A Comparison of Four Active Technology Transfer Programs

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ABSTRACT

Four ongoing technology transfer (T²) programs, differing distinctly in structure and in the environment in which they operate are described. Although varying circumstances result in unique problems of organization and delivery, parallels and similarities were observed among all programs. The programs compared include two T² centers established under FHWA's Rural Technical Assistance Programs (RTAP): the Highway Extension and Research Project for Indiana Counties and Cities (HERPICC) at Purdue University, and the Transportation Information Exchange (TIE) at Saint Michael's College, Winooski, Vermont. The other two programs are the Technology Transfer Roadshow of FHWA Region 9, and Delaware's DelDOT program, an example of a state department of transportation approach to technology transfer. The programs are compared in terms of sources of technology transfer information, the audience, topic selection, and technology delivery. Effective technology transfer does not result from adherence to a particular format or ritual technique of delivery. A range of skills and methods, an openness to new methods, and experiments with different ways to reach clients are required.

Four ongoing technology transfer (T²) programs, differing distinctly in structure and in the environment in which they operate, are described. At times, varying circumstances resulted in unique problems of organization and delivery; at the same time parallels and similarities can be observed among all programs.

The programs compared include two T² centers established under the Federal Highway Administration's (FHWA) Rural Technical Assistance Program (RTAP). One center was founded in a small Vermont college that had no history of highway T² activity; the other center was superimposed on the well-established T² programs at Purdue University. Of the other two T² programs, one is run by a state-level organization in the Delaware Department of Transportation (DelDOT), and the other is administered by FHWA through the Region 9 office in San Francisco.

The program that covers the largest geographical area is the Technology Transfer Roadshow of FHWA Region 9, which has been operating since 1978, serving Arizona, California, Hawaii, Nevada, and the Trust Territories. Making use of the circuit rider principle, the roadshow consists of a technology transfer specialist with a traveling van provided with brochures, pamphlets, manuals, and audiovisual equip-

ment. The roadshow has traveled approximately 200,000 mi and has given 280 presentations in 7 years.

The earliest established program of the four is the Highway Extension and Research Project for Indiana Counties and Cities (HERPICC), at Purdue University, which grew from a project initiated by the Indiana legislature in 1959. However, technology transfer has been practiced at Purdue since the beginning of the Purdue Road School in 1915. In 1982 HERPICC became a T² center, one of the 32 (as of early 1986) centers funded under FHWA RTAP.

The other T² center of the group is the Transportation Information Exchange (TIE), at Saint Michael's College in Winooski, Vermont. It is operated by a two-person, nontechnical staff. TIE had no previously established programs to build on because the concept of having a central office deliver technical assistance to local governments solely in transportation matters was new to the state. In operation only since 1983, the center was challenged with structuring an entirely new program where none had existed before.

The fourth program, Delaware's DelDOT program, described here after 4 years of implementation, is an example of a state department of transportation (DOT) approach to technology transfer. An important element distinguishing DelDOT's organization of the technology transfer process from the others is the fact that the state itself administers all roads and streets—there is no local government responsibility.

The programs are reviewed here to reveal innovative ideas and successes, as well as the problems and frustrations experienced. The sources of technology, type of audience, method of selecting topics for presentation, delivery of the technology, useful materials, and measurement of program effectiveness are compared.

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SOURCES OF TECHNOLOGY

Those programs that have no internal facilities for conducting research-oriented work seek out technologies that have been successfully implemented in other jurisdictions. Some materials may be obtained via mailing lists or official routing; others may be obtained by request. The following sources were useful to DelDOT: (a) Transportation Research Board papers and reports distributed periodically; (b) Highway Research Information Service monthly abstracts of selected subject matter as requested by state DOTs; (c) FHWA implementation packages as well as reports on research conducted through the FHWA Federally Coordinated Program; (d) findings of studies conducted by other state DOTs; (e) technical magazines reporting on technologies implemented abroad that have solved problems similar to those experienced by the authors; (f) demonstration projects on new technologies publicized by the Demonstration Projects Division of the FHWA; (g) reports mentioned at meetings, workshops, and conferences that were written by organizations that did not have DelDOT on their mailing lists; and (h) private industry promoting new products or processes after submitting free samples to DelDOT for testing in the state's facilities.

