

Technology Transfer: Strategy for Innovation Adoption at the Washington State Department of Transportation

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The current literature regarding technology transfer is first reviewed in this paper to provide a context for a detailed consideration of the Washington State Department of Transportation (WSDOT's) technology transfer program. Interviews were conducted with WSDOT managers to gather information on existing practices and thoughts on improvements. Information from the literature review and interviews provides the basis for a new model of technology transfer for the WSDOT.

In 1984, the Washington State Department of Transportation (WSDOT) began developing a long-range "strategic plan." In order to define the issues the strategic plan would address, executive managers participated in a seminar to discuss conditions in 1995 and beyond that might affect the state's transportation system. These managers then evaluated the present functions of the WSDOT and identified immediate actions that would give it the capability to meet those future conditions.

WSDOT executive managers generally agreed that in the next two decades a number of changes will occur that will have a major impact on the amount and type of required transportation facilities and services. Among the conclusions they reached was that WSDOT will need to continuously evaluate the way in which it does business in order to fully use rapidly advancing technology and innovation in the transportation field (1).

In light of these forecasted conditions, the managers evaluated the department's present ability to meet future transportation challenges and needs. Seven major objectives were identified that required immediate actions by the department. One of these seven objectives dealt with technology transfer and was stated as follows: "provide a program of research and development that integrates technological innovations, methods, and techniques into the activities of the department" (2).

Management then developed strategies to accomplish each of the objectives. One strategy identified for the objective just described was to "develop a program of coordinated technology transfer" (2).

In this paper the authors report on an effort to study technology transfer practices at the WSDOT to

- Determine the state-of-the-art in technology transfer;
- Identify the current technology transfer practices at the WSDOT;
- Assess the current practices and determine whether any coordination of activities is necessary;
- Recommend resources, procedures, and activities required to enhance technology transfer practices; and
- Provide an implementation plan if a coordinated technology transfer program is required.

TECHNOLOGY TRANSFER PRACTICES IN INDUSTRY AND GOVERNMENT

Literature Search and Interviews

The subject of technology transfer is not new or unique to the transportation field. Discussions of technology transfer, innovation adoption, and other related subjects are found in literature from the fields of public and business administration, research use, social sciences, and communications. A review of this literature provided definitions of technology transfer, identified important principles of the process, and showed the state of knowledge in technology transfer.

Technology transfer is also practiced by many private- and public-sector organizations. Interviews with technology transfer specialists and a review of the literature regarding these programs is provided to demonstrate the experiences, techniques, and practices of other organizations.

Department Interviews

Current WSDOT technology transfer practices were identified through a survey of 32 work units in all WSDOT divisions and districts. The survey method consisted of interviewing one or more managers from each work unit. The interview format was borrowed from ethnographic research and, thereby, encouraged managers to express their ideas and definitions on the subject of technology transfer.

An inventory of the existing technology transfer practices that each work unit provided was obtained. The managers

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identified technology transfer practices that WSDOT employees participated in but that were provided by sources outside the unit. They also discussed organizational constraints that presented barriers to technology transfer in the work unit.

Technology Transfer Model

A review of the literature on the subject of technology transfer is necessary to understand the definitions of technology transfer and some of the organizational issues that influence the process. The literature also shows a trend in technology transfer research. Earlier studies on the process of technology transfer focused on the ability of an individual to adopt innovations. More recently, research has begun to examine issues that affect an organization's ability to produce or adopt innovations.

Technology transfer is practiced by several diverse groups, including government policy makers, business executives, and academic researchers. An examination of technology transfer programs that exist demonstrates the variety of their use by different organizations.

Since the 1950s, many professionals have been writing about technology transfer. A review of books, journals, and articles shows that most authors begin discussing technology transfer by providing a basic model of the process. The popular illustration shown in Figure 1 is used to describe technology transfer by many experts.

Three significant groups are identified in the process of technology transfer: source, user, and transfer mechanism. The identities of these groups are described as follows:

- *Source*—the sources of knowledge created from scientific research, experimentation, and human experience;
- *User*—the person or group who adapts or adopts the knowledge produced by a source; and
- *Transfer mechanism*—the method used to bring innovation from the source to the user.

Stated simply, the process by which a source produces or modifies a technology, how it gets communicated to a potential user, and whether the user adopts such innovation consists of dynamic linkages between these groups.

Social Process

E. Rogers (3), one of the early authors on the subject of technology transfer, concentrated on the diffusion of inno-

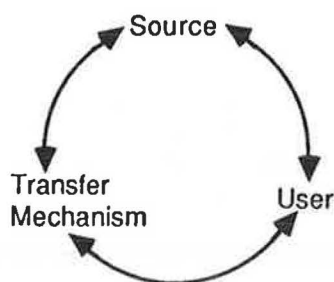


FIGURE 1 Technology transfer model.

vation as a social process. Rogers described five stages involved in the process of individuals adopting an innovation:

1. Individuals become aware of the innovation.
2. There is interest or a need for the innovation.
3. An evaluation takes place that weighs the risks against the benefits.
4. The user must have the capability to try the innovation.
5. The individual adopts the innovation when the trial of the innovation produces a significant improvement over the current practice or method.

