Standing Committee on Technology Transfer (ABG30)
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Technology Transfer within TRB

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HISTORY AND BACKGROUND OF THE COMMITTEE

The Transportation Research Board (TRB) with its committee structure is to a significant degree a technology transfer agency. It brings the transportation community together to exchange information on research results, technology innovations, and new practices. It sponsors meetings and discussion forums, issues publications, and gathers groups of experts on numerous topics in support of government transportation needs. Thus, while all of TRB are practitioners of technology transfer in one way or another, TRB created a Standing Committee on Technology Transfer to serve as a focal point in eliciting awareness of and enhancing the practice and effectiveness of all technology transfer activities within the TRB organization.

The Mission and Scope of the committee:

To promote a shared understanding of the methods and processes of technology transfer among members of the TRB community, the committee, with the sponsorship of the Federal Highway Administration's Office of Technology Applications, published a comprehensive resource as *Transportation Research Circular 488*[i] in May 1998. The material in this paper is highly compressed from the circular so the reader is encouraged to obtain a copy of the *Transportation Research Circular 488* to examine the full development of each topic. This paper draws heavily from that circular as well as the committee's Millennial paper[ii]

EVOLUTION OF TECHNOLOGY TRANSFER

WHAT IS TECHNOLOGY TRANSFER?

Technology transfer is a proactive form of advocacy for change through adoption of technology. Practitioners of technology transfer are variously referred to as change agents, communicators, teachers, trainers, technology marketers, and by many other terms. Whereas they are usually welcomed, the idea of change that they advocate is frequently resisted. Moreover, it is nearly always impossible to measure, by any commonly accepted method, whether the technology they profess has actually transferred.

Technology Transfer has been defined in many ways. Key one was given in *NCHRP Synthesis of Highway Practice 150*[iii]: "Technology transfer is the process by which research and other new technologies are transferred into useful processes, products, and programs. Another way of saying the same thing is: technology transfer is the process by which a better way of doing something is put into use as quickly as possible."

An earlier technology transfer primer[iv] suggests that technology transfer "refers to all the activities leading to the appropriate adoption of a new product or procedure by any group of users. 'New' is used in a special sense as it means *any* improvement over existing technologies or processes, *not necessarily a chronologically recent invention*" [emphasis in original]. The

authors go on to say, “Technology transfer is not simply information dissemination; that is, it is not simply sending out information—whatever the form—and then passively awaiting its use. Technology transfer is a more active term. It implies interaction between technology sponsors and users and results in actual innovation.” A United States and German study[v] of technology transfer processes led to the following comprehensive definition (pp. 2-3), which adopts a private-sector point of view:

> Technology transfer (is defined) as the movement of technological and technology related organizational know-how among partners (individuals, institutions, and enterprises) in order to enhance at least one partner’s knowledge and expertise and strengthen each partner’s competitive position. Technology transfer occurs at all stages of the technology innovation process, from initial idea to final product. Like the innovation process proper, technology transfer is usually iterative, involving multiple transfer steps.

HOW IS TECHNOLOGY TRANSFER PRACTICED?

Technology transfer includes training but is much broader than that. Technology transfer involves[vi]:

- Identification of user needs (via questionnaires, focus groups, market research, and direct contact, to name a few methods),
- Information exchange (via newsletters, manuals, videos, training courses, demonstrations, direct technical assistance, software, etc.),
- Implementation of research findings (which can include licensing, training, marketing, and more), and
- Feedback (to the developers and manufacturers of the technology concerning problems identified, suggestions for improvement, etc.).

In the broadest sense, technology transfer is a process of communication that results in putting research findings or new information into practice. Research is implemented as a result of technology transfer activity, whether the process of technology transfer is formally engaged in or not. Implementation of research is more likely to occur, however, when technology transfer is practiced formally and purposefully. To be most successful, technology transfer must engage all those involved in the research and implementation process. Technology transfer should not only be a consideration upon the conclusion of research; instead, it is a process that most effectively is integrated throughout the entire research effort, resulting in greater benefit from the research results.

Technology transfer can also come from exchanges with peers from other agencies or jurisdictions who have prior experience with the technology, or through implementation partnerships where multiple agencies work together to implement a common technology.

LESSONS LEARNED

Practitioners of technology transfer have found that its hardest lessons can be summarized as follows[vii]:

- People and organizations are naturally resistant to change.
- Personal contact—the human element—is the most important factor in the diffusion and adoption of innovation.

- Personal contact—through one-to-one technical assistance and special transfer agents—is expensive in the short run, but immeasurably cost-effective in the long run.
- Effective communication of new ideas and techniques is best done through multiple channels: people, newsletters, case study reports, professional association networks, and publications. No one way will be enough.
- The experience and endorsement of peers are important elements in the widespread adoption of innovation and technology.
- Acceptance of new technology takes time and a lot of work, and it involves risk.

BARRIERS AND OPPORTUNITIES

If success is defined as accomplishing change, what are the barriers to success? The principal barrier is the attitude of resistance. Change is dangerous. Change is risky. Change forces one to abandon a comfortable position.

Barriers

Barriers restrict or constrain success. They may be self-imposed, technological, economic, institutional, or political. They may be caused by the provider, the intended receiver, or both. The most obvious barriers are institutional and may include the following factors:

- Lack of resources—funding and people;
- Lack of management support to implement new ideas;
- Lack of an organizational infrastructure;
- Inflexible regulations, incentives, and rewards; and
- Resistance to risk-taking and change.