TIE's typical procedure in gathering written and audiovisual materials is to ask for a bibliography or resource list. It has developed a listing of resources in a number of general categories: the state of Vermont (DOT and other agencies), universities and colleges, federal agencies, periodicals, national organizations such as the American Public Works Association (APWA), and the National Association for County Engineers (NACE), private organizations such as the Asphalt Institute and Salt Institute, other T² centers, engineering associations such as the Institute of Traffic Engineers (ITE), and state groups; and contractors such as AGC of Vermont and individuals.

The roadshow uses not only federal and state resources for visual aids, but also commercial vendor productions.

HERPICC is the only technology transfer program of these four that enjoys a major, in-house, formal research program. The Joint Highway Research Project, also located at Purdue University, conducts research in cooperation with the Indiana Department of Highways (IDOH). The former's projects could benefit IDOH.

THE AUDIENCE

The most effective means of delivering technology depends on the type of clients and the organizational structure in which they work. Each program discussed here has developed its own methods to best serve its unique constituency.

TIE, operating in Vermont, serves a relatively small rural state where 81 percent of the roads are locally maintained. Each city, town, and incorporated village has its own road department. Most local road officials are volunteers who work part-time in government while maintaining fulltime jobs elsewhere. It is difficult, if not impossible, for most local road officials to attend an all-day statewide seminar. They also lack time for reading. A typical road department is composed of one to four men who have learned their skills on the job; there are very few people in Vermont local government who have engineering degrees. TIE makes a special attempt to maintain an up-to-date mailing list of all local road workers as well as their supervisors, so

it may maintain contact with all levels of those employed in local road maintenance.

The state of Indiana also gives local public agencies a great deal of responsibility for highways, roads, and streets. The extent to which the local agencies meet their responsibilities varies greatly, and the variation as seen in the quality of personnel and overall effort makes technology transfer for HERPICC a more difficult task. As does TIE, the program currently tries to reach all levels from elected local officials to maintenance crew members. However, this audience includes people responsible for larger jurisdictions than exist in Vermont (counties and larger cities), and many more clients with stronger professional and technical backgrounds.

DelDOT's program can use a streamlined approach to defining its audience because it need deal only with its own employees rather than local government officials. The director of each of the divisions indicates in a memorandum to specific section heads the type of people who should be present for a particular session. Designation is by level (squad leaders, area supervisors, or designers) or by activity (such as road designers or traffic engineers). Some section heads then assign people to attend, and others ask for volunteers.

Copies of the memorandum are sent to local jurisdictions throughout Delaware that have engineering or public works departments. When the technologies of a particular session have universal appeal, such as computerization, safety, and management, participation from these local agencies is strong.

The Technology Transfer Roadshow, by virtue of the area it serves, has by far the most scattered and diverse audience. Its purpose is to transfer information and materials to state, county, city, and private-sector individuals. Attendees range from state highway department engineers, public works directors, department heads, and maintenance superintendents to heavy equipment operators and general roadshow maintenance workers.

The sometimes vast distances that the roadshow must travel necessitate careful scheduling and planning by the coordinator. Currently, lead time for booking presentations is about 3 months, although agencies within 100 mi of the San Francisco FHWA office can usually be worked in sooner for a program of a day or less. Generally the roadshow operates on a first-come, first-served basis, but the farther the distance, the more agencies the show tries to serve in one tour. When it is traveling to Hawaii or the Trust Territories, or to sparsely populated areas that are a considerable driving distance from San Francisco, it tries to make sure that all agencies near the training site, interested organizations, local contractors, and consultants have been invited. To make the most efficient use of time, the coordinator determines possible travel routes and asks agencies along the way about their interest in the roadshow. The coordinator records requests from agencies that express interest the next time the roadshow will be in the area, and when a cohesive circuit tour can be mapped out, the coordinator contacts those agencies to make arrangements. When necessary, the roadshow travels on weekends or gives presentations at night or early in the morning. The presentation schedule is published as far in advance as possible in the roadshow's newsletter, Technology Transfer Update.

An initial difficulty experienced by the roadshow was advertising the program's availability and gaining credibility among its intended audience. The planners had not considered the element of their prospective clients' resistance to change and the fact that local agencies were wary of becoming involved in the relatively unusual practice of invit-

ing a federal agency into their territories to give them advice. Furthermore, the public works directors, engineers, and superintendents, whom the roadshow was trying to reach, were busy and extremely reluctant to invest their own or their employees' time in any activity not of proven worth. Finally, the roadshow started with the aid of the Caltrans Local Assistance Office and other personal contacts who helped arrange the first bookings.

