on \$3,000 per year plus dependency and tenure allowances and tuition. Additional support is available for post-doctoral trainees.

Trainee selection is based on the potential which the student appears to have in terms of fulfilling both his department's MS or PhD degree requirements and the aims of the TARGET Program. Consideration is also given to the applicant's interests and stated future plans.

The TARGET Program is administered by a Program Director and Co-director who assume responsibility for the financial administration of the project, trainee appointments, and general coordination between the participating departments. Periodically a student projects administrative committee is convened to discuss proposed course content, guest speaker selection, off-campus trips, and trainee selection. Normally, one or two faculty members represent each of the participating departments.

Each seminar is a three credit-hour work course with the class meeting a minimum of three hours each week. Two off-campus trips are generally scheduled each quarter of the academic year with each trainee required to participate. During each course, specific work assignments may be given including problem solving, trip and speaker evaluation, design of experiments, critiques, and term papers. A major term paper is generally assigned instead of a final examination. Often this paper is a state-of-the-art review of a particular facet of transportation accident prevention, e.g., "Accident Prone Theory," "The Relationship Between Highway Geometry and Accidents," "The Pedestrian Accident Problem," "Traffic Flow Theory," "The Air Traffic Control Problem," or "The Mathematical Analysis of the Traffic Signal Control Problem."

During the three main academic quarters, each participating department is responsible for one seminar. The remaining Summer Quarter is devoted to a colloquium in which each student presents his current or planned dissertation or thesis research for class review and discussion.

In determining the specific content for each of the three main courses, consideration was given to the fact that certain of the trainees would have little or no prior exposure in a specific area while others would have previously received extensive graduate training in that area. The solution adopted was, to be sure, a compromise. In each course,

Table 1

The Ohio State University TARGET Program
Autumn Quarter
Responsible Department: Industrial Engineering

- Introduction to the Problem**
1. Course Overview, Program Philosophy
- The Concept of Cause and Effect and Accident Research**
2. Concept of Accidents, Cause and Effect, Accident Research Methodology
- Measurement of Accident Research**
3. Relevance of Measurement Scales in Accident Analysis
4. Psychophysical Scaling — Guest Speaker
- Accident Investigation and Reconstruction**
5. Accident Investigation and Formal Reporting Schemes (ASA)
6. Intensified Accident Investigation
7. State-of-the-Art of Accident Investigation — Guest Panel
- Accident Analysis — Retrospective Methods**
8. Sampling Methods
9. Regression and Coordination Techniques
10. A Critique of Accident Prone Theory
11. Critical Incident Technique, Behavior Sampling
- Accident Analysis — Prospective Methods**
12. Experimental Designs — Factorial Designs
13. Experimental Designs — Analysis of Variance
- Accident Causation Research — Simulation Methodology**
14. Simulation Methodology — Types and Applications
15. Trip to Simulation Facility — Providence, R. I.
- Accident Causation Research — Epidemiological Methods**
16. Epidemiological Methods
17. Epidemiological Methods and Their Applications
- Accident Causation Research — Psychophysical Methods**
18. Application of Psychophysical Methods to Accident Causation Studies
- Accident Causation Research — Analytical Models**
19. Feedback Model Formulation and Models of the Human Operator
- Systems Research in Accident Prevention**
20. Overview of OSU research in driver behavior
- Discussion of Class Projects**
21. Research Proposal Evaluation, Project Critiques, and Final Exam
22. Between Quarter trip to John Lodge Expressway

the lectures were consistently maintained at an advanced graduate level. However, outside reading material was assigned prior to each lecture so that each student would have the opportunity to achieve a reasonable degree of proficiency in the specific topic area before attending the lecture. Additionally, group problems or papers were frequently assigned in which the composition of each group was established such that the students from different disciplines would have the opportunity to work with each other. This approach was found to be highly successful in that each student was given the opportunity to work from his current level of knowledge to that of the lecture and, additionally, to receive assistance from other students who are knowledgeable in the area. For example, some students came to experimental design lecture with a background of 15 hours of graduate statistics while others had as little as 3 hours.

