Training Requirements for Transportation Technicians and Technologists

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Several forces have acted to raise the need for technicians in transportation to increasingly higher levels. Shrinking real dollars in transportation budgets have moved transportation professionals into broader analytical and management responsibilities. Inflation and conservative legislatures have held down the transportation work force and incentives to young professionals. The volume of work has changed to reflect more manpower-intensive projects due to budget and environmental pressures and the need to get better utilization from existing facilities and to avoid replacement or costly expansion. Transportation agencies are facing growing demands and a shrinking trained work force.

THE TRANSPORTATION TEAM

The role of the various members of the transportation team is not rigidly structured. There is, however, general agreement on the scope of the responsibilities of each member.

- Transportation Technician. An especially trained individual who conducts routine duties that require considerable skill and judgment. This will include duties that are repetitive in nature.
- Transportation Technologist. A graduate of a 4-year academic program in transportation technology with special emphasis on the application of transportation principles. The training and experience of the individual enable him or her to do most basic transportation design and make fundamental operations decisions.
- Transportation Professional. A graduate of a 4-year accredited program in transportation. This training equips the individual to solve special technical transportation problems, to make transportation trade-off decisions, and to manage the transportation team.

In the highway engineering field, examples include the following job descriptions:

- Technician: Routine soil and materials testing and quantity takeoffs from the cross sections.
- Technologist: Geometric design, cross-section design, and basic decisions on alignments provided by the engineer.
- Professional Engineer: Selection of alternative alignments to be examined, social, economic, and political trade-off decisions; and cost-effectiveness analysis of alternatives.

Although there is a wide variety of application of the individual skills within specific agencies, this structure has proven to be both economic and technically workable. In this paper the role of the technologist and advanced technician in the transportation profession is addressed. The term technologist is used to encompass this broader definition of technician and technologist.

The investment required to produce trained technologists is considerably less than for transportation professionals, and the salary requirements are lower. Many functions performed by professionals in the past can now be performed by properly trained technologists. Why? Because of the availability of high-speed computation and decision-making capability on routine matters.

The advent of the mainframe computer connected science and practice. The development of the microcomputer transferred much of the routine technical work previously being performed by professionals to the transportation technologist. Analytical computation, once the domain of the professional has, in a very brief time, been relegated to the technologist. Professional work is no longer how to do something, but rather what the results mean after the computer delivers the computations. Computers, even the relatively small ones, are capable of performing the computations needed more accurately, faster, and at the time the professional needs them. The bulk of engineering computation is now being accomplished on the computer. The transportation technologist is taking over the performance of analytical computations, leaving the decisions on special cases and interpretation of the computer results to the transportation professional.

There are many in the transportation profession who believe this is a bad trend. They believe that persons without a true understanding of transportation principles are cranking out specific solutions to transportation problems on the microcomputer; this is true. The challenge to all of the transportation and technology educators is to teach the proper use of the microcomputer's capability. Instead of viewing this emerging microworld as a challenge to the transportation profession, the authors believe that it frees the transportation professional to do the creative work for which transportation training best equips the individual. Only a very narrow view of transportation would consider the tremendous number of computations required in the past as professional work. These computations were simply tools needed to reach a solution to a problem. The microcomputer frees the professional from these laborious computational tasks. Once the computer program is written, it enables the professional to examine 10, 20, or even 100 different alternatives in order to produce a suitable and economic design. The microcomputer has substantially expanded the role of the transportation professional to better meet the needs of society.

To effectively use the current computer capability skilled operators are required. They must understand analytical computations and the operation of the computer. The trained technologist fills this role. Just as the technologist replaced the engineer in laboratory testing of soil, materials, and water quality, so will routine transportation design become the domain of the technologist. The transportation professional will become more decision- and management-oriented.

ROLE OF TECHNOLOGICAL CHANGE IN TRANSPORTATION

The change in basic disciplines such as transportation will be far more dramatic than in the other analytical fields for two reasons. First, the nature of the overall transportation function has shifted. Transportation agencies were created

and experienced their periods of major growth in the "build" mode. In this mode, standards were developed and substantial uniformity evolved. A given type of roadway had certain standard requirements of design, and only a limited number of design alternatives had to be evaluated. The current "maintenance-rebuild-add on" mode in which new capacity is added to older facilities by upgrading of existing roadways instead of building new facilities on new right-of-way is the common rule. Each project is unique with a large number of options to be evaluated; each requires computations and analyses suited to the computer.

Second, computerization of the newer technical specialty areas came first because of the concentration of manpower and the relatively large projects on which these professionals worked. This made mainframe computation practical. The more basic human needs-oriented areas were traditionally scattered in relatively small professional groups which, at best, had to share computation capability and were dependent on others for getting the work accomplished.

The lack of responsiveness of the mainframe computer operator to the special needs of the professional, combined with the high cost associated with the purchase and maintenance of a mainframe computer, limited the application to special needs that could not be accomplished by other computational procedures. The microcomputer provides the computational capabilities needed by the transportation professional at relatively low cost. It effectively brings to the transportation professional the full benefit of the computer.

RESPONSIBILITY OF THE UNIVERSITY

The role of the university or college in this process is to:

1. Provide the expert training to help the technical schools adequately prepare their students to serve and supplement transportation professionals.
2. Transfer new ideas, research findings, and demonstrated techniques from research and development to training and implementation.

