

Development of an implementation infrastructure to support a traffic safety culture

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Overview

*The incentive to **do** research is greater than the incentive to **report** research—especially in the language and detail such findings can be implemented*
(Watkins 1974).

There are successful strategies to increase the potential of producing benefits from research activities. These strategies streamline the adoption of new methods, processes, or technologies, create a more effective return on investment of research funds, and enable a more rapid application of worthy improvements to the system. However, implementation of research results and innovations do not happen automatically. Purposeful effort must be taken to facilitate the implementation of research results to realize the anticipated benefits of the research activities.

Because there are successful strategies that will increase the potential to affect change in the current culture for traffic safety, the primary purposes of this paper are 1) to focus attention on the critical role of implementation of beneficial research results, 2) to facilitate the process of implementation by suggesting the creation of a traffic safety research implementation infrastructure, and 3) to firmly place the activities of implementation in the position of being entirely merged with the work of research. The overarching outcome is to assure that productive research results are integrated into operations as a viable and even preferred choice to support decision making and for accomplishing specific tasks.

Taken as a whole, the variety of successful implementation strategies forms an implementation infrastructure. The infrastructure has five basic elements, *Technology* (the research results to be implemented), *People*, *Marketing and Communications*, and *Implementation Tools*, plus *Lever*s that increase the effectiveness of the other four elements. This infrastructure presents a systematic approach to accomplishing implementation of research results. This systematic approach—applying the strategies of an implementation infrastructure—can and should be incorporated into the research activities being performed to enhance the traffic safety culture. If the members of the traffic safety community, particularly the sponsors and those vested in the results of research, use strategies for successful implementation, these actions will corporately build a traffic safety implementation infrastructure. The implementation infrastructure will more effectively enable the institutionalization of positive change and adoption new behaviors,

products, methods, and practices within the traffic safety community and among transportation users of this nation.

Introduction

Purpose and scope

One of the most critical issues facing research and education that contributes to a traffic safety culture is whether the results of the research and innovative practices are used. Creating or enhancing such a culture for the United States implies the intent to implement the best practices and the most successful innovations identified nationally and internationally. To bring about change, making use of successful innovations is necessary. However a significant issue accompanying use of research results or innovations is technology and knowledge transfer—the implementation processes that sustain and institutionalize positive change.

While basic research to develop new knowledge in safety topics is highly desirable, the AAA Foundation’s goal of fostering and improving a culture of traffic safety points toward applied elements of a broad research program. An objective of the traffic safety culture, therefore, must be application of research results. Such implementation of new methods, processes, and products leads to changes in organizational operations and user behavior—the opportunity to influence the way safety is addressed and incorporated into the nation’s transportation choices. Past research has shown the need for assistance in implementing research results and innovative practices, especially in the public sector. (Bikson et al. 1996; Deen and Harder 1999; Harder and Benke 2006). Moreover change in the public sector generally is not easy, is often accompanied by increased risk to multiple parties, and requires substantially more resources and effort than expected.

There are successful strategies to increase the potential of benefits resulting from research activities. (Harder and Benke 2006). These strategies streamline the adoption of new methods, processes, or technologies, create a more effective return on investment of research funds, and enable a more rapid application of worthy improvements. However, implementation of research results and innovations does not happen automatically. Purposeful effort must be taken to facilitate the implementation of research results to realize the anticipated benefits of the research efforts.

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The strategies and concepts for implementation of research results and innovations to foster and improve a traffic safety culture are applicable on two levels. Implementation issues must be

addressed at a program level as well as a project level. Program-level implementation strategies deal with building trust and credibility through identifying relevant research goals and projects, and communicating the benefits of the research once it is deployed. Project-level implementation strategies center on the methods and tools used to put a research result into standard practice. Many of the strategies are common to both levels and addressing both the program and project levels is essential for fostering an increased awareness and application of traffic safety research results.

Taken together, the elements and activities that cause a research result or innovation to be applied can be viewed as a basic framework for implementation, an implementation infrastructure. Such an infrastructure can and should be built into traffic safety research activities. An implementation infrastructure will assist in assuring that successful research results are put into practice.

The best time to consider the use of research results is at the beginning of the overall research effort. The allocation of resources for implementation needs to be considered as part of the whole research process from problem identification through creating a new standard of practice based on a broadly implemented technology or innovation.

Although a number of public-sector transportation research programs are very successful at implementing the results of their research, other programs continue to struggle in this area. Hurdles abound such as addressing research results implementation in a fragmented manner rather than using a systems perspective, failure to consider research as a strategic asset that contributes to national or organizational goals, the misunderstanding of needed resources for implementation activities, and the continued difficulty in determining quantitative benefits of research and implementation are challenges that continue to require attention. A more effective process for implementation of research results across the whole of the traffic safety community, however, will assist in solving a number of these challenges.