In early 1980, researchers from the University of Wisconsin produced a more refined description of the characteristics that influence potential users in the technology transfer process. Their work focused on practitioners in the transportation field. These authors identified the following stages of the technology transfer process (4–6):

1. *Adaptation*—the altering of innovation and the new setting to enhance the “fit” of the new innovation;
2. *Adoption*—the testing of the innovation, which leads to the implementation, modification, or abandonment of the innovation;
3. *Implementation*—the long-term incorporation of the innovation; and
4. *Diffusion*—the dispersion (both internal and external) of the results.

Organizational Acceptance

Almost a decade after Rogers published his first book on the diffusion of innovation, he coauthored a book that identified certain factors, in addition to costs, that affect the degree of acceptability of an innovation in the organization (7). These are:

- *Relative advantage*—the degree to which an innovation is perceived as being better than the idea it supersedes;
- *Compatibility*—the degree to which the innovation is consistent with past experiences, values, and present needs of the organization;
- *Complexity*—the ease at which potential adopters can understand the innovation;
- *Trialability*—the extent to which experimentation or limited testing is possible; and
- *Observability*—the degree to which the results of the innovation are easily visible and communicated to others.

The attitudes of individual organizations were recognized in the late 1970s as an important influence on the adoption of innovation. Three major organizational characteristics that affect adoption are (8)

- *Risk-taking climate*—the general willingness of a firm to undertake new ventures that have a potential for failure;
- *Regulatory framework*—the extent to which others (legislature) can intervene (either positively or negatively) in the decisions of an organization by placing requirements on procedures and programs; and
- *Labor reaction*—the likely reaction of unions and employee groups to an innovation.

Innovation in Corporations

By the 1980s, the subject of innovation became an important topic to business leaders. Increased market competition, rapidly developing technology (particularly in the computer field), a changing work force, and the economic climate were conditions that influenced managers to evaluate the way in which their organizations produced or adopted innovation. The analysis focused on not only the companies' ability to produce new products and technologies but also to adopt or adapt those that were being rapidly developed in the marketplace.

In a major study of American corporations, R. M. Kanter (9) selected 10 companies to determine the significant elements that contributed to their ability to be innovative. She defined innovation as "the process of bringing new problem-solving ideas into use. This process involves the generation, acceptance, and implementation of new ideas. Innovation occurs in any part of the organization and can involve creative use as well as an original invention."

Kanter found that innovation was the result of companies who practiced integrative management and problem solving. "Integrative (management) is the willingness to move beyond received wisdom, to combine ideas from unconnected sources, and to embrace changes as an opportunity to test limits." The contrasting management style and structure is "anti-change oriented and prevents innovation." Kanter called this "segmentalism" because "it is concerned with compartmentalizing actions, events, and problems and keeping each piece isolated from the others." Companies who have segmental operations find it difficult to innovate or to handle change.

Kanter made important recommendations to managers for providing innovation in an organization. These are summarized as follows:

- Encourage an innovative culture in the organization by highlighting the achievements of its employees. This culture is established by providing rewards, introducing innovations to different areas in the organization, and letting the people who discover or produce the innovation be the marketers of the product or method.

- Provide employees with greater access to a responsive system by establishing multidiscipline committees that review and support proposals for innovation.

- Improve lateral communications by bringing people from different departments together. Allow greater horizontal mobility for employees by allowing work groups or teams to work on projects.

- Create cross-functional links, even overlaps in functions, so that teams of people are responsible for the same end product.

- Reduce the layers of hierarchy that produce barriers to resources. Push decision making downward, making it possible for people to directly pursue what they need. Allow employees to share information and provide quick intelligence about external and internal affairs.

- Reduce secrecy about the organization by providing employees more information about the company's plans. Avoid surprising employees with new plans by involving them in the development of such plans.

- Give people at lower levels in the organization a chance to contribute their ideas by involving them in task forces and problem-solving groups or through more open-ended, change-

oriented assignments, with room for the employee to determine the approach.

- Establish an organizational structure for change that is parallel to the existing organization. Provide recognition of the change structure to employees.

Another important observation that Kanter made was that "top executives need at least some of the qualities of corporate entrepreneurs in order to support this capacity at lower levels in the organization." In other words, executive managers must not only support innovation within the organization, they must be innovative leaders.

INNOVATION IN PUBLIC ORGANIZATIONS

P. Drucker (10), an author of many books on management, entrepreneurship, and organizational excellence defined innovation as the "effort to create purposeful, focused change in an enterprise's economic or social potential. The success of an organization is based on its ability to adopt change and to provide a work environment that induces employees to be innovative."