The first of these responsibilities stems from the limited monies available for transportation education and the ever increasing cost. The result will tend to force technical training out of the university and into the smaller colleges and technical institutes. Research, on the other hand, will remain a major responsibility of the university. Usually the need to transmit the new technology to the center where the technologist is trained will become more critical as the information base expands.

There will also continue to be a large body of practicing technologists who need and must obtain the most current technical information. A high percentage of this need can be satisfied by updating the computer software that the technologist uses. There will also be a continuing need to teach both the practicing technologist and the transportation technology educators the meaning of the computer output: which data are meaningful and which are nonsense. This role will become even greater as we move further into the information age. More people must be trained to a higher level of technical competence. The magnitude of this need is still unknown, and the number needed is still probably grossly underestimated. Industry (some have recognized) must allocate more of its budget to training if America is to become competitive.

In summary, the transportation profession will, or has, changed more toward a

management and a technical decision-making role. Routine duties that previously were in the domain of the professional are rapidly becoming the work of the technologist. The trend of the duties of the transportation professional is more toward project management, research, and technical decision making.

TRAINING NEEDS IN TRANSPORTATION

There are two fundamental needs for training in the transportation field: (a) technical training to prepare the potential technologist for initial employment in the transportation field; and (b) retraining current transportation technologists, and those who transfer from other fields, to serve critical or specialized needs. This training must come from (a) in-house training provided by the employer, (b) equipment manufacturers' special training, (c) technical organizations, and (d) technical schools.

A combination of the training provided by all of these sources will be required to meet the needs created by the expanded role of the transportation technologist in the next decade.

SCOPE OF TRANSPORTATION TECHNOLOGIST TRAINING

The areas of training for the general civil engineering technologist have been identified by The National Institute for Certification in Engineering Technologies (NICET) (1). These needs include the following:

- General Skills
  - Communications skills
  - Mathematics through pre-calculus
  - Microcomputer use
  - Personnel management
  - Vehicle fleet management
- Civil Engineering Skills
  - Concrete mix design
  - Highway design
  - Structural design
  - Mapping and photogrammetry
  - Inspection and materials testing
  - Environmental analysis
  - Surveying
  - Foundation design
  - Blueprint reading
  - Soil analysis and testing
  - Cost estimating
  - Materials inspection and testing
  - Construction equipment use and functions
  - Excavation and fill computations and planning
  - Drainage design for highways and streets

[Note that microcomputer use, personnel management, and vehicle fleet management were added to the NICET list by the authors.]

The engineering-related transportation speciality area requires some skills not listed in the basic NICET skills list. These special training needs in highway engineering subspecialization areas are as follows:

- Highway and Street Design
  - Structural concrete design and detailing
  - Structural steel design and detailing
  - Pipe and drainage structure design
  - Hazardous waste transport and safety
  - Stabilized base materials
  - Intersection design
  - Pavement design--portland cement and asphalt cement
  - Overlay design and pavement rehabilitation
- Surveying, Mapping, and Field Location
  - Electronic surveying (EDM)
  - General surveying
  - Drainage area measurement
  - Quanity estimates from aerial photographs
  - Computer mapping
  - Structure location and elevation controls
- Traffic Control
  - Traffic control systems layout for construction and maintenance
  - Transit route planning and bus stop location
  - Hazardous waste transport and safety
  - Traffic signal design and plans preparation
  - Solid state electronic circuits
  - Intersection design
  - Traffic control principles
- Construction and Maintenance
  - Aggregate sampling
  - Traffic control layout for construction and maintenance areas
  - Hot-mix installation techniques
  - Mixer drum operations
  - Portland cement pavement design techniques
  - Pipe and drainage structure sizing
  - Pothole and pavement maintenance techniques
  - Trenching safety
  - Stabilized base materials
  - Hand-tool and power-tool safety
  - Hazardous waste transportation and safety
  - Herbicide and pesticide use and safety
  - Safety practices for in-the-road maintenance
- Public Transportation
  - Transit route planning
  - Transit operations and evaluation
  - Bus maintenance programming and scheduling
  - Fleet management principles
  - Transit marketing
  - Public attitude surveys and rider interviews

Transportation technician and technology educational programs will need to be

general enough to allow employment in any transportation mode and yet specific enough that the technologist will be fully functional on the job. The specific mix of courses will, by necessity, be different for each institution.

ESTIMATED DEMAND FOR TRANSPORTATION TECHNOLOGISTS

The number of transportation technologists that may be needed in the various levels of government in the coming decade is unknown. A ballpark estimate based on the authors' perception of the present employment trends and expectations for the future role of the technologist in the transportation field suggests the need for highway and street design, traffic control, and construction and maintenance technician and technology programs in every state. The remaining speciality areas will probably be regionally focused.

SUMMARY AND CLOSURE

The changing nature of transportation suggests that the bulk of the routine transportation tasks of the past will, in the future, be accomplished by transportation technologists. The economy and the technical capability favor a greatly expanded technician and technologist role in transportation in the next decade.

REFERENCE

1. NICET Certification Programs, 1983 ed. The National Institute for Certification in Engineering Technology, Washington, D.C.