Literature and data sources

The primary sources of information for this paper focus on public sector transportation research conducted through state departments of transportation. (DOTs). These sources are the National Cooperative Highway Research Program (NCHRP) synthesis reports on research management topics: *Synthesis 280, Seven Keys to Building a Robust Research Program* (Deen and Harder 1999), *Synthesis 312, Facilitating Partnerships in Transportation Research* (Harder 2003), and *Synthesis 355, Technology Transfer: Successes, Challenges, and Needs* (Harder and Benke 2006). These reports are state-of-practice reports that document a snapshot in time, highlight successful practices, and provide practical examples of methods, procedures, or tools. Because NCHRP is an American Association of State Highway and Transportation Officials (AASHTO) effort, these syntheses reflect a high level of contribution from state DOTs. Additionally, each of these synthesis reports also includes state-of-practice information from the private sector and academic institutions.

A second and related source of information for this paper is a number of example state DOT research programs that have been performing strategically valuable research over many years. These programs have developed, whether purposefully or not, an infrastructure for their

implementation activities. Programs like those operating at the Virginia Transportation Research Council, the Joint Transportation Research Program (Indiana Department of Transportation, Purdue University, FHWA), or past programs like the initial Strategic Highway Research Program, teach valuable lessons for applying results to practice. Furthermore, concepts are incorporated in this paper from work currently in progress with the Pennsylvania Department of Transportation's Research and Innovation Implementation Program.

In addition, the classic publication, *Diffusion of Innovations*, by Everett M. Rogers presents important treatment of the manner in which innovations are put into practice. A further source of information is the Research Peer Exchange meetings conducted by the state DOTs' research units to enhance their research management practices.

Definitions

The terminology for implementation of research results often has a variety of definitions, many of which may be acceptable. However, for this paper the definitions used in the recently published NCHRP *Synthesis 355, Technology Transfer: Successes, Challenges and Needs* are used.

Adoption or Application to Practice: Making a technology or innovation an organization's standard operating procedure or causing the technology or innovation to be used as the generally accepted means for accomplishing a specific task. Such action is an outcome of implementation of research results or technology transfer activities.

Deployment: The systematic process of distributing an innovation for use. This term implies a relatively broad use, rather than pilot, demonstration, or incidental use of the innovation. A technology can be considered deployed when it is used multiple times within an organizational or group context, such as use resulting from a newly written specification.

Knowledge Transfer: The diverse activities causing the flow of knowledge from one person, group, or organization to another. Such knowledge transfer can be a systematic process to identify, capture, and share tacit knowledge to enable it to become explicit knowledge.

Implementation of Research Results: Used in highway transportation and particularly by the research community to describe the various activities required to put an outcome of a research project into widespread use. Oftentimes, this term is used synonymously with technology transfer by those in research. The activities can span the entire duration of the research project and extend until the research result is adopted, for example, as part of a standard operating procedure. Implementation activities may be pilots or demonstrations, training, technical assistance, provision of needed resources, or any activity that fosters use of the research result.

Innovation: A procedure, product, or method that is new to the adopting

organization. The item may be a result of research or may be a new application of an existing improvement that has been used in another context or other organization.

Technology: A term used very broadly to include practices, products, processes, techniques, and tools.

Technology Transfer: The activities leading to the adoption of a *new-to-the-user* product or procedure by any user or group of users. New-to-the-user means any improvement over existing technologies or processes and not only a recent invention or research result. Technology transfer includes research results implementation and product or process deployment. Activities leading to the adoption of innovations can be knowledge transfer, training and education, demonstrations and showcases, communications and marketing efforts, technical assistance, and more (Wallace et al. 1998; Schmidt et al. 1985). In addition, technology transfer in this transportation context also includes the complex process of change, a comprehensive achievement dealing with cultural as well as technical issues

Needs and gaps

From the first... research is the process of reducing an idea to practice... Research efforts cannot long survive without some promise of implementation of their findings. (Watkins 1974)

For decades, implementation of research results has been an issue demanding attention from organized transportation research programs in the U.S. The primary concern was described in one of the early National Cooperative Highway Research Program Synthesis Reports, No. 23, *Getting Research Findings Into Practice* as “The incentive to *do* research is greater than the incentive to *report* research—especially in the language and detail such findings can be implemented” (Watkins 1974). Additionally, in 1967 getting results applied was a concern for an AASHTO Special Committee on Utilization of Research (known as the Stevens Committee). The committee, “noted that there was an undesirable and unnecessary time lag between the completion of research and the utilization of that research” (Hodgkins 1989). An outcome of the committee’s effort was seen at that time in FHWA’s formation of an Implementation Division that specifically addressed accelerating the utilization of research results.

More recently, implementation of research findings has been the subject of various NCHRP efforts as well as with programs such as AASHTO’s lead states’ activities, and its Technology Implementation Group, as a focus of FHWA/state DOTs research organizations’ peer exchange meetings, and the FHWA’s promotion of its Priority Market-ready Technologies and Innovations. Moreover, as an example of the awareness of the need for assistance in application of innovations, there is implementation guidance for applying strategies of the Strategic Highway Safety Plan.