Likewise, some barriers arise from the technology suppliers' impediments:

- The receivers' needs are misunderstood.
- The technology is not suitable for the conditions or the environment.
- The technology is not presented appropriately; that is, the right amount of information is not given to the right people.

Finally, human behavioral barriers also exist:

- Culture,
- Language (generally internationally, but this occurs even in certain regions of the United States),
- Lack of interest or perceived need, and
- Poor attitudes from provider and recipient toward one another.

Opportunities

Transportation technology is changing rapidly, and most practitioners do not have enough time to keep up with the changes. To avoid becoming out of date there is a need for continuous learning. Therein lies an opportunity for technology transfer.

High rates of personnel turnover, particularly within departments of transportation and public works agencies, result in another reason, or opportunity, for ongoing technology transfer programs.

Look back to the changes in transportation technology, coupled with the changes in communications and information technologies, that have occurred in the past decade alone.

Apply this look forward. The future is both promising and uncertain but clearly challenging. Building new (and expanding existing) opportunities for communications and experience sharing is essential. We also need visionaries to continue to network technology and learning opportunities.

FUTURE CHALLENGES FOR TECHNOLOGY TRANSFER

Today we live in a world that is geographically, culturally, politically, economically, and technologically diverse—yet the power of communications has exposed most of the world to its neighbors, both near and far. States, regions, and nations are no longer isolated, and transportation and better methods of transport are in demand by all.

In recent years a great deal of thought, effort, and sharing has boosted technologies around the United States and the world. Yet, as we have increasingly recognized the need for technology transfer, we realize even more acutely that more effort is required.

Appropriate human resource development is essential, as is the creation, support, and preservation of a national scientific and technological capacity to absorb, adapt, and manage the knowledge, products, and techniques to be transferred. The adaptation to changing technology requires a continuing process of adjustment throughout the transportation sector: government, companies, and institutions. To ensure the necessary increase in personnel skills, a major educational and training effort will need to be undertaken.

Probably the most influential issue facing us is that of technology expansion. Recent years have seen truly staggering technological revelations and advances. Following history's traditional spiraling trends, we can only expect this to continue at an ever-exciting pace. People in technology transfer, and especially those on the Committee on Technology Transfer, need to challenge themselves to be ready—out on the leading edge.

New tools, such as distance learning and the World Wide Web, will have to be explored, mastered, adopted, and appropriately used for the purpose of technology transfer. In much the same way that transportation technology is rapidly expanding, so too are the tools of the trade for technology transfer. Developments in communication technologies make it possible to reach a broader audience in greater numbers than before. The challenge is to match the appropriate communication technology or technology transfer tool to the particular needs and technical readiness of the target audiences. As new communication tools are implemented, production quality standards will be continuously increasing as audience sophistication grows. The days of a "talking head" videotape, giving a boring lecture on a technical topic, will not continue forever. People will know that better methods exist, and they will not sit still for communications they find uninteresting.

Yet as Calvin Grayson of the Kentucky Local Technical Assistance Program Center once noted "technology transfer is a 'contact sport.'" The need for person-to-person communication in furtherance of technology transfer can be expected to continue well into the new millennium. We must plan to use the new tools of the trade, but we must not abandon the technology transfer methods that continue to be effective.

New concepts will make us ever more successful in the future. They include global communications, super microcomputers, virtual-reality technology, and space-age materials in everyday use. They also include new social structures, innovative partnerships, creative financing, and most important, the old-fashioned goodwill and determination of the technology transfer community to continue to do the good work.

This all points to the need for a strong transportation technology transfer program in the new millennium. It is fortunate that the Committee on Technology Transfer is in place to do its part in facilitating the technology transfer mission of TRB. Herein lies a key challenge to the committee. As a committee whose emphasis is cross-disciplinary as well as multimodal, how can the committee best integrate to become a recognized technology transfer resource to the transportation community, including the TRB committees? Conversely, how can the committee take full advantage of the potential resources of TRB, its committees, the broad transportation community, and those progressively implementing technology transfer strategies outside of the transportation community? Education and integrated information outreach must be a driving focus of the Committee on Technology Transfer in building an informed community of transportation researchers, practitioners, and academics working together to more fully utilize the benefits of transportation research.

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[i] Wallace, C. E., J. A. Anderson, and E. M.Wilson. *Transportation Research Circular 488: Transportation Technology Transfer: A Primer on the State of the Practice*. TRB, National Research Council, Washington, D.C., May 1998.

[ii] Irwin, L. H. *Millennium Paper for Committee on Technology Transfer*. Transportation Research Board, Washington, D.C., 2000.

[iii] Hodgkins, E. A. *NCHRP Synthesis of Highway Practice 150: Technology Transfer in Selected Highway Agencies*. TRB, National Research Council, Washington, D.C., Dec. 1989.

[iv] Schmitt, R. P., E. A. Beimborn, and M. J. Mulroy. *Technology Transfer Primer*. Report FHWA-TS-84-226. University of Wisconsin, July 1985.

[v] Abramson, H. N., J. Encarnacao, P. R. Reid, and U. Schmock (eds.). *Technology Transfer Systems in the United States and Germany*. Fraunhofer Institute for Systems and Innovation Research, National Academy of Engineering, Washington, D.C., 1997.

[vi] Irwin, L. H. *Millennium Paper for Committee on Technology Transfer*. Transportation Research Board, Washington, D.C., 2000.

[vii] Schmitt, R. P., E. A. Beimborn, and M. J. Mulroy. *Technology Transfer Primer*. Report FHWA-TS-84-226. University of Wisconsin, July 1985.