Fellowships

A university research program would provide student funding in the form of graduate research assistantships or funding for undergraduate hourly employees. In place of or in addition to this, grants for railroad education could be made directly. A program of support to individual graduate fellows would require $7000-$12 000/year/fellow, depending on the level of tuition and fees. A $1 million program would fund about 100 graduate fellows. In comparison, FHWA currently offers about 186 fellowships/year for studies in highway transportation.

Again, there are existing models for FRA to follow. Both FHWA and UMTA sponsor fellowships. Their enabling legislation and program guidelines can be useful in structuring a similar program for FRA.

Railroad funding of graduate study is extremely rare, since individual railroads find it difficult to grant an employee a full year of leave and are concerned about losing the employee after they have paid for his or her education. Yet the industry as a whole benefits from the advanced education of its professionals. This is a strong argument for federal funding of railroad fellowships or, for that matter, for funding of the other university programs described above.

SUMMARY

A well-coordinated and government-aided program consisting of short courses targeted to entry-level professionals, enrichment of university curricula, university railroad research, and fellowships for studies in rail management and engineering will meet the modern educational needs of the railroad industry. Annual funding of $1 million would support any one of the following (although combinations are obviously preferable): 40 one-week short courses, 25 rail transportation professorships, 15 university research projects, or 100 graduate fellows. This program would do much to provide the railroads with a new pool of talent, people with strong career motivation and the skills needed to respond to the changing business and technological environment of the railroad industry.

ACKNOWLEDGMENT

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Program for Certifying Transportation Engineering Technicians

Larry E. Jones

The results of a joint effort by the Institute for the Certification of Engineering Technicians (ICET), the American Association of State Highway and Transportation Officials, and the Federal Highway Administration to establish and pilot-test a program for certifying transportation engineering technicians are summarized. The program that resulted from this effort provides four levels of certification in each of six broad disciplines: construction, design, materials, traffic operations, surveys, and maintenance. Under the program, technicians may be certified by ICET once they demonstrate relevant experience and performance capabilities, as verified by professional engineers and qualified technicians, and satisfactorily complete tests administered by ICET. The certification program was pilot-tested in the state highway departments of North Dakota, Rhode Island, and Utah. These tests were successful, and the ICET certification program is now open to anyone who wishes to use it. A second facet of the joint effort is discussed—i.e., the attempt by ICET to identify training materials that technicians can study to bolster their knowledge in specific fields and to prepare themselves for certification examinations. Numerous training materials were identified. It was found that the International Correspondence Schools offer many courses that are closely aligned with the training needs of transportation engineering technicians.

Highway administrators and personnel managers have for several years discussed the potential values of developing a national program for certifying transportation engineering technicians. Among the benefits they thought could be derived from such a program were

1. Nationwide acceptance of criteria for assessing and determining career status for technicians and technologists in highway transportation,
2. A rigorous means for relating state civil-service position classifications to staff technical capability,
3. A rational basis for collective-bargaining negotiations to help ensure proper recognition of technical competence as opposed to longevity,
4. Increased assurance that work assignments within agencies are based on job proficiency and that demonstrated proficiency receives due recognition across agency lines,
5. Improved work performance and sharpened knowledge and skills that result from a certification program undergirded by appropriate training, and
6. Improved employee morale and motivation resulting from personal satisfaction and from employer recognition of the employee's milestone accomplishments as the employee works toward certification and career advancement.

It was not until July 1974, during the Engineering Foundation Conference on the Assessment of Resources and Needs in Highway Technology Education, held in Rindge, New Hampshire, that it appeared that such a program might eventually become a reality. One of the principal recommendations of the conference was as follows (1, p. 193):

> That local, State, and Federal highway agencies; highway industries; and professional societies, in cooperation with educational institutions, establish performance standards of certification and recertification for technicians and technologists engaged in highway transportation related work.

A specific action taken by the conference provided for the formation of an ad hoc committee to determine the actions required by the respective agencies and organizations to bring about a certification program.