SELECTION OF TOPICS

DelDOT established a routine for determining presentation topics through efficient use of its own bureaucratic structure. The process begins in the cold season, which is a slack time for most field personnel. A memorandum is circulated among all section heads of every division of the department asking about problems encountered in their work, and asking for suggestions for subject matter, speakers, films, and other presentation aids. Reply deadlines are specified, and section heads are reminded of the request by telephone. During the personal contact that follows receipt of the responses, details such as the date of the presentation, the target audience, in-house participation, area of emphasis, and structure and composition of the program are also discussed. Replies are compiled and grouped by related subject matter to comprise one session. New technology is not always requested; items requested include those that have existed for some time but have only recently become important through a change in priorities or a change in areas of emphasis. No suggestion, however trivial, is rejected.

In nearly all situations, HERPICC uses a planning committee to assist in identifying program topics and speakers.

TIE formed an advisory committee, conducted a survey of local needs, and introduced the concept of the new program to a number of groups. However, the method of polling the prospective clients was necessarily more decentralized than that of DelDOT. TIE solicited input from local road officials and arranged the topics in order of priority based on informal discussions and by mailing a one-page form. A one-page program summary was also mailed to hundreds of other local officials and short presentations were made to groups or their directors, explaining the T² program and soliciting their ideas. Groups contacted, for example, were the Vermont League of Cities and Towns, the Vermont Town and City Managers Association, the Vermont Municipal Highway Association, the Vermont Association of Planning and Development Officials, the Vermont Agency of Transportation, the University of Vermont Extension Service, and representatives from the private sector (vendors, contractors, and engineers). After several months of answering requests and observing local practices, TIE noticed other needs that were not articulated originally because they were not recognized by the clients as needs or deficiencies.

The method by which roadshow topics are chosen is completely different. Typically an agency representative writes or calls to request the roadshow. A specialist briefly explains the purpose and the operation of the roadshow to a new customer. A current catalog of roadshow subjects is sent and topics are selected according to the agency's needs and the amount of time it wants to spend. The topics chosen for inclusion in the catalog are predicated on the availability of good visual aids.

DELIVERY OF THE TECHNOLOGY

Reviews of all the programs concur that the transfer of technology in purely written form, particularly as research or technical reports, is the least effective method because of the lack of time, inclination, or technical background that makes reading such reports desirable or useful.

In addition, TIE found that most available written material is inappropriate for use because it rarely addresses the rural situation. Because TIE's clients are usually looking for a practical how-to-do-it article, the T² center is developing a series of how-to guides on more than 25 topics. The goal is to produce written materials that are concise, written in lay language, and sensitive to the Vermont situation. Alone, each guide is a training aid that addresses a particular topic, collectively, the papers form a Vermont local roads manual. Similarly, HERPICC has done a large amount of collecting and customizing of state-of-the-art reports for use by Indiana's local road and street agencies.

Session Format

The combination of written materials with a visual presentation is generally believed to be a most effective means of technology transfer that provides both a refreshing break from routine and a real learning experience. Possible formats are straight presentations, demonstrations, training sessions, and workshops.

The mainstay of DelDOT's program is the extensive use of audiovisual aids and the guest speaker, who is the most important aspect of a presentation. DelDOT invites top-flight professionals from the Transportation Research Board, federal and state governments, and private industry. University professors and employees from other state DOTs also share their expertise. The active participation of the section head is considered important for the success of a presentation. The section head opens the session with appropriate remarks, participates in any panel discussion, and fields questions. Each session is designed to last one day (from 9:00 a.m. to 4:00 p.m.). All sessions are held in Dover, which is centrally located, allowing sufficient travel time for participants coming from all parts of the state.

HERPICC's workshops and seminars are held at different locations throughout the state. Many have been developed around printed reports that are distributed to all appropriate local organizations. Guest speakers are often invited from IDOH and FHWA.

TIE's approach to presentations is to limit them to one day, allowing for travel time, and to repeat sessions in various regions of the state to allow maximum participation. All sessions are as practical as possible and allow plenty of time for participants to ask questions. Audiovisual aids consist of slide shows and videotape. Instructors come primarily from the state DOT, the private sector, and colleges and universities. TIE plans to take maximum advantage of the instruction by videotaping sessions for use in regional or local settings. Although the seminar format is popular, TIE concludes that the most effective education effort so far is to visit communities and meet with road crews one-on-one.