These types of implementation-related activities show a recognized need for special effort to apply innovations and new technologies to practice. Yet programs and research projects still

struggle to be successful in making the leap from research result to realizing the benefits of the research. Public-sector programs have a difficult time because often there is no structured approach to implementation of research results, no manner by which management can formally support research efforts, and little understanding of the challenges associated with implementation.

Adding to the struggle, research programs have in implementing their results is a considerable degree of risk aversion in the public sector. Public servants are understandably reticent to move from a currently successful treatment to anything different. Lives are at stake, taxpayers dollars are used, often in large amounts, and major consequences can occur due to failure. Furthermore, for public applications of the research results, the effort to adopt a new method, process, or product can be overly burdensome. The effort to implement a new process or innovation may require anything from an act of the legislature to writing a new specification or addressing intellectual property rights—all of which must be accomplished within a bureaucracy that is not necessarily attuned to research operations.

Compounding the concerns for exposure to risk is a need for the research community to better communicate that research activities and their results are a strategic asset to the sponsoring agency and to the practicing community at large. Research programs are one element in an executive's portfolio for productive, effective agency management. Results of research save dollars, enable greater efficiency, reduce fatalities, and produce a host of other benefits. Yet, the message of "research as a valuable strategic asset" is often neglected or not expressed in terms usable by executives.

The needs and gaps related to research results implementation can be addressed to some degree by conducting implementation of the research results with the same commitment and focus as that devoted to the actual research effort. NCHRP *Synthesis 355* notes that DOT research programs spent 6.5 percent of all research and research-related funds on technology transfer and implementation activities. Experience shows that this is not a sufficient level of expenditure. Furthermore, agencies or programs having an identified coordinating role for implementation had a greater openness to incorporating innovations to the agency and more readily recognized the positive influence of senior management in the process of implementation. Other findings from this study concluded that in 2003/2004, nearly fifty percent of state DOT research program survey respondents had five years or less experience in technology transfer or implementation—and those with 15 years or greater tended to have a more robust research implementation effort.

While several of the syntheses discussed in this introduction present good things to do to increase the effectiveness of research results implementation, a systematic approach is lacking. Many programs make an effort to apply successful strategies for implementation of research results. However, most programs whether they are state DOT programs or industry or research community-driven initiatives, fail to address implementation activities as a priority program element. Many research programs treat implementation activities in ad hoc manner. There is little recognition of the interdependency of the various implementation strategies and the need for treating implementation as a complete process. The greatest need or gap is to address implementation through an organized systematic approach that incorporates all the resources required to get the job done—to change practice and apply improvements.

Creating change

*... agencies must use research findings—primarily to change practice.
(Watkins 1974)*

Implementation of innovations resulting from research is an important means of addressing and creating change in an organization and throughout standard practice. If the research program is built upon the concept that research is a strategic asset, the results of which will produce strategic value, research can be a powerful tool to improve and enhance management and operational effectiveness. Simply put, the change brought about by successfully implementing the results of research is improvement in the state of practice.

The strategies used to foster implementation directly deal with creating a receptive environment to allow change to happen. Researchers, research managers, and users alike will perform more efficiently if implementation strategies are used. It is critical to note that following a systematic approach to implementation of research results presents the likelihood of more consistent and sustainable change.

Various research programs are successful at implementing innovations generated by the research or in use by others. In general, these programs are well established and have, through time, created a well-run system for applying innovations to practice. A vision for the traffic safety culture is to learn from these programs, not requiring the years taken to adopt these strategies incrementally, but using the existing successful implementation strategies as a coordinated process.

Research leading to an enhanced culture of traffic safety needs a well-prepared implementation process that is responsive to creating positive change. Sponsors of traffic safety research can incorporate implementation strategies, building an implementation infrastructure for traffic safety improvements.

Creating an implementation infrastructure

Goal and vision

The most important goal of any research activity is the result of the research effort and how it will be used. With basic or fundamental research, new knowledge for use in subsequent research activities is the primary goal. With applied research, the results are put into practice to improve current practice. For the most part, research that is to further and enhance a traffic safety culture will tend to be applied research—directly seeking to change behavior and create improvements to practice.

The vision for accomplishing traffic safety research involves providing answers to many difficult and some long-standing problems, and then having the answers positively affect practice—that is, to enhance the traffic safety culture. To fulfill such a vision, implementation of the research results must be a vital part of the research activities. In fact, without incorporating a purposeful implementation effort within the research initiative, the vision will very difficult to accomplish.

Changing roles

Roles within the public-sector applied-research community are changing. The standard role of researcher had been to perform the research, write the report of findings, and move on to tackle the next problem. Furthermore, research program managers and research sponsors were concerned with getting the research results delivered within the appropriate administrative structure. The users coped with change in the best manner they could. Since the early 1990s, researchers, program managers, and users alike have been experiencing a growing awareness of the importance of their respective roles in fostering implementation of research results. Researchers, for example, are being drawn into the implementation process through being prompted to create implementation plans, by having greater interaction with the ultimate users during the course of the research, and by being asked to provide more user-ready innovations. Research program managers and owners are being required to fill the role of partnership manager, entrepreneur, and transfer agent. Users are now more frequently being consulted regarding how best to deal with change, are developing into champions, and are being more effectively prepared to handle new products, processes, or methods.