The ad hoc committee presented a recommended concept for a certification program to the American Association of State Highway and Transportation Officials (AASHTO) Administrative Subcommittee on Personnel at the AASHTO meeting in November 1975. The subcommittee endorsed the concept of certification and voted to appoint a task force to take up the work of the ad hoc committee. Their function was to

1. Work with the National Society of Professional Engineers (NSPE) and the Institute for the Certification of Engineering Technicians (ICET) to expand and refine the program and
2. Identify the various tasks in which technicians should demonstrate proficiency to qualify for certification [it was envisioned that this task force would work closely with the project manager to be appointed by ICET under a proposed contract with the Federal Highway Administration (FHWA)].

The first contract between NSPE-ICET and FHWA was signed on April 30, 1976. Under this contract, the original program concepts were expanded and certification criteria for transportation engineering technicians were developed. The transportation engineering technician field was divided into six broad disciplines: construction, design, materials, traffic operations, surveys, and maintenance. For each of the six disciplines, ICET established four levels of certification: level 1, student technician; level 2, associate engineering technician; level 3, engineering technician; and level 4, senior engineering technician.

The next, and probably most difficult, task accomplished by ICET was to break down the technician job duties and responsibilities for each identified position in each discipline into basic components or tasks, or what ICET has termed work elements. These work elements are the heart of the program. Through them, technicians are able to identify areas in which they are most knowledgeable and therefore best qualified to become certified by ICET.

A candidate may enter the program at whatever level he or she demonstrates proven ability and experience. The program requirements are given in Table 1 (2). For each level of certification, candidates must select and pass examinations on a specified number of work elements. Table 2 (2) gives the requirements for the construction field. The other disciplines are quite similar. To attain initial certification above level 1, a candidate must furnish satisfactory evidence of having the work experience required for the level at which certification is desired plus that required for all lower levels. Such experience must be documented according to ICET procedures.

Certification is based on ability to perform specified work elements and on the knowledge and skills required to perform such tasks proficiently. Therefore, firm evidence of actual performance of these work elements by a candidate in a job environment is essential. Certification requires that professional engineers and qualified technicians who have supervised a candidate in the performance of work elements verify that the candidate has actually performed each required work element in a satisfactory manner. After the candidate receives satisfactory endorsement, a written examination is administered by ICET. Candidates may choose work elements that will enable them to become certified at one level in one discipline and at a different level in another discipline.

The examinations administered by ICET are made up of questions prepared by volunteer committees of professionals for each discipline. The committees are responsible for preparing, screening, and validating all questions that are to be included in the computerized question bank maintained by ICET. Before new or revised questions can be entered into the bank, they must be reviewed and approved by the AASHTO task force.

A report prepared by ICET (3) includes the procedures and standards for certification, detailed descriptions of the work elements, and an inventory of available training resources that relate to each of the work elements.

The program development work undertaken under the contract with FHWA was accomplished under the direction, guidance, and coordination of the task force appointed by AASHTO. The program concepts were approved by AASHTO as recommended guidelines.

The AASHTO task force considered the completed program design and detailed job tasks and unanimously recommended that the program be implemented in three states as a pilot project. The intent was to refine procedures and to identify problems that may arise in the states and in other agencies as they begin to use the program. The task force, with the full agreement of the chairman of the AASHTO personnel subcommittee, unanimously recommended that the FHWA contract be extended, with additional funding, for a pilot implementation program. The objectives were to assist the states to use the program, set some direction in the development of training materials to meet the technician's specific needs, and accelerate the projected availability date of the first examinations. Utah, Rhode Island, and North Dakota, each of which was represented on the task force and has a personnel training system with unique characteristics, volunteered to be pilot states. A second contract between FHWA and NSPE-ICET was signed on September 30, 1977.

While conducting the pilot testing phase of the implementation program, ICET staff made several visits to the three pilot states to explain the program to the technicians and to the appropriate personnel and administrative officers. Applications were then reviewed; reference reports screened; examinations generated, administered, and scored; and the examination results returned to the candidates.