During the first quarter of this program's operation (Fall 1966), the Industrial Engineering Department assumed responsibility for both the course content and lectures. It was decided to begin the seminar with a discussion of the history of safety research, the classical approaches to the problem, and a review of the various methodological approaches available to the transportation accident

prevention researcher. Table 1 gives the course outline that was followed during the Fall Quarter. Although the amount of material covered in this course is exceedingly large, the students, with a reasonable amount of judiciously selected outside reading, were able to readily comprehend and see potential applications within their own fields. During this quarter, lectures were provided from the participating departments when their knowledge could be effectively utilized, e.g., epidemiological methods from the Department of Preventive Medicine. Additionally, one lecture was given by an outside speaker and two field trips were taken. The work assignments during this quarter included eight specific problems and written critiques of the guest speakers and the field trips. No term paper was assigned due to the length of two of the problem assignments.

One of the class assignments that engendered considerable student participation was an evaluation of an accident prevention research proposal. Working in interdisciplinary teams, the students were able to appreciate the strengths and weaknesses of a proposal that was actually funded by outside sponsors.

The winter program curriculum gave particular emphasis to the highway transportation system, its specific problem areas, and the state of research dealing with these problems. The Department of Civil Engineering assumed prime responsibility for the conduct of this course. Table 2 gives the course outline for this quarter. As in the Fall Quarter, the curriculum was extremely broad in scope. However, it was possible to achieve a reasonable depth of coverage in each area, again through outside reading and specific, well-structured lectures. Outside speakers were also used where appropriate and one field trip was taken. In this quarter more emphasis was given to ascertaining the nature of the highway traffic accident prevention problem and the areas in need of research. This was important in order to develop potential thesis topics for students.

Table 2

The Ohio State University TARGET Program
Winter Quarter
Responsible Department: Civil Engineering

Introduction and Background to Problems of Automotive Accident Causation

1. Course Overview— Safety Research Overview: Current Research, Primary Researchers, Institutions and Sponsors
2. Economics of Accidents
3. Training of State Highway Patrol Officers and Visit to Academy

Highway Research Board Attendance

4. Attendance at 47th Annual Meeting of the Highway Research Board
5. Attendance at 47th Annual Meeting of the Highway Research Board

Highway Geometry and Accident Causation

6. Elements of Geometric Design
7. Ohio Department of Highway Accident Prevention Program— Guest Speaker
8. Effects of Geometric Design on Highway Safety

Vehicle Factors and Accident Causation

9. Vehicle Dynamics and Accident Causation
10. Road Surface/Tire Interface and Vehicle Control
11. Vehicle Defects and Accident Causation— Guest Speaker
12. Vehicle Safety Standards— Guest Speaker

Human Factors and Accident Causation

13. Accident Research: Human Factors— Guest Speaker
14. Automated Control Systems (Including Laboratory Visit)
15. Field Trip to Ford and Crash Injury Studies— Guest Speaker

Accident Reconstruction

16. Accident Investigation and Reconstruction— Guest Speaker
17. Highway Accident Reconstruction: Legal Aspects
18. Presentation and Discussion of Assignments on State-of-the-Art Policies
19. Review of Course

Table 3

The Ohio State University TARGET Program
Spring Quarter
Responsible Departments: Departments of Preventive Medicine and Aviation

Introduction

1. Introduction: The Dimensions of the Problem
2. History of Aerospace Safety Research

Aircraft Accident Reconstruction

3. Aircraft Accident Investigation: Human Factors— Guest Speaker
4. Aircraft Accident Investigation: Other Factors

The Physical and Operational Environment and Aircraft Safety

5. The Physical Environment: Weather
6. The Physical Environment: Decompression
7. Field Trip to Washington: The Operational Environment and Air Traffic Control
8. The Legal Environment: Regulation of Aviation— Guest Speaker

The Legal and Social Environment of Aircraft Safety

9. Medical Control of Pilots
10. The Social Environment: Effects on the Community
11. The Task: The Amateur in the IFR System

The Flying Task and Aircraft Safety

12. What Should the Professional Pilot Be?
13. The Man: Selection of Airmen

The Man in the Aerospace System

14. All-day Field Trip: Commercial Airline Training Center: Training of Professional Pilots
15. The Vehicle: Complexity vs. Reliability
16. The Vehicle-Pilot Interface: Problems and Opportunities for Research

The Vehicle

17. The Man: Training of Amateur Pilots
18. Performance Under Stress

The Spring Quarter seminar gave particular emphasis to the problems of air transportation. Table 3 gives the course outline followed. This seminar was conducted by the Departments of Preventive Medicine and Aviation. Department faculty members and outside speakers presented comprehensive lectures on the problems of both commercial and general aviation, the physiological limitations of man, problems of pilot training, etc. In addition to several outstanding guest lectures, the class visited the Washington Air Traffic Control Center and a commercial airline's research and training facility.