The role of research is beginning to change as well. In the past, research efforts were regarded as a project-defined, problem-solving activity—limited by the technical aspects of the problem. Today, of course, research must still solve problems, but it is now being recognized as a strategic asset that advances the agency's strategic agenda, contributes to agency mission and goals, and brings value to the organization.

The importance of these changing roles for the traffic safety culture is: 1) to recognize the contribution of the various participants in the process of implementation and to effectively use them to maximize the benefits of the research efforts and 2) to encourage the perspective within the transportation community that implemented research results are valuable strategic assets for accomplishing programmatic or organizational goals.

Infrastructure elements

There are a number of excellent strategies being used to foster the implementation of research results. Each strategy, when applied, can produce beneficial results. Certainly, public-sector transportation research programs today have learned some solid implementation lessons: that champions of an innovation are critical to sustain promotion of the research result, that senior management support is often the extra incentive for operational staff to give the innovation a try, or that planning for implementation significantly increases the potential for getting an innovation applied. However, when strategies are used in combination with others, greater benefits are the likely result, and more can be done by developing a more rational approach than just picking and choosing whatever strategy seems to work. Implementation needs a framework, an infrastructure that allows the successful implementation strategies to be addressed in a systematic, organized manner. When the whole traffic safety community applies successful implementation strategies, an implementation infrastructure will emerge.

An implementation infrastructure for applied research is built with five major elements: technology, people, marketing and communications, tools, and levers that enhance implemen-

tation effectiveness. Each of these five elements and the strategies they represent are discussed below.

Technology

The initial element of the implementation infrastructure is the “technology”—the research result or innovation that will be put into practice. (Technology is being used in a broad context, a new or improved product, process, or method.) Three strategies are discussed in this section: the push of the technology, pilots and demonstrations, and benefits of research results—meeting users’ needs.

The technology “push”

Often results of research or innovations are championed by organizations and individuals having excellent technical credibility. Considering these members of the transportation community are trusted and reliable, they are a source of potentially very successful innovations for other users. The technology is pushed out from these innovators through effective technology transfer or deployment activities. Examples of such activities are AASHTO’s Technology Implementation Group, FHWA’s promotion of its Priority Market-ready Technologies and Innovations, and research results from well-respected organizations in the transportation community. The value of these types of innovations is that they have been vetted by trusted bodies. The consensus and widespread backing that caused the innovation to be endorsed by such organizations provides a jump-start for the user. Generally, such innovations entail lower risk to the user because champions of the research result and early adopters have already implemented the research result. The user may have to customize the innovation to its operating environment, yet often the championing organizations will provide assistance in accomplishing that task. Fostering a traffic safety culture can use this type of strategy. If credible organizations supported specific safety innovations for implementation, prospective users will have greater trust in the innovation and will be more predisposed to apply it in their own contexts.

Demonstrations and pilots

Providing a hands-on demonstration to show research results is one of the most attractive means to get users to consider adopting an innovation. Seeing the innovation in operation or being applied is proof that the innovation works. Moreover, demonstrations provide an excellent opportunity for the potential users to determine “up close and personal” the applicability of the innovation to their own needs. Demonstrations are best conducted in the type of setting that most accurately represents the user application settings. In addition, technically competent individuals must be available to answer the potential user’s questions. The strategy of conducting demonstrations reassures the potential user that the innovation “will also work for me.” Results from traffic safety research activities can employ demonstrations to educate and involve potential users. In particular, demonstrations to opinion leaders of ready-to-apply research results are especially effective. It is this segment of the user population who will motivate others to also adopt a new practice. Demonstrations or “Showcases” have been very effective for the Florida DOT Local Technical Assistance Program, among others.

Pilots—an initial use of the research result in a user setting to exhibit the performance or effectiveness of the innovation; a pilot can be conducted toward the end of the research activity to supply empirical proof of the innovation’s effectiveness—often a proof of concept. Incorporating pilots into the plans for research to affect change in the traffic safety culture will

assist in producing ready-to-implement innovations. In fact, both demonstrations and pilot uses of a research result will enhance implementation efforts.

Benefits of the research result—meeting user needs

For applied research, the benefits of the research result must address the user's needs. If the research result provides a solution to a well-known problem or presents a recognized safer or more effective means of accomplishing a task, this assists implementation. Addressing needs allows champions to support the research result, enables senior managers to endorse the change, and provides a solid message for communications regarding the effort. However, because a need is met does not reduce the necessity for a focus on implementation of the research results. Implementation hurdles still abound even if one "builds a better mousetrap."

The research performed to foster the traffic safety culture likewise must address the users' needs. Finding solutions to the users' needs establishes vision and purpose for the research, assisting researchers, research managers, and users to overcome even most difficult of barriers. In addition, the credibility of the research initiative will be served if outcomes of the research effort are seen to directly affect current practice.

