Demand for Transportation Education: What Should the Product Be?

SUMMARY OF PAPERS

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The topic for discussion in this session is "Demand for Transportation Education: What Should the Product Be?" and I will begin by summarizing the papers prepared by the authors. Although some of the authors discuss some common considerations, such as the impact of the microcomputer on the transportation profession, it is more useful to summarize each paper separately. However, if there is reinforcement of the same point by more than one author, I will attempt to make note of this concurrence of ideas. At the conclusion of my summary, I will pose some questions for consideration by the panel and the audience.

The authors and their topics are as follows:

- Transportation Education: Educating Tomorrow's Transportation Planners, Michael D. Meyer.
- Educating Tomorrow's Transportation Engineers, Thomas D. Larson and Harvey Haack.
- Transportation Education: Training Requirements for Transportation Technologists, Donald L. Woods, A. Nelson Evans, and Charley V. Wootan.
- Education Requirements for Transportation Consultants, Wilbur S. Smith.
- What are Shippers and Carriers Looking For?, Gayton E. Germane.
- Training Requirements for Transportation Operations Personnel, James E. Reading, Barbara A. England, and James W. Strecker.

TRANSPORTATION EDUCATION: EDUCATING TOMORROW'S TRANSPORTATION PLANNERS

Meyer reviewed several studies conducted during the last 5 years that were concerned with an examination of the purpose and scope of transportation planning. From these studies he established a number of propositions and subsequently used them to define the desired characteristics and attributes of transportation planners. These propositions included the following:

1. Among many planners there is a growing distinction between strategic planning and systems planning. There is a shifting of emphasis from systems planning (i.e., how best to develop, operate, and manage a transportation system) and a move toward strategic planning (i.e., how best to meet the challenges of the future and prepare for a changing environment).
2. Regional transportation planning agencies are becoming more concerned about satisfying local community needs than about meeting federal planning re-

quirements. This shift has been fostered by cutbacks in federal funding and, therefore, increased funding from state and local sources, which has resulted in greater accountability to the latter. The consequence of this change is a greater concentration on short-range problems, providing more visible results to local constituencies.

3. Rapid computer analysis capability is making planning more relevant to decision makers. Microcomputers have provided planners the capability of analyzing problems and producing results much more quickly.

4. Increasing focus on rehabilitation and system maintenance will create increasing pressure for implementation-sensitive planning. This shift has been fostered by a widespread recognition of the critical need to rehabilitate and rebuild the public works infrastructure, particularly in the older cities, which results in a greater concentration on effective implementation than system development.

5. There are many planning processes in an urban area that require alternative styles of planning. All of the previous four propositions reinforce this fifth one; that is, effective transportation planning must be more flexible in developing alternative planning approaches and more responsive to the needs of decision makers by providing additional relevant information.

Based on these propositions, Meyer concluded that an effective transportation planner is one who possesses the following attributes:

1. Ability to understand the decision-making process. It is necessary for the transportation planner to not only have a thorough knowledge of the decision-making process but to also understand the environment in which the decision maker must operate.

2. Ability to define the problem and identify the problem-solving approach in an appropriate manner. It is necessary for the planner to define the problem in a comprehensive way to ensure the most appropriate response or solution, considering available resources and the needs of the decision maker.

3. Ability to understand implementation concerns. It is necessary for the planner to have a thorough understanding of the myriad potential obstacles that may be encountered in project implementation.

4. Ability to utilize the most appropriate analysis methodology and techniques. This capability is directly related to the ability to define the problem.

5. Ability to incorporate basic community (or organizational) values into planning efforts. It is necessary for the planner to describe the consequences of alternative planning approaches as comprehensively as possible to permit the decision maker the opportunity to assign judgmental values to the potential consequences of his or her decisions.

6. Ability to communicate information. Meyer made no attempt to correlate these attributes with programs of study or specific courses because of the difficulty of evaluating what can be taught and what can be developed through experience.