The Summer Quarter seminar (Table 4) was operated as a colloquium in which each student presented his own research. One thesis, which was the outcome of an engineering student's association with the Department of Preventive Medicine, was entitled "The Problems of Carboxyhemoglobin Poisoning in the Automobile Environment." Other

Table 4

The Ohio State University TARGET Program
Summer Quarter
Responsible Department: Industrial Engineering

Introduction to Course

1. Introduction: Course Content, Student Responsibilities, Assignments, and Discussion of Problem Statement

Vehicle Crash Worthiness

2. Vehicle Crash Worthiness— Current, Proposed and Potential— Guest Speaker

Student Research

3. The Problems of Carboxyhemoglobin Poisoning in the Automobile Environment
4. Ohio Turnpike Accident Analysis, 1960-1965
5. The Design of the Ohio Transportation Research Center
6. Accident Causation Models and Their Validity
7. The Application of Eye Movement Recording Techniques to the Driver Task

Simulation as a Research Technique

8. Driver Research Through Simulation

Discussion of Project Research Review Assignments

9. Specification of an Intervehicular Signalling System
10. Research on Visual Requirements in Night Driving

students' theses and research topics included "Ohio Turnpike Accident Analysis, 1960-1965," "The Application of Eye Movement Recording Techniques to the Driving Task," "The Design of the Ohio Transportation Research Center," and "Accident Causation Models and Their Validity." In addition to these research reviews, the class was given problem statements and/or research reports from two recent research projects for written comment concerning general research goals, methodology, the relationship between the research findings and the sponsor's needs, and the implementation of the research findings. This was followed by presentations and extensive discussion of the actual research as it is being conducted. In addition, two guest

speakers lectured on their research activities and the methodological approaches to their problem areas.

Because of an active interest in this program by nontrainees, the seminars have been opened to other students who have the necessary academic background. Generally, the total enrollment in the courses is restricted to 15 because of the desire to have active student participation in all sessions. This participation by other students has led to several applications for traineeships. In addition, the seminars have been opened to the University community at large, and to other off-campus research personnel when guest speakers are lecturing. Particularly active "sit-in" participation has come from the Department of Optometry, the Colleges of Engineering and Law, and Battelle Memorial Research Laboratories.

In addition to these formal courses, each trainee participates in several of the ongoing research projects, either as an experimental assistant or as a test subject. Also, the trainees were frequently invited to attend project staff meetings and research reviews. In these ways, the trainees kept abreast of the status of current departmental accident prevention research.

During the second year the same general format is planned for new trainees while advanced study is planned for second-year trainees.

The ideal point of entry into this program is at the beginning of the Fall Quarter. Our experience has been that the majority of students prefer to begin at this point. However, the transition into the program has not been difficult for those who have entered at other times of the year.

One minor aspect of the program that has had a considerable effect on maintaining a strong trainee interest is that they are given desk space alongside the participating department's professional research staff. In this fashion, the students are in personal contact with the researchers and have first-hand knowledge of the problems and progress of the research. In addition, the trainees rapidly develop a sense of belonging and participating in the various research programs. This sense of participation is further enhanced through a specific assignment that requires the trainee to critically evaluate comment on the research methodology employed in a current research project in his department.

In conclusion, it should be pointed out that this program is now in its second year of operation. Like the majority of other new programs, it is in a constant state of evolution—as weaknesses are discovered, the program is modified accordingly. Specific examples of changes that have been made in the program as a result of the first year's experience include (a) better preparation of the class for the guest speakers; (b) an increased emphasis on methodology rather than state-of-the-art; and (c) more interdisciplinary problem solving. Despite this evolutionary nature, the training program has been of value within its short period of operation. Perhaps the most significant facet of the program is that it has brought several distant disciplines together with a single purpose of training competent transportation system safety researchers.

Although this program has completed only its first year of operation and has had only five graduates, most of these graduates have entered the transportation accident field. Two have taken research positions with the Ohio State University Transportation Research Center, another has joined a large insurance firm as a staff researcher, and a fourth man has accepted a position as accident researcher with The Highway Safety Foundation in Mansfield, Ohio. It is our expectation that the graduates of this training program, and others like it, will play a prominent role in alleviating today's transportation research manpower needs.