People

People are a critically important resource for enabling implementation. The three strategies discussed in this section are champions, placing qualified people in lead roles for implementation and early involvement of the users.

Champions

Champions are the people who believe in the benefits and applicability of the innovation and are committed to getting others to know about and apply the improvement. Champions are technically qualified, credible members of the user community who have experience with the innovation either as a very early adopter of the innovation or through having been involved with the research effort. Every new product, process, or method needs champions to keep the "new way of doing things" in front of the user community. Champions often head up implementation efforts. In fact, the Virginia Transportation Research Council will not forward a research proposal unless it has a champion. For research projects addressing traffic safety culture issues, champions should be identified for the various efforts so that strong, credible voices will support the application of the innovation.

Qualified people in lead roles

Coupled with the presence of a champion is the necessity to have very qualified people involved with implementation efforts. In the public sector, often the job of fostering implementation is given to junior personnel and assigned as a collateral duty. The activities for furthering the use of a research result, then, can get bogged down because the person leading the implementation has no voice in the organization, may not have the technical qualifications to be a leader for the organization in adopting something new, and then has other duties that most likely are given priority over the job of implementation. To forward research that will create change in traffic safety, there must be qualified lead people, those respected by peers, as the agents for adopting innovations into an organization. The expert task group concept used by the SHRP program is an example of using such qualified people.

Early involvement of the users

One of the most basic tenets of implementation is to involve users early in the research process. For applied research results to be well accepted by the users, the users must have input to the conduct of research. User-oversight groups, user websites for the conduct of the research, and any user contact that will help shape the results to be more readily applicable at the end of the research effort are beneficial for implementation. Often user involvement in the research helps the researcher to have a result that is known among the user community prior to the completion of the research project. Once the innovation coming out of the research is available, an influential segment of the user community is ready to adopt it.

Marketing and communications

Implementation of anything new requires marketing and communicating the message of the research's benefits through established channels. These strategies are discussed below.

Message

Organizations that are successful in implementing their research results and their programs “market boldly,” one of the seven keys to building a robust research program (Deen and Harder 1999). Unfortunately, researchers and those managing research, for the most part, do not have communications expertise as their primary background. Developing a message of improvement, the new standard operating procedure, or a new manner of conducting the assigned task is not a strength of the research community. The implementation effort needs to get the message of innovation to senior management, opinion leaders and early adopters, and the general user community. If the talent to get the message to the right people is not available, programs that are successful at implementing research results get the talent and use it wisely. Fostering or improving the traffic safety culture has a serious task of creating excellent communications about the innovations and results of research. Communicating a critical message will not just happen. Talent to assure the message is crafted well and disseminated appropriately is necessary.

Networks/established channels

Building a network or channel for communications is an essential part of the implementation infrastructure. The message of innovation—improvement, cost savings, or safety will be carried more quickly and accurately if an established network exists. The network includes 1) the researchers, and the organizations sponsoring the research and overseeing implementation, 2) executive and other management that will influence the use of the research results, and 3) the user community. The Pennsylvania DOT is currently establishing an implementation infrastructure which includes creating a network throughout the organization to foster the identification of innovations and to implement research results that are ready to be applied. Research addressing a traffic safety culture, likewise, will need an effective network of implementation agents ready to encourage and foster application of the results of research.

Implementation tools

There are four tools that are important to the process of implementation and are included in the implementation infrastructure: an implementation plan, a means to identify successful innovations, a web portal or electronic home base for implementation activities, and implementation packages containing whatever is needed to further the implementation.

Implementation plan

Just like the research plan, an implementation plan is important for achieving success. The implementation plan identifies the anticipated resources required for application of the research results and describes the activities that will most likely further implementation. The implementation plan is prepared early during the conduct of research and may even be part of a researcher's proposal to perform the research. If necessary, the plan assists the researcher to point toward implementation of the result rather than only to achieve the answer to the problem being researched. Moreover, the plan presents the opportunity to incorporate users into the conduct of research, where appropriate, so that the research results will be more applicable.

Identifying successful innovations

A number of organizations that focus on implementation have a tool to assist the research program management to determine whether a result of research is ready to be implemented. These tools are an initial screening device that provide sufficient information to make a “go,” “not yet,” or “no go” decision regarding the implementation. Minnesota and Virginia DOTs have used a series of questions to determine readiness for implementation. The Pennsylvania DOT Research and Innovation Implementation Program currently uses a “Checklist for Winning Innovations.” This checklist asks questions regarding what is in place, such as resources, champions, and implementation tools—and what is needed, including hurdles to overcome, benefits identification, additional resources, and other support. A “ready to implement” decision can be made upon review of the information supplied on the checklist. Because research results often require more work prior to implementation, tools like this are very valuable. They save time and effort and help advance the research results that are truly ready for application. Tools or screening such as this will be helpful for research results that forward a traffic safety culture.