According to Drucker, most innovations in public agencies are imposed by outside sources or catastrophes. He explained that for many organizations the belief is that "if you invent a better mousetrap, the world will beat a path to your door." But what managers fail to consider is, what makes the mousetrap "better," and for whom?

Drucker proposed that the vehicle for a change in attitudes, values, and behavior is a "technology" called management. He sets forth principles for managing innovation that include analyzing the opportunities for innovation by looking, asking, listening, and introducing simple focused changes on a small scale.

Drucker explained why innovative enterprises are difficult for a public agency. His reasons are summarized as follows:

- Operations are based on a "budget" rather than results.
- Innovation in the public sector must please many constituents, rather than just the customer.
- Change can be a threat to a public agency's existence, beliefs, and values.

Drucker recommended policies for organizations to establish that would provide a climate for innovation:

- Establish a clear definition of the department's mission;
- Develop a realistic statement of goals;
- View failure to achieve objectives as an indication that the objective is wrong;
- Instill a constant search for innovative opportunities through policies and practices; and
- Allow opportunities for lower-echelon employees to participate in the process of innovation.

Barriers to Innovation

J. B. Quinn (11, p. 34), author of books on strategic management and technological innovation, explained that innovative organizations must "recognize that the random, chaotic

nature of technological change cuts across organizational and institutional lines, laps into a multitude of outside resources and user groups.” Quinn described the bureaucratic barriers in an organization that affect its ability to innovate as follows:

- Executive managers have little contact with workers who might influence their thinking about technological innovations.
- People who go outside the chain of command are viewed as “fanatics, troublemakers, or nonteam players.”
- Executive managers have expectations for immediate quantifiable results.
 - The costs of assessing direct, indirect, overhead, overtime, and service costs against a project add to development costs; big projects often become political targets.
 - Managers who want innovation to occur only through formal research and documented results rationalize excessively.
 - In the name of efficiency, the organizational structure can require many approvals; it can take a chain of “yeses” to approve a project and only one “no.”
 - Reward and control systems are designed to minimize surprise, yet innovation is full of surprises that can disrupt plans and control systems.

Technology transfer is practiced by several diverse groups including government policy makers, business executives, and academic researchers. The following examples of technology transfer are provided to demonstrate the various technology transfer programs in other organizations.

U.S. Department of Agriculture

Since 1914, the U.S. Department of Agriculture (USDA) has funded cooperative extension services at universities around the country. As universities generated new knowledge through research, it soon became apparent that there was a need for technology transfer to teach the results of the research to practitioners in the field. The present-day cooperative extension service centers were established in most states through a cooperative effort by the USDA, universities, and local governments.

The cooperative extension’s mission is to assist people in making informed decisions through research and experience based on educational programs; improve agriculture and natural resource management; improve the capabilities of individuals and families; aid communities in developing and adapting to changing conditions; and provide developmental opportunities for youth (12).

Cooperative extension “agents” link the needs and problems of people and communities with rapidly developing technology. Extension service centers practice technology transfer by teaching; distributing publications, newsletters, and brochures; arranging demonstrations, workshops, and seminars; and providing one-to-one technical advice and problem solving.

FHWA

The FHWA developed the Rural Technical Assistant Program, commonly called RTAP, in 1982. This technology transfer program focuses on rural roads, bridges, and public transportation. “Rural” in this program means counties, small cit-

ies, and towns that are not part of urbanized areas. Around the nation, 41 technology transfer (T2) centers assist local transportation agencies in receiving the training and new technology they need. The T2 centers provide materials to local agencies, distribute newsletters on the latest technology, conduct training, and evaluate programs. Most of these T2 centers are coordinated from a university, although some are administered from a state transportation agency. Under this program the latest in technology, as developed by research, industry and other sources, is transferred to a network of local transportation agencies.

International Organizations

Technology transfer is practiced globally by the U.S. State Department and other federal and privately funded agencies to introduce new technology and knowledge to developing nations. Unique considerations in international technology transfer include geography, language, and culture. The United States transfers knowledge to other countries about agricultural technology, population control, space technology, and weapons (13).

Summary

Research on the technology transfer process began with examinations of the factors that influence individuals to adopt innovation. Today, technology transfer is analyzed in the context of organizations because the organization determines whether the individual seeks out and uses innovation in the work environment. Another reason that the focus of technology transfer research is now on organizations is that managers recognize the individual as an important source of innovation. Organizations must have the ability to capture innovation that is created or discovered by employees.

Programs of technology transfer play important roles in the functions of many different organizations. Educating farmers about new agricultural technology, transferring population control methods to developing nations, and bringing new products and methods to rural transportation workers are examples of the technology transfer process. Successful technology transfer is important to an organization because more knowledge, better use of resources, progress, and the elimination of inefficiencies are all feasible outcomes. Technology transfer is important to individuals and communities for the same reasons.