Examinations were administered to 104 employees of the pilot states during the first of two test cycles. Several problems were encountered, and questions were raised. Most of the questions were resolved when ICET published a manual (4) designed to assist the technicians and their employers in understanding the application and testing procedures. A second manual (2) was also published by ICET to give employers an overview of the certification program and its many potential uses by employers in the areas of per-

Table 1. Enrollment and certification requirements.

Level	Minimum Full-Time Experience	Verification of Experience	Recommendation Requirements	Written Test Requirements	Form of Certification	Performance Capabilities
1	No minimum time requirement; eligible when ability in required work elements is established	By supervising engineers(s) and/or job superintendent(s) who actually supervised candidate	One from person familiar with candidate's work	No written test	Letter of enrollment; no formal certificate	Beginning-level work under direct supervision
2	At least two years; students enrolled in engineering or technology courses may apply without entering at level 1	Ideally by professional engineer (PE) familiar with candidate's performance or by certified engineering technician (CET) if no PE available	One from person familiar with candidate's work	Written test covering work elements	Certification as associate engineering technician (AET)	Intermediate-level work within specified field under general supervision
3	At least five years total	By PE except in specific instances strongly justified by circumstances of job	One from person familiar with candidate's work	Written test covering work elements	Certification as engineering technician (ET)	Independent work with little or no supervision on jobs covered by standard and complete plans, specifications, or instructions
4	At least ten years total plus actual supervision of one major project	By PE except in rare instances strongly justified by job conditions, in which case ICET may accept alternative verification	At least one recommendation as to character and integrity from PE personally familiar with candidate's job performance	Written test covering work elements; personal interview may be required	Certification as senior engineering technician (SET)	Assistant to PE with authority to act in name of PE in matters in which authority is delegated and engineering precedent exists

Table 2. Work elements listed and required by type and certification for construction discipline.

Certification Level	Position	General Work Elements		Special Work Elements	
		Listed	Required	Listed	Required
1	Student technician[a]	4	3 endorsed from level 1[b]	10	4 endorsed from level 1
2	Associate engineering technician	7	3 already endorsed from level 1 + 6 from level 2 = 9	25	4 already endorsed from level 1 + 2 more from level 1 + 7 from level 2 = 13 to be examined
3	Engineering technician[c]	13	10 from level 3	10	2 more from level 1 + 7 more from level 2 + 3 from level 3 = 12 to be examined
4	Senior engineering technician[c]	9	7 from level 4	Elements in previous levels	4 from level 2 + 3 from level 3 = 7 to be examined
Total		33	26	45	32

[a] No examination required.
[b] Supervisor's endorsement.
[c] Examination required.

sonnel and salary administration, project planning, training, and job assignment of engineering technicians in the field of transportation. Both of these manuals are available from ICET.

During the second cycle of testing, 88 state employees applied for and were given examinations. Additional familiarity with the program by all concerned substantially improved the smoothness of the entire application and testing operation. At the conclusion of the second testing cycle, 17 technicians had fulfilled the ICET requirements for certification and 52 others were quite close to achieving that goal. ICET is preparing a report that will summarize the results of the pilot implementation program.

The AASHTO task force reviewed the preliminary results of the pilot testing at their April 1979 meeting and recommended that the program immediately be opened to state, local, federal, and private employers and technicians.

The ICET certification program has built into it the flexibility necessary to keep it responsive to ever-changing and expanding requirements. Since the entire program is based on work elements, by changing or adding to the list of work elements the program can be manipulated to handle all foreseeable requirements that may be placed on it. Among the requirements being addressed at this time is the need for qualified technicians to inspect the more than 550 000 bridges in the United States. A special committee has been formed to review the existing work elements to identify those that match the work being performed by bridge inspectors. Where necessary, the committee will draft additional work elements that, after being approved by the AASHTO task force, will be incorporated into the program. Technicians may then become certified as bridge inspectors by passing a specified number of these work elements.