Web portal

An electronic home base for research activities is very desirable. A web portal can provide a host of purposes that enhance implementation efforts. Researchers, research program managers, and users alike will find web access to program elements enhances communications, permits administrative tracking, and enhances dissemination of available implementation products. An important function also is to provide space for sharing of best practices. In addition, when implementing research results for the general public, such web access is indispensable for promoting those best practices.

Implementation packages

One of the most important tools that can be developed for implementation is a package of whatever is necessary to assist users to adopt a research result. These packages can contain training materials, information bulletins/specification sheets, news articles, contact information for technical champions and current users, demonstrations information, or whatever is required to ease the user's transition to the new way of doing things. The critical aspect of these packages is that they are available when a user requires them. The innovations developed to enhance the culture for traffic safety will benefit by having implementation aides packaged for users to ease transitions to use of new practices.

Levers

There are four strategies that work like levers when applied to the implementation infrastructure. These strategies multiply the effect of the implementation activities. Partnerships and alliances, committed funding, a coordination function, and senior management support all increase the effect of the other strategies in the infrastructure.

Partnerships and alliances

Partnerships and alliances benefit the conduct of research for state DOTs by leveraging most particularly, technical expertise and funding (Harder 2003). In general, partnerships for research are organized because there is mutual advantage for all partners. Together, the partners can achieve results that each partner individually could not do, or do as effectively. Partners make available a broader base from which to promote the benefits of the result of the research effort. In the same way, collaborative research provides a broader distribution of the risk associated with promoting the results of the research effort. One drawback of creating a partnership for research activities is the loss of some control over the research as the direction of the research becomes collaborative. Yet this is a small price to pay considering the other valuable advantages especially for implementation of the research results. Research partnerships for work done to encourage and promote the traffic safety culture will multiply the resources contributed by each partner.

Committed funding

In the past, implementation of research results has not been considered a specific activity to be funded. Implementation efforts were recognized as needed, but few funds were committed to the job and mostly operational areas were expected to pay the costs of adopting something new. Appropriately, research programs have carefully guarded the funds designated for research to be used for research. Today, however, transportation research managers in the public sector are realizing that research funding must be augmented with implementation funding. Unlike the private sector, the public sector has no profit incentive that often provides funding to get a product to market. Yet state DOTs, like Minnesota's DOT, that do provide committed funding for implementation, are noted innovators. Funding implementation is a powerful lever for increasing the effect of the implementation activities. Moreover, this funding must be reserved for implementation only. Funding assists in marketing, preparing implementation tools, travel for champions, and a host of other tasks that allow an innovation to be applied to practice. Mistakenly research initiatives or program managers may not include a budget for implementation during the research program or project planning.

Currently the state DOTs are spending, on average, 6.5 percent of their available funds for research and related activities for implementation (Harder and Benke 2006, 27). More consistent implementation successes tend to be seen in programs with long-standing implementation experience, and these programs are committing greater funds for implementation activities. Research results promoting a traffic safety culture will also need committed funding for implementation and, likely, in amounts greater than the average that the states are currently committing for their implementation of research results.

Coordinating function

An effective lever for implementation is a coordinating function for implementation activities. This is an individual or an organization that assures the implementation infrastructure is working and that implementation strategies are being used. This function also serves to enlist the people, tools, and other resources necessary to allow an implementation to happen. Generally, the cost (in time and dollars) of such a role is far outweighed by the positive results achieved. Organizations involved in traffic safety research can serve as this type of coordinating function.

Senior management support

Change can happen without senior management support, but it is easier if the top people in a field or an organization endorse and actively support the change. The degree of management support a research result garners is also important. The support must be fully and genuinely given. Strong management support usually guarantees that the research results will receive due consideration by the users. Executive support within an industry does much the same as that of senior management within an organization. Endorsement of a research result by recognized leaders is a factor that influences people to try something new. There are few more effective levers than senior, influential people championing an innovation. In fact, this lever often positively affects many of the other implementation strategies, such as commitment of resources including technical expertise and funding. Advancing the traffic safety culture will entail planning to enlist the executive level support that the changes in the culture will require.

Infrastructure elements summary

In summary, the strategies discussed herein form an implementation infrastructure. The primary elements of the infrastructure are Technology, People, Marketing and Communications, Tools and the Levers that multiply the effectiveness of the individual strategies contained in the other four elements. Figure 1 shows the effectiveness increase of the levers on the other elements of the implementation infrastructure.

Every research sponsor can be a positive factor in promoting implementation of research results.

Sponsors can review the infrastructure strategies and determine the extent to which they can provide the necessary resources and procedures that will promote implementation. Federal agencies sponsoring traffic safety research such as the Federal Highway Administration or the National Highway Traffic Safety Administration are in excellent positions to enhance their present efforts or to incorporate the implementation strategies discussed in this paper into their programs. These agencies can contribute substantially by setting the example for requiring implementation strategies to be accomplished in association with the research they sponsor or results they promote.