CURRENT WSDOT TECHNOLOGY TRANSFER PRACTICES

Technology transfer is practiced in all WSDOT divisions and districts through a variety of methods and techniques. The techniques or “transfer mechanisms” that individuals and work units use to introduce sources of knowledge to potential users are categorized for the purpose of discussing the current practices in WSDOT.

Many external organizations and groups, such as the U.S. Department of Transportation and private industry, also provide technology transfer.

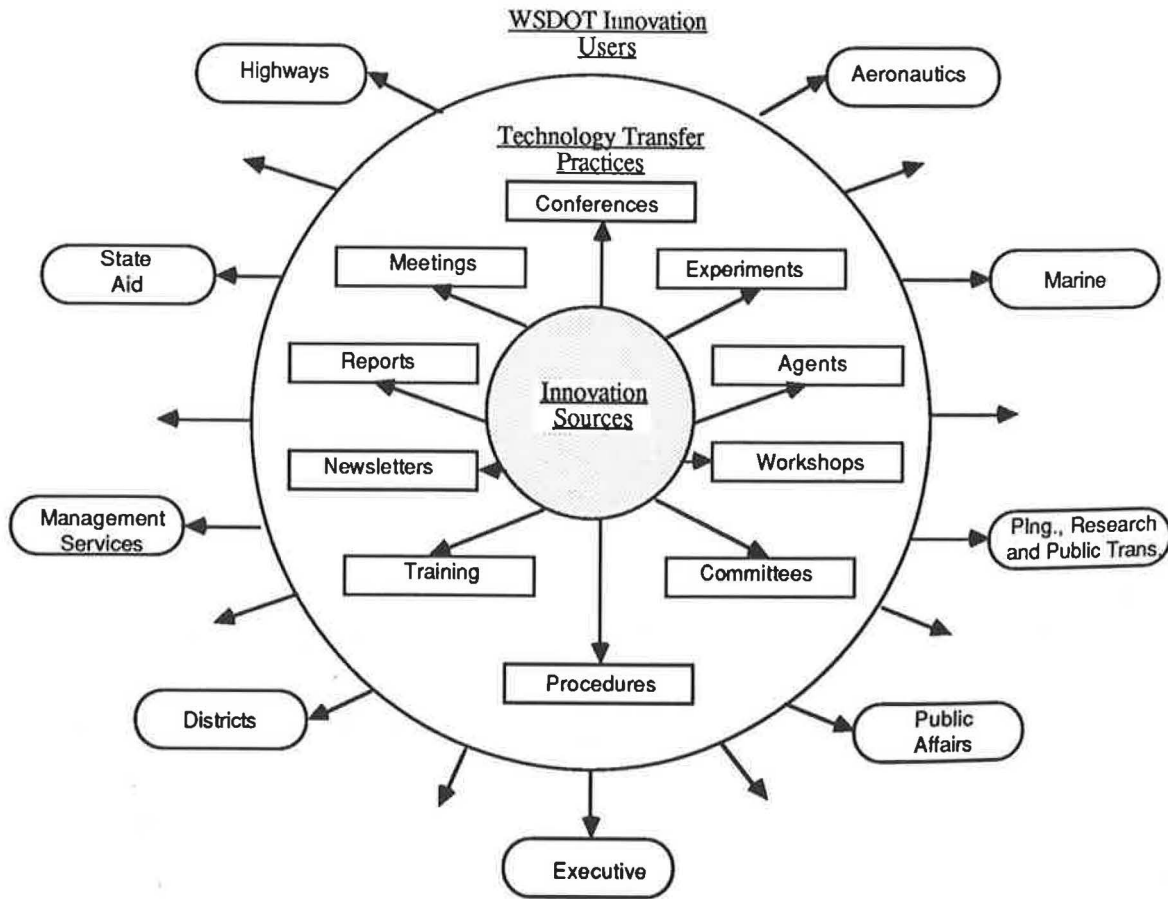


FIGURE 2 Current technology transfer practices at WSDOT.

Figure 2 illustrates how innovation is transferred through conferences, meetings, reports and so on into WSDOT divisions and districts. Technology transfer is clearly practiced within each district or division but with no recognized connection between different sources, WSDOT offices, or functions, so that much information simply never reaches appropriate users.

An overview of the technology transfer practices of each work unit that participated in the study is provided in a matrix (Table 1). This information was collected from interviews with WSDOT managers from 32 work units.

The following sections describe how each activity is used for technology transfer. Data gathered by the survey interviews provide specific examples for each practice. Relevant issues pertaining to the practice are also discussed.