EDUCATING TOMORROW'S TRANSPORTATION ENGINEERS

Larson and Haack believe that, because of the broadness of the field, it is not possible to define a discrete body of knowledge that should be used as the basis

for educating transportation engineers. To arrive at a better understanding of the implications for engineering and engineering education, Larson and Haack, like Meyer, examined a number of trends in transportation. The impacts of these trends are primarily related to a public transportation agency. These trends included the following:

1. Systems development to systems management. There is a shifting of emphasis from transportation system development toward transportation system management. This shift has resulted in greater fiscal responsibility and a more business-oriented approach to transportation programs.
2. Subject technology to public acceptance. There is a tendency not to use technology until it is thoroughly understood by the various constituencies that are affected by it. This has resulted in a greater sensitivity to and interaction with local officials and the public.
3. Pocket calculators to personal computers. The shift to greater and more rapid computer technology facilitates the ability of a public agency to establish adequate control systems for overall monitoring and management. Management control is reinforced and enhanced by computer-assisted design and drafting and office automation.
4. Federal government to local government and private enterprise. The shift from federal government intervention in transportation to state government and from state to local government has resulted in greater reliance on local management and greater accountability. A ramification of this shift is an increased use of private contractors as a means of achieving more cost-effective operations.
5. Research to innovation. The shift from unsuccessful attempts to apply high technology in the design, control, and operation of transportation systems to innovative approaches to solving more traditional transportation problems, such as infrastructure materials and technology and bridge and pavement rehabilitation, has resulted in a resurgence of interest in transportation research. However, it would be a serious omission not to mention the successful application of high technology to transportation achieved by other countries of the world.

It is interesting to note that there is practically 100 percent overlap between the shifts regarding transportation planning and those regarding transportation engineering as identified by Meyer and Larson and Haack.

After identifying the preceding trends, the authors defined the "ideal" engineer for transportation as "well grounded in basics and capable of solving unique problems in creative, imaginative, high-tech ways." This individual should also have the ability to work independently or as part of a team, and should have the ability to interact and communicate successfully with others. The individual should also possess entrepreneurial capabilities and an understanding of domestic and international political structures. In addition, the individual should exhibit high moral standards, leadership qualities, and the ability to fit transportation systems into the social, economic, and physical environments in such a manner that the quality of life would be improved for all.

Based on the observed trends in transportation and the definition of a model engineer, the authors drew conclusions about impacts for education and industry. With respect to education, they indicated that an impact must be made on all levels of education in order to produce the model engineer; greater emphasis must be placed on developing individual capabilities commensurate with the individual's ability.

With respect to industry, the authors discussed the implications with regard to the experienced engineer, the engineer-in-training, the engineering profession, and the involvement of industry in education. Various techniques were identified to avert the danger of stagnation of experienced engineers, including job rotation, retraining, in-house training, and continuing education. The engineer-in-training should be challenged as early as possible to perform to the full extent of his or her capability. For the engineering profession, it is necessary to develop and promote the image of engineering and the attractiveness of engineering as a career path. Industry's involvement in education can take several forms, including encouraging employees to run for membership on local school boards and to be guest speakers, adopting a secondary school type of program, providing summer jobs and internships, making funds and equipment available to institutions of higher learning, encouraging employees to assume adjunct faculty positions, and encouraging full-time faculty to accept a short-term appointment to industry as a visiting scientist.

TRANSPORTATION EDUCATION: TRAINING REQUIREMENTS FOR TRANSPORTATION TECHNOLOGISTS

Woods et al. indicated that there is a growing need for technicians in transportation. They considered the engineering team to be made up of engineering technicians (presumably graduates of a 2-year certificate program), engineering technologists (graduates of a 4-year bachelor of technology program), and engineers (graduates of a 4-year bachelor of science or engineering program). As used in their paper, the term technologists included both technicians and technologists.

Because of the widespread availability of microcomputers, many functions previously carried out by engineers are now relegated to technologists who can be readily trained to execute routine technical data processing. The engineer's main function, in this regard, is the interpretation of results rather than the performance of computational work. He or she can be provided with several alternative solutions to a given problem from which the most suitable solution can be recommended on the basis of whatever criteria are established for project evaluation. The role of the engineer becomes more creative and management-oriented. This same point is strongly made by Larson and Haack.

The authors anticipated that there will be a much greater change experienced in transportation engineering as compared with the more traditional branches of engineering. They attributed this to two factors: (a) the shift from capital programs to transportation system management programs and (b) the shift from mainframe computers to microcomputers. The ramifications of these shifts are that the engineer's functions will become more associated with project management, technical decision making, and research.