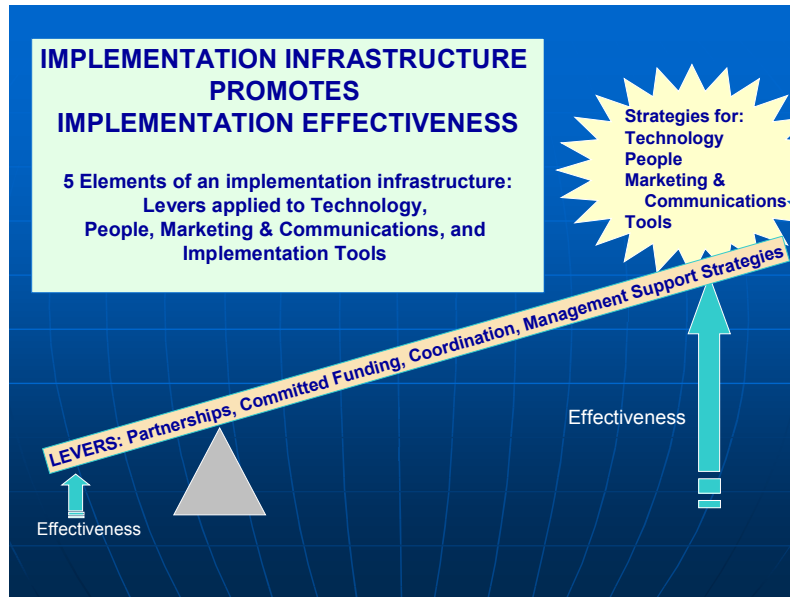


Figure 1. Implementation infrastructure promotes implementation effectiveness.

Organizations such as the AAA Foundation for Traffic Safety can provide valuable leadership by encouraging systematic implementation practices. For example, the Foundation can perform the following functions.

1. For the technology element of implementation:
 - Champion credible innovations and technologies.
 - Promote and collaborate with others for the sponsorship of demonstrations of viable traffic safety research results and innovations.
 - Include pilots of research results in its research activities and encourage others to do so as well.
 - Be a vigilant voice to assure research activities are addressing genuine user needs.
2. For the people element of implementation:
 - Encourage champions to promote viable traffic safety research results and provide a forum or structure for champions to communicate with other researchers, others performing implementation, and users.
 - Promote organizations to put forth their best talent to do the job of implementation of the results of traffic safety research.
 - Through the research it sponsors, as well as through research partnerships and collaborations, provide opportunities for user involvement in the conduct of the research.
3. For the marketing and communications element of implementation:
 - Provide a voice for the message of improvement and change affecting the traffic safety culture that is enhanced by using systematic implementation strategies.

- Develop, promote, and use networks and channels for communicating traffic safety improvements that will enhance the culture of safety in the US.
4. For creating implementation tools for implementation:
 - Develop in conjunction with researchers, implementation plans for the Foundation’s research as well as for research activities in which it collaborates.
 - Promote use of screening tools to determine the implementation readiness of innovations and research results.
 - Encourage or participate in enhancing or creating appropriate web-based resources for the traffic-safety community to share best practices.
 - Participate in developing implementation packages for research results of traffic safety research activities to enable users to effectively change practice.
 5. Though use of the implementation levers:
 - Participate and encourage partnerships and alliances to leverage the expertise and funding, among other items, that are required by traffic safety research activities.
 - Be a coordinating function among traffic safety research sponsors to promote synergy in research and to help avoid duplication of effort.
 - Attract and encourage senior management within the transportation community to champion traffic-safety improvements and to supply resources to accomplish them.

If organizations, as mentioned above, and others in the traffic safety community will adopt and invest in the various applicable implementation strategies together as a community, an implementation infrastructure will emerge. A positive result will be achieved by using some of the individual strategies, but a purposeful approach will produce an infrastructure of reliable methods to assure the best environment for change. Creating an implementation infrastructure to advance the adoption of innovations identified by safety research will foster and encourage the traffic safety culture in this nation.

Challenges and barriers

The most important challenge to successful implementation for fostering a culture of traffic safety will be to acknowledge and accept that a purposeful, systematic process is required. A second and related major challenge will be to use the elements of the implementation infrastructure to assist in institutionalizing the applied research results. The third major challenge will be to reserve resources to accomplish the tasks of implementation—expertise, time, tools, and funding. Each of these major challenges must be addressed at the senior decision-making level. If change is to happen on a broad scale, there is no other choice but to subscribe to a viable implementation effort.

Many state DOTs are currently trying to overcome these major challenges and, by trial and error, some have taken years to put various implementation strategies in place. Safety research activities leading to an enhanced traffic safety culture can incorporate the elements of the

implementation infrastructure from the outset of its efforts, leaping over the incremental processes of the past.