Conferences

Many formal and informal opportunities for technology transfer occur at conferences. Displays, presentations, workshops, demonstrations, and papers are all technology transfer mechanisms that can be part of a conference program and used to introduce innovation to potential users. Conferences provide an opportunity for attendees to gain knowledge about events that are external to their own organization. More important, conferences provide attendees opportunities for face-to-face

contact with peers and other professionals. Important contacts for future activities and problem solving can be made at conferences.

Although conferences are an excellent technique for providing technology transfer, the number of employees who attend is limited by budget constraints and out-of-state travel restrictions. Opportunities for attending conferences in WSDOT are provided to executive managers and some employees from middle management levels. Therefore, it is important that managers who do attend conferences communicate their experiences to other members of the organization. Some managers accomplish this by conducting staff briefings on conference events. Other managers file "trip reports," which are distributed to other executive managers.

Workshops

Workshops can be a technology transfer practice because they give attendees an opportunity for first-hand experience with a new product or procedure, usually in a "working session." Workshop topics are specific in nature and provide an opportunity for the attendees to discuss their experience with each other. WSDOT's Management Information Systems office conducts workshops on new software packages with informal groups of employees. WSDOT participates in workshops sponsored by the FHWA and private industry.

TABLE 1 OVERVIEW OF WSDOT TECHNOLOGY TRANSFER PRACTICES

Group	Confer-ences	Work-shops	Train-ing	Demon-stration	Exper-iment	Agent/Liaison	Reports	News-letter	Proce-dures	Research	Committee	Annual Meeting	Assoc-iations
Staff Development	—	AC	C Crd	C	—	—	PR	—	F	Y	Y	Y	Y
Public Affairs	S	—	ACS	S	—	—	PR	PR	—	Y	Y	—	Y
Aeronautic	ACS	AC	AC	AC	C	—	PR	PR	—	Y	Y	Y	Y
Highways													
Resource	—	—	C	—	—	Carr	—	—	I	—	Y	—	—
Bridge	ACS	AC	AC	AC	C	Henley	PR	R	F	Y	Y	Y	Y
Location/Design	A	AC	AC	AC	C	Gripne	PR	R	F	Y	Y	Y	Y
Construction	A	AC	AC	AC	C	—	PR	R	F	Y	Y	Y	Y
Materials	A	AC	AC	AC	C	Anderson	PR	R	F	Y	Y	—	Y
Maintenance	A	AC	AC	AC	C	Williams/Kesseck	R	PR	F	Y	Y	Y	Y
Traffic	A	A	AC	AC	C	C. Mansfield	PR	R	F	Y	Y	Y	Y
Support	A	AC	AC	AC	C	—	PR	R	F	Y	Y	—	Y
Management Services													
Administration	AS	AC	AC	AC	C	—	PR	PR	F	—	Y	Y	Y
MIS	A	AC	AC	AC	C	Area Reps	PR	PR	F	Y	Y	Y	Y
Mgmt./Oper.	A	—	—	—	—	—	—	—	—	—	—	—	—
Library	—	—	ACS	—	—	Russo	RD	R	I	Y	Y	—	Y
Methods/Procedures	—	—	—	—	—	—	—	F	F	—	—	—	—
Marine Division	A	A	AC	AC	C	—	R	PR	F	Y	Y	Y	Y
PRPT													
Research	A	SC	A	C	C	—	PRD	PR	F	Y	Y	Y	Y
Public Trans.	AC	AC	AC	C	—	—	PRD	PR	I	Y	Y	Y	Y
State Aid	A	AC	AC	—	—	—	PR	R	F	Y	Y	Y	—
T2 Center	AC	AC	AC	AC	—	Crommes	PRD	PR	I	Y	Y	Y	Y
Districts													
1	A	AC	AC	C	C	Jacobson	PR	PR	F	Y	Y	Y	Y
2	A	A	AC	AC	C	Senn	PR	R	F	Y	Y	Y	Y
3	A	A	AC	A	—	George	PR	PR	F	—	Y	Y	Y
4	A	AC	AC	AC	—	Coffman	PR	PR	F	—	Y	Y	Y
5	A	A	AC	A	—	McNeil	R	PR	F	—	Y	Y	Y
6	A	AC	AC	AC	C	Larson	PR	PR	F	Y	Y	Y	Y

Key: A = Attend Crd = Coordinate F = Formal P = Publish S = Support — = Not identified
D = Conduct D = Disseminate I = Informal R = Receive Y = Yes

Training

Once someone has proved that an innovation will benefit the department, a training activity is developed for adopting the innovation on a larger scale. Training is a mechanism of technology transfer when the training activity introduces new skills, products, or methods, rather than instructing employees on established practices of the organization. Technology transfer training is concerned with more than just informing the participant of the existence of new methods or products; the training is intended to help the participant adopt the innovation. For this reason, technology transfer training is most effective when it uses multiple communication methods and provides an interactive learning experience.