During both the first and second contracts, ICET has sought to identify training materials that technicians could study to bolster their knowledge in specific fields and to prepare themselves for examinations to become certified. As part of the first contract, many individual training materials from various sources were identified and listed (3). Each training resource was cross-referenced to the work element or work elements that were most applicable to the material. Many state highway departments indicated that they had good training materials on their shelves; some were willing to share with others, but some could not because of budget and staff limitations. ICET simply did not have the resources to review and evaluate all of the materials identified.

Traditionally, transportation engineering technicians have received their education and training in on-the-job training programs, technical schools, or classes conducted by the employer. In order to be able to make

recommendations on training, it was deemed desirable for ICET to explore a number of other training possibilities. These possibilities narrowed down to a new concept called "minicourses" and the better-known correspondence method of course delivery. Audio-visual-based training packages were considered to be quite effective, but ICET felt that the cost of providing these materials to a large number of technicians spread across the country—some in remote areas—made them comparatively expensive.

The difficulty and, again, the expense of keeping materials current and an apparent duplication of effort in developing materials on the same subject matter warranted an examination of the concept of a minicourse constructed as an inexpensive manual. ICET prepared drafts of 24 different minicourses structured to correspond to specific work elements. The courses were reviewed by practicing engineers and technicians in state, federal, and private engineering offices. In the feedback received from these reviewers, they supported the concept of the minicourse approach but cited numerous problems with the course drafts. The nature of the problems reflected the need for considerable expertise in selecting and presenting the topical content in ways that were valid in different states and employment situations. This expertise could only be developed over a considerable period of time.

ICET, supported by approval of the minicourse concept but lacking in expertise to develop the training materials in-house, contacted the International Correspondence School (ICS) of Scranton, Pennsylvania. It was found that ICS had been using the job-task-inventory approach to training (similar to work elements) for many years as a means of increasing educational effectiveness and efficiency. Because of the apparent compatibility between the ICS program and the training requirements needed to support the ICET certification program, the AASHTO task force recommended that NSPE and ICET work with ICS to establish a major training resource for all transportation engineering technicians employed in both the public and private sectors. NSPE followed through and signed an agreement with ICS to implement the task force's recommendation.

ICS is currently cross-referencing all of its existing training materials to the applicable ICET work elements so that they will be prepared to advise prospective students as to which of the ICS courses would be most appropriate when technicians are seeking certification in a particular field. ICS is not envisioned as the sole source of training materials for students who are preparing for ICET certification. But it has been identified as a readily available source of training information for many of the work elements.

From the very beginning, the development of the technician certification program has benefited from the support and participation of a substantial number of individuals. Private as well as public-agency employees have participated because the construction and maintenance of the national transportation system is a massive project that involves millions of people and billions of dollars. Technicians are the backbone of the transportation system; an estimated 750 000 of them are employed in highway-related activities alone. Motivating this work force—e.g., in the identification of areas in which additional training may be needed to support career-development plans—is extremely important.

The Certification Program for Transportation Engineering Technicians has definite potential for improving the work performance of technicians and ultimately improving the national transportation system overall. The decision to take advantage of the program rests with technicians and their employers.

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Training and Education in Transportation: Future Directions

Lester A. Hoel and Michael D. Meyer

The dramatic changes in the environment in which transportation professionals operate in the United States and the impact of these changes on transportation education and training are examined. Within a decade, the definition of the urban transportation "problem" has been expanded from one focused solely on congestion to one that includes at the very least the relationship between transportation and the following factors: energy, air quality, equity, safety, congestion, land use, noise, and more efficient use of scarce resources. These new problem definitions and the skills necessary to deal with them effectively have added to the responsibilities of transportation educators and represent forces of change in U.S. educational programs. Actions that could be taken to prepare for the future professional needs of the transportation sector are recommended.

The environment in which transportation professionals operate has changed dramatically during the past 10 years. During this time, we have seen the definition of the urban transportation "problem" expand from one focused solely on congestion to one that includes at the very least the relationship between transportation and