In addition to the challenges of creating an implementation infrastructure, there are two barriers that are also important to discuss. The first barrier is that there is relatively little work done on performance measures for implementation efforts. In fact, only at the time of this writing are state DOTs examining a performance measure system for comprehensive research activities through work being done by NCHRP. Some states' DOT research programs regularly develop a return-on-investment or a cost-benefit ratio for their research programs. However, for many, quantitative assessment of the benefits of implementation activities have been elusive, at best. An effort to determine the benefits of the work done to implement the traffic safety culture will be very useful, yet the implementation activities should not be thwarted because such tools are not in place. Yet even without such quantitative figures, if implementation activities assist in increasing safety research improvements by only a few percent, the costs of the implementation will be small compared to the overall benefits.

Implementation of research results has a second and unique barrier that must be overcome. This barrier is much like the concept of reaching critical mass (Rogers 2003). Houghton Mifflin Company defines critical mass as the smallest amount of fissionable material that will sustain a nuclear chain reaction at a constant level. Similarly in the social sciences, the concept of critical mass is fundamental to understanding a wide range of human behavior because an individual's actions often depend on perception of how many other individuals are behaving in a particular way (Schelling 1978). As in the nuclear and social sciences contexts, the process of implementation must reach a point where it will continue at a constant level. A critical mass of supporters and users is necessary to sustain broad deployment. Without reaching critical mass, the implementation efforts will struggle and only partially realize the benefits envisioned. The key is to use the implementation infrastructure to assure that critical mass is achieved. As shown in Figure 2, once researchers, research and senior managers, early adopters, opinion leaders and champions have endorsed or used the research result, incorporating influential staff open to change begins the stage at which critical mass can occur. When these influential users apply the research results or innovation, the remaining user community will follow. In this context, one of the benefits of the AAA Foundation for Traffic Safety highlighting the goal of enhancing a culture of traffic safety is to assist in creating the critical mass poised to increase change.

Furthermore, a detailed and valuable treatment of critical mass for deployment of innovations is contained in Rogers' work *Diffusion of Innovations*, 3rd edition. Understanding the process of critical mass will strengthen the approach and results of creating an effective traffic safety culture.

These challenges and barriers presented are not insurmountable. If they are identified in the process of implementation planning, much can be done to mitigate their effect, and solutions to them can be developed.

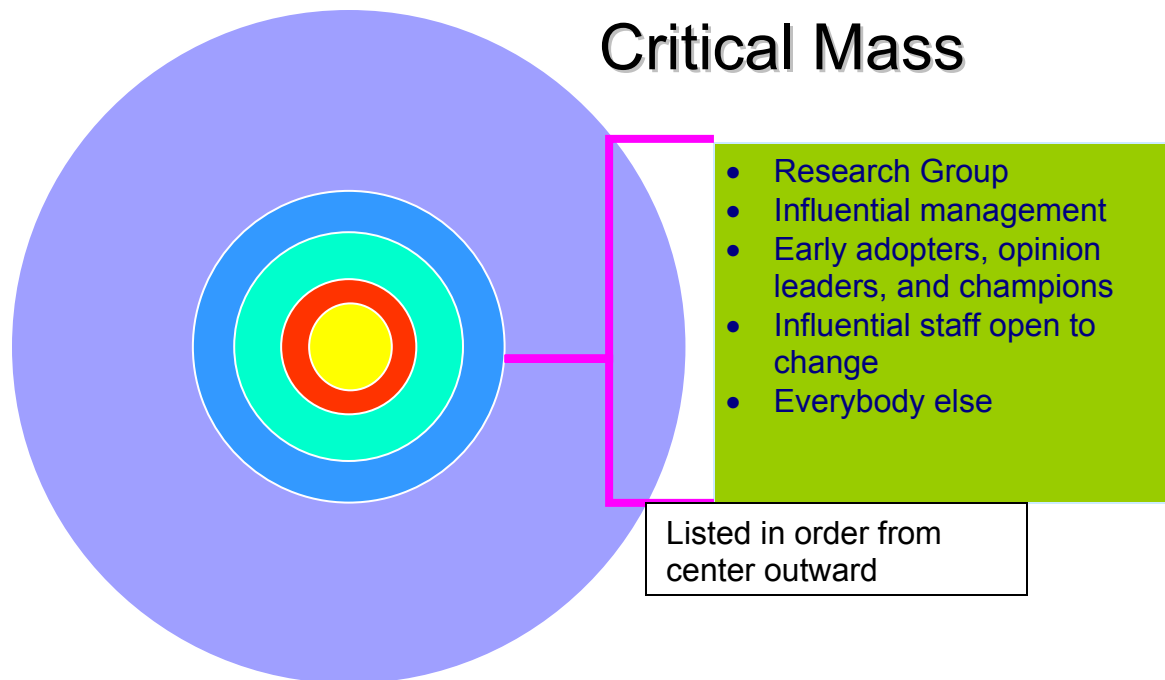


Figure 2. Critical mass for implementation.

Summary and recommendations

A focus on implementation must occur for traffic safety culture research activities to create positive and timely change. This focus must include addressing implementation of research results in a systematic manner. Such a systematic approach taken by the organizations sponsoring and encouraging traffic safety research will