Employees in all divisions and districts attend training of some type, as required by statutes concerning human resource development and the requirements of certain job classifications. However, this training is concerned with employee development. Technology transfer training is more oriented toward organizational development because it strengthens knowledge and skills that are identified by the organizations' needs, rather than the individual employees' needs.

Technology transfer training is often part of contracts with private industry vendors who supply WSDOT with new products or equipment. For example, after WSDOT purchases a new product, the vendor may be required to provide training on its use.

Demonstrations

Demonstrations are a technology transfer practice because they provide potential users an opportunity to witness or experience innovation in action. People are more likely to adopt or adapt a product or method when its use has been demonstrated. Demonstrations are conducted informally by various employees in WSDOT when a new product or method has been discovered.

Demonstrations that give employees first-hand information on innovations are also conducted at conferences and meetings. An example at a conference or meeting might be a demonstration of a new traffic control device that operates on light intensities. The inventor of the device might set up a booth at a conference and provide attendees an opportunity to witness the traffic signal's response to varying light intensities.

WSDOT employees also attend demonstrations of new products, equipment, and technology that are provided by private industries. These demonstrations are conducted when vendors contact field offices directly to introduce new products and arrange demonstrations. In many instances, local transportation or public works agencies arrange to attend these local demonstrations.

The FHWA develops demonstration projects from the results of research conducted by transportation organizations. WSDOT participates in these demonstrations sponsored by FHWA.

Experiments

Experiments can produce knowledge that requires a technology transfer practice in order for a user to adopt the innovation. The experiments that are included in WSDOT's tech-

nology transfer practices are tests conducted by various offices without a formal connection to the WSDOT research program. These experiments are conducted by employees and work units outside the research office and tend to be more informal than formal scientific experimentation. The successful or failed results of experiments should be communicated to other work units and employees in order for WSDOT to benefit fully.

Agent-Liaison

Technology transfer "agents" are persons whose job responsibilities include keeping apprised of innovative developments in their fields and transferring the innovation to other users through various techniques. Agents also have credibility with users because they are usually at the same peer level as many others in the work unit. In WSDOT there are a few examples of employees who are designated "agents." Examples of some of the technology transfer practices the agent provides are development of proposals for incorporating new technology into bridge construction and maintenance, review of published reports on innovations and consideration of their application in the work unit, and maintenance of a network with peers in other states with bridge operations.

Not every program or work unit in WSDOT has a designated agent or liaison who can be used for technology transfer. In these instances, technology transfer practices occur more randomly and are more difficult to quantify.

Reports

Reports are a practice of technology transfer because they provide information about innovations from a source of knowledge to a potential user.

The WSDOT library, located in WSDOT's headquarters building, catalogs and maintains reports and other printed documents published by WSDOT and other organizations and persons. The WSDOT library is also linked to a regional library system for accessing collections stored in the state and university library systems. The library publishes a regular listing of new acquisitions of interest to transportation officials. This list is distributed throughout WSDOT divisions and districts.

Reports are a passive technology transfer practice because they rely solely on the reader's understanding of the material presented for the method, idea, or product to be applied. The reader does not have the opportunity to ask questions or to communicate with the source of the innovation. Furthermore, research reports are often so technical that the potential user cannot understand the application of the research results. In many cases, research reports are written for other researchers. Brief, concise summaries of the research result or report topic must be produced in order for employees to consider using the information.

Newsletters

Newsletters are a communication tool that, by relating developments and advancements in various fields, can spark ideas

in WSDOT employees. Newsletters are also a method to recognize the accomplishments and contributions of employees.

Research

The WSDOT research program operates under a formal Research Council that includes members from the Washington State Transportation Commission, WSDOT executive managers, representatives from the state's two research universities, FHWA staff, and people from private industry. One important aspect of research use is the involvement of potential users in the definition of the problem and the creation of the solution. This is a practice of technology transfer because the process brings researchers and potential users together.

Department Committees

Committees provide an opportunity for technology transfer to occur because members usually represent different organizations, work units, disciplines, and levels of authority. The committee methods of management, decision making, problem solving, and operation provide different perspectives. Committee members introduce innovations and the dynamics of the committee usually provide a vehicle for others to obtain political support for their application.

Procedures

Procedures are used in the practice of technology transfer when WSDOT officially adopts an innovation that has departmentwide impact. When innovations become a procedure, a change or addition to the published WSDOT manual is required. Formal procedures are published for many of the department's functions including highway maintenance, construction, design, administration, and traffic engineering. The manuals describe the accepted standards, specifications, practices or methods of the department. WSDOT manuals go to WSDOT employees, local agencies, and private contractors.

Formal procedures can impede technology transfer because they discourage employees from trying different procedures or deviating from established practice. Legal liabilities and tort claims make changes in proven methods or standards riskier for the WSDOT. For these reasons, changes to formal procedures are carefully reviewed and tried before WSDOT adopts them. Furthermore, much time can pass between acceptance of a new procedure and the publication and distribution of the new procedure to manual holders.