Regarding the implication for academic institutions, the authors perceived a change in orientation of some institutions to satisfy the increased demand for technologists. They believed that the more practice-oriented technical training will largely become the domain of the smaller technical institutions, and that, presumably, the graduate transportation pedagogical and research programs will be the domain of the universities. The role of the universities will continue to be to educate and train professionals for industry and faculty for technical institutions as well as for universities, and to provide for technology transfer in training and implementation.

The authors indicated that there are two basic needs for training transporta-

tion technologists: (a) technical training to prepare technologists for entry-level positions and (b) retraining those currently employed as technologists. These training needs will be provided by four sources including (a) in-house training, (b) equipment manufacturers, (c) technical societies, and (d) technical schools.

The authors identified various skills required to properly train civil engineering technologists, and they supplemented this listing of basic skills with specific skills associated with specialization areas of transportation stratified into (a) highway and street design; (b) surveying, mapping, and field location; (c) traffic control; (d) construction and maintenance; and (e) public transportation.

EDUCATION REQUIREMENTS FOR TRANSPORTATION CONSULTANTS

Smith believed that the training required for employees of transportation engineering consultants does not basically differ from that required of all types of engineering consultants. However, he indicated that there is almost no restriction on the use of a wide range of disciplines in transportation engineering consulting because of the broad array of services offered. Most projects require articulated teams of individuals from different disciplines. Larger firms can support highly specialized professionals, but both small and large firms require more broadly educated engineering professionals.

Smith believed that transportation engineering may more likely be subjected to rapid changes in technology as compared with some of the traditional engineering disciplines, recognizing, for example, that we are on the verge of space transportation that will draw on the innovative talents of those engaged in the transportation field.

He also pointed out somewhat unique characteristics of transportation consulting, including the need to be particularly sensitive to client needs, working excessive hours, carrying on additional study and research beyond working hours, and extensive travel with a substantial portion of it taking place beyond working hours.

Smith indicated that consulting engineering firms require individuals who are innovative and who have high personal and professional goals, an entrepreneurial drive, adequate verbal and oral communication skills, an acquaintanceship with business administrative activities (particularly accounting principles), and marketing skills. He believed that civil engineering provides the best undergraduate background for transportation consultants, supplemented by elective courses in transportation, economics, business administration, marketing, and international studies. Individuals who receive a substantial amount of training in nontechnical courses are generally preferred by transportation engineering consultants. Where a high degree of specialization is required it must be acquired in graduate school.

Smith's description of the attributes that should be possessed by those working in transportation consulting offices compares closely with the ideal engineer described by Larson and Haack.

Smith used the United Kingdom to illustrate the long-established practice in many European countries of articulating the training of professional engineers and engineering technicians. He believes this practice could result in maximizing productivity. He recognized the importance of in-house training, continuing edu-

cation, and the need to encourage employees to participate in professional activities.

The paper concluded with the thought that the transportation professional today is involved in a complicated process of planning, design, and management of projects, and, therefore, it is not as important to become highly proficient in one component of transportation as it is to have a better understanding of how all the components fit together.

WHAT ARE SHIPPERS AND CARRIERS LOOKING FOR?

Germane discussed the attributes that individuals should possess to assume entry-level management positions and to assume major responsibilities in his or her profession in later years. In establishing these criteria, he drew not only on his own considerable experience but also on the opinions expressed by senior-level executives from various modes of transportation.

He presented several characteristics that shippers and carriers would look for in judging the qualifications of an individual. The person should be (a) intelligent, (b) industrious, (c) personable, and (d) should possess basic knowledge and skills. The evaluation of attributes is largely done by indirect measures such as grades, awards, recommendations, and more direct measures obtained by interviewers. This process is quite satisfactory in selecting an individual for an entry-level position, but not necessarily in judging the potential of an individual to assume significant responsibility in the future.

With respect to the prospects for significant advancement, Germane identified three considerations, including (a) determination, (b) imagination, and (c) judgment. These attributes are difficult to evaluate by interviews, performance in school, or records, and they are generally determined by providing opportunities for progressively greater responsibilities and observing performance. He provided many excellent examples (or mini-case studies) to illustrate the attainment of the qualities of determination, imagination, and judgment.