The roadshow, an audiovisual presentation on wheels, is geared to present most transportation-related subjects in general and several subject areas in depth if specifically requested. Usually the presentation of a wide variety of subject areas in a relatively short time is required; a 30-min general overview is then provided on each of these subjects. The trainer attempts to initiate a productive discussion among participants, takes the background until the dialogue falters, and then introduces the next subject. In-depth subject presen-

tations involve a variety of visual aids, along with discussion and lecture. Supplementary written materials are also supplied when they are appropriate. Roadshows run as short as one hour or as long as one week, whatever time is necessary to meet the need. Agencies tend to require too much at one time; however, 4- to 6-hr running time in one day is enough.

Equipment

Basic roadshow audiovisual equipment includes a 16 mm film projector, a super-8 film projector, an industrial-grade 35 mm slide projector, a cassette recorder/projector synchronizer, a 5- x 5-ft screen, a removable speaker, a portable PA system, a full daylight concave projector screen, a super-8 macrofocus motion picture camera, and a 35 mm SLR camera, plus spare parts and connections for all equipment. The roadshow does not use video equipment for two reasons: a video monitor cannot effectively communicate technical material to more than a small group at one time; and the equipment is also sensitive to dust, moisture, and mishandling, tending to malfunction frequently under the conditions in which the roadshow operates. The producers of the roadshow believe that it is particularly important to have their own equipment, thereby ensuring its suitability to their purposes and reliability through proper maintenance. Because of the distances traveled, the van also carries tools for equipment and van repair.

Networking

All of the programs emphasize the importance of networking as part of the technology transfer process, particularly as it develops spontaneously during presentations. Sometimes just asking people from different departments or neighboring agencies into the same room generates an almost immediate exchange of ideas, and leads to long-term exchange relationships. Sessions offer opportunities to enhance the informal contacts that already exist among participants, and HERPICC moderators note that not only do participants learn from each other, but the moderators learn the practical know-how of those who work at the local level.

Newsletters

TIE, HERPICC, and the roadshow each publish a newsletter as an integral component of their program. For TIE and the roadshow, the newsletter was the key element in initiating contact with prospective clients and in establishing the credibility of the program as a technical resource. TIE and HERPICC make a point of keeping the content interesting by including a variety of topics rather than focusing on a single issue. An item unique to HERPICC's newsletter is financial information on funding and fiscal matters concerning local highways, roads, streets, and bridges. The newsletter is a crucial element in the operation of the roadshow because it is the only method of communicating with a widespread audience and announcing in advance the schedule of roadshow bookings.

TIE and HERPICC, both T^2 centers under RTAP, make on-going development of their resource centers a priority. Local leaders are encouraged to call more frequently with inquiries and questions (TIE provides a toll-free line). HERPICC refers questions of a technical nature to a staff member who assists in identifying the best source for the answer. TIE maintains a limited library of approximately 250

titles and obtains information about other resources and how to access them. It also maintains a list of local roads officials who may be contacted for networking purposes, which encourages communication among communities.

USEFUL MATERIALS

In addition to the materials that the programs produce themselves (newsletters, rewrites of technical materials, and practical guides), there is a vast amount of materials available from the government, universities, and private industry. Examples of items particularly useful to the programs are listed.

1. Useful T^2 resource materials: publications:
   * Road and Bridge Guidebook (Oklahoma State University)
   * Road Maintenance Techniques (Oklahoma State University)
   * The Vermont Backroad
   * The Hole Story (APWA)
   * NACE Training Guide Series
   * NACE Action Guide Series
   * Maintenance manuals from states and municipalities
   * Transportation Technology Support for Developing Countries from TRB (Compendia and Syntheses)
   * TRB Records on low-volume roads conferences
   * Asphalt Institute publications
   * Pavement Patching Guidelines (FHWA-TS-82-211),
   * Field Maintenance Manual for Georgia Counties, Local Roads and Streets (FHWA-TS-79-218)
   * A Training Manual for Setting Street Maintenance Priorities (Texas Innovation Group)
2. Useful T^2 resource material: audiovisual aids:
   * Road Resurfacing
   * Riding on Refuse
   * Petromat
   * Recycling of Portland Cement Roadways
   * Hot Mix Recycling
   * Recycling with Emulsions
   * Recycling Asphalt with Portland Cement
   * Water in Pavement
   * Subsurface Investigation--The Reason Why
   * Field Sampling and Testing of Portland Cement Concrete
   * Field Aggregate Sampling
   * Cement Treated Base and Portland Cement Concrete Pavement Inspection
   * Prestressed Portland Cement Concrete Construction
   * Asphalt Plant and Pavement Inspection
   * Geotextiles in Civil Engineering
   * Extending the Bituminous Pavement Construction Season
   * Full Depth--Deep Strength Asphalt
   * Asphalt Emulsion Spray Applications
   * Open Graded Asphalt Friction Course
   * Gabions
   * Super Span
   * Slotted Drain Inlets
   * Rock Creek Crossing
   * Lime, a Versatile Stabilizer in Construction
   * Upgrading Performance of Existing Bridge Rail Systems
   * Evaluation of Post Mounted Delineators
   * The Marshall Method of Mix Design
   * Engineering Filter Fabric--Mirafi 140
   * Reinforced Earth Retaining Wall Construction