Meetings

Technology transfer is practiced at meetings where peers discuss mutual issues and topics, share information, and communicate with employees who share similar job responsibilities. Annual meetings are held by professional groups in WSDOT, such as the traffic engineers, location engineers, construction engineers, project engineers, and maintenance

supervisors. Quarterly meetings are held by WSDOT professionals, including the safety officers, personnel officers, and marine engineers. Most work units hold staff meetings on varying schedules.

The safety meetings are about the only opportunity for field employees to meet in one location. Safety topics are presented by district safety officers, and the employees provide feedback on various equipment and operations. These meetings also provide an opportunity for field employees to discuss work matters with their peers and supervisors.

Meetings, particularly the annual meetings, which are well attended by most professionals in WSDOT, provide many technology transfer opportunities. Workshops, demonstrations, presentations, and displays are sometimes provided at these annual events. The annual meetings provide an opportunity for peers to informally discuss projects and work topics and allow employees to establish and maintain networks within WSDOT.

Professional Associations

Professional associations support technology transfer by providing materials, meetings, publications, newsletters, and networks for employees. Associations also conduct research that produces innovations and report on the latest developments in their professional field.

SUGGESTED PROGRAM OF TECHNOLOGY TRANSFER

Technology transfer is and should be a decentralized process because innovation adoption is more likely if the mechanisms used to introduce innovations are generated and conducted from the users' work areas. Each division and district conducts some type of technology transfer practice, and employees participate in technology transfer provided by external sources.

The various technology transfer practices identified in this study should continue in each of WSDOT's functional areas. However, there must be a concerted effort to reduce departmentwide barriers to innovation adoption.

Kanter (9) suggests three elements that must be integrated into an organization in order for employees to be innovative and for innovation to be adopted. These "basic commodities" are

- Information (data, technical knowledge, political intelligence, and expertise);
- Resources (funds, materials, space, and time); and
- Support (endorsement, backing, approval, and legitimacy).

In some areas, staff and time are only available through a predetermined budget, information only flows through the identified chain of command, and legitimacy is available only through the formal authority vested in specific areas, with no support available for consideration of innovations in work methods.

Kanter would call this a segmented organization because each piece is separated from the other in terms of information, resources, and support. Technology transfer requires a more integrative management style because, typically, the creation

or adoption of innovation requires a search for information, resources, and support from a variety of functions and work units in an organization.

Coordinating technology transfer requires connecting people from different organizational boundaries as well as sharing information, resources, and support from a variety of groups. Support is obtained for the adoption of innovation through peer groups and management. Strategies for innovation adoption can be more effective if existing resources can be shared and borrowed. Kanter (9) describes three organizational operatives that are necessary to create an integrative management environment. These operatives should be part of a coordinated technology transfer program:

- Open communication system so that employees can locate information that they can use to shape and sell a project;
- Network forming arrangements that can help employees with innovative ideas build a coalition of supporters; and
- Sharing and borrowing of resources to get technology transfer mobilized into action.

Development of a coordinated technology transfer program requires an integrative management to have these operatives. Coordinating does not mean control or centralization of these activities; rather, coordination provides information, resources, and support for technology transfer in an organization.

These three elements—resources, information, and support for innovation—are important to an organization’s ability to use state-of-the-art technology and innovations in its work methods and operations. Resources exist within an organization that can be more effectively used if managers are able to share them to the benefit of the whole organization and not just the specific work unit. Information from sources outside the immediate work unit provides workers with broader perspectives of the field, and support from peers and management helps facilitate the adoption of innovation.

In WSDOT’s case, resources in technology transfer are expended to benefit external organizations, communities, and the public. WSDOT employees also participate in technology transfer practices that are conducted by WSDOT transfer agents, federal agencies, associations, and private industry. However, more attention is needed to provide technology transfer activities by WSDOT for the WSDOT work force.

The inventory of existing technology transfer practices indicates that there are many opportunities for employees to learn about innovative ideas, methods, and technologies. However, the conclusion cannot be drawn that the knowledge that employees are obtaining from participating in these technology transfer practices is actually being applied to their work methods and activities. Certainly, there has been some impact, considering the improvements and innovations that have been made in the transportation field in recent years. However,