In conclusion, Germane made several suggestions to enhance the development of these qualities. With respect to determination, he recommended (a) use of guest speakers to discuss the role of leadership in reaching objectives, (b) review of biographies and history to find examples in which individual determination was a significant factor in obtaining goals, and (c) use of case studies to illustrate the role of determination in decision making.

With regard to imagination, he suggested (a) use of case studies to illustrate how development changes significantly with time to stimulate imagination, (b) discussion of material associated with the commercial development of outer space, (c) use of problem cases based on current innovations, and (d) use of problem cases with no standard solution.

With respect to developing judgment, he advocated (a) practice in evaluation of choices through problem cases or research projects, (b) experience in making the various decisions required in the development of a plan, and (c) use of guest speakers to discuss the analysis and evaluation preceding the making of a particularly difficult decision.

In conclusion, Germane noted that "for maximum benefit, we need to shape our questions and comments carefully since they structure the responses we will obtain."

TRAINING REQUIREMENTS FOR TRANSPORTATION OPERATIONS PERSONNEL

Reading et al. discussed the skills required for transit operations personnel and the training provided after individuals are hired. Using the Operations Division of the Central Ohio Transit Authority as a case study, the authors examined the different training and other qualifications a transit authority might require of their employees as well as training opportunities they should be offered for the purposes of self-motivation and enhancing the possibility of advancement.

For higher level positions such as assistant general manager, operations executive assistant, and superintendents of different departments, the authors believe that in addition to competency in the area of specialization, a degree in business administration is desired.

Operations are generally divided into the major functional areas of transportation, maintenance, and building and grounds; each area is headed by a superintendent. The majority of motor coach operators, clerical staff, maintenance staff for equipment and buildings, and other positions, are unionized. After selection for most of these positions, employees are given on-the-job training, possibly supplemented by special training offered by equipment manufacturers.

Employees are provided various incentives to enhance job performance and opportunity for advancement through training and education activities, including (a) tuition reimbursement programs for courses and for continuing education, (b) reimbursement for expenses incurred in attending and participation in professional meetings, and (c) contracting for training programs.

The authors concluded with the observation that a dynamic process exists, and that the success of the process depends on the realistic assessment of skills needed for various positions and the establishment of a comprehensive program to develop further technical skills, leadership qualities, and the ability to deal effectively with others and with problems.

QUESTIONS FOR CONSIDERATION

1. The corporate sector adopted strategic planning about 10 years ago and, apparently, has abandoned the approach. Is government behind the times in its shift from system planning to strategic planning in light of the corporate sector's experience?
2. Will the shift from federal government intervention in transportation to state government to local government and the consequent focus on short-range problems have a stifling effect on innovation and research initiatives?
3. Is U.S. technology leadership challenged? If so, what are the implications of this challenge?
4. Is there not a need to develop research and implementation approaches to using technology more effectively in transportation?
5. What is the impact of the inability of governmental agencies to attract and retain transportation engineers in competition from the private sector?
6. Billions of dollars are being spent annually by all levels of government to rehabilitate and rebuild the infrastructure of major urban areas as well as public works throughout the nation. What should be the impact of this substantial commitment of resources on education, training, and retraining?
7. There has been little discussion by the authors of the impact of deregulation on transportation planning and engineering. What has been the impact of

operating in an increasingly deregulated environment? What are the implications for transportation education and training?

8. Although the student must be taught to cope with the rapid rate of obsolescence of his professional background, there is an indisputable need for continuing education programs. Is there a need to intensify continuing education efforts?

9. What is the impact of disproportionate enrollment of non-nationals in engineering, particularly at the graduate level?

10. The ability of universities to produce the best is jeopardized when second- and third-rate equipment, obsolete instrumentation, and inadequate library collections are used. University instrumentation inventories are nearly twice as old as those of leading commercial laboratories. The ivory towers are now in industry. What will the impact be of the deteriorating university infrastructure and the obsolescence or unavailability of instructional equipment and facilities, such as hardware required to provide students with experiences in computer-aided design, mapping, and drafting and office automation at many institutions?

11. Engineering educators are concerned about the decrease in the proportion of programs in engineering receiving certification from the Accreditation Board for Engineering and Technology. Is the quality of engineering education deteriorating?