* Keyed Rip Rap
* Small Sign Supports
* Runaway Truck Escape Ramps
* Rural Mailbox
* Pedestrian Safety by Design
* Positive Signs of Life
* Traffic Management for Freeway Incidents
* Traffic Barriers on Slopes
* The Road to Clean Water
* Bikeways, Let's Get Serious
* The Audible Landscape
* Downtowns for People
* 10 Mile Creek
* Maintenance of Granular Surfaced Roads
* Pot Hole Repair
* Rolling and Compaction of Asphalt Pavements
* Basic Concrete
* Cracking and Seating of PC Concrete Pavements
* Compacting Asphalt Pavements Using Vibratory Rollers
* Rolling a Test Strip
* Soil Road Stabilization
* Fiberglass Roving for Slope Erosion Control
* Ditch Erosion Control
* Paint Stripe Removal by Burning with Excess Oxygen
* Multiple Choice
* Down is Up
* The Other Guy
* Backhoe Operation and Safety
* Motor Grader
* Hydraulic Excavator
* Crawler Tractor-Front End Loader
* Bulldozer
* Elevating Scraper
* Articulated Loader
* Crawler Tractor
* Backhoe
* Trencher
* Rolling and Compaction
* Maintenance of Granular Surfaced Roads
* Loading Logic
* Partners in Safety
* Traffic Control for Street Construction and Maintenance
* Night Safety at Work Zones
* War on Wet Weather Accidents
* Barricades in Construction Zones
* The Flagman
* Pavement Marking in Construction Zones
* Highway Construction Workzone Safety Concepts
* Measuring Results

A comprehensive program evaluation involves looking at several levels of the technology transfer process. If the simple presentation or distribution of materials is taken as a measure of success, then it is relatively easy to obtain quantifiable data. Attendance at presentations and workshops is re-

corded, as well as the number of requests for information and printed materials.

TIE and the roadshow note a measure of success in the responses to their newsletters; TIE occasionally asks readers to evaluate the newsletter by mailing back a form. Participants also evaluate training sessions and seminars for TIE. In addition, FHWA and a team of state and local officials are conducting an overall evaluation of the RTAP T² program.

If successful technology transfer is regarded as a process not only of delivering information, but also of gaining acceptance and of implementing technology, then determining technology transfer becomes more difficult.

At the final level of implementation, there is no clear quantifiable data. Here, only more subjective, qualitative judgments can be attempted. The specialist conducting the roadshow has worked 25 years in a region, therefore the road systems and problems of most agencies in the region are familiar. A log is kept for the roadshow itinerary, the problems in the area, and the topics of discussion. The specialist later notes definite regional changes and improvements, and although the technology for those changes is probably attributable to various sources, the roadshow is certainly one of them. The director of TIE reported that since the establishment of the center, people have begun communicating more, problems are being solved, and towns in Vermont are beginning to apply money-saving techniques.

CONCLUSION

Effective technology transfer does not result from adherence to a particular format or ritual technique of delivery. A range of skills and methods, and an openness to new methods and experiments with different ways to reach clients are required.

Organizational and financial constraints determine the scope of a program, whether it be administered by the federal government, a state government, or an educational institution. The receiver is ultimately the one to whom the technology is transferred, and the needs of clients from rural or urban areas, warm or cold climates, and from areas where local road responsibility lies at the local level or entirely with state officials cannot all be alike. Underlying the services of all the programs presented here is an unstated reliance on personal knowledge of the audience, its capabilities, and its needs.