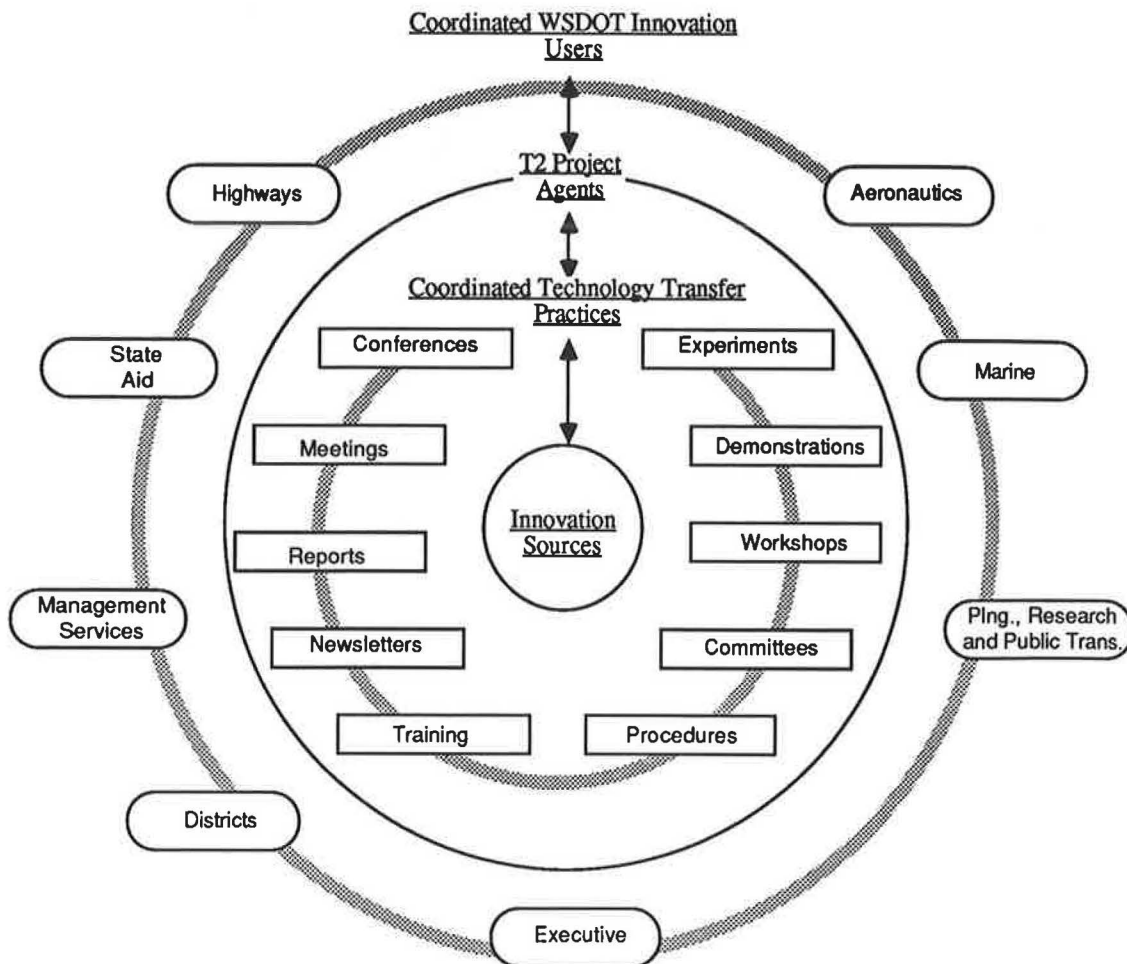


FIGURE 3 Proposed coordinated technology transfer program that parallels current WSDOT program.

there is no certainty that the organization is capturing the most knowledge possible from its employees or using the latest innovation as a result of specific technology transfer practices. Examples of innovation adoption exist, but there is no clear explanation of how the innovation was discovered, how it was adopted, and whether its integration into work methods has had positive or negative effects. It also cannot be concluded that the majority of the work force is receiving information about new technology or that the innovations they are creating are being shared with other work units.

One purpose of this study was to determine whether any coordination of technology transfer is necessary to enhance the process of integrating innovation into WSDOT. The conclusion of this study, based on information from literature and WSDOT employees, is that a coordinated technology transfer program can be one strategy for enhancing WSDOT's ability to adapt and adopt innovation. Figure 3 illustrates a coordinated technology transfer program in which resources, information, and support are shared by different work groups in WSDOT.

Consider the following advantages of coordinating WSDOT's technology transfer practices:

- Resources would be more effectively used in technology transfer practices.
- Opportunities for technology transfer to occur in WSDOT's existing programs and activities would increase.
- More employees would be involved in the existing technology transfer practices.
- Technology transfer practices would be evaluated to improve practices and to provide management with information on their impacts.
- New technology transfer practices would be developed in areas where a need was identified by changing conditions or work groups.

The proposed technology transfer program relies on a strong network of technology transfer agents dispersed throughout the organization. These agents occupy space with their target client groups but communicate with other technology transfer agents to trade techniques and provide encouragement. One

primary activity of technology transfer agents is to document innovative adoption successes to provide management with feedback on the status of the process.

In a world of shrinking resources, state departments of transportation must continually seek more cost-effective practices. An institutionalized technology transfer process is a necessary activity in every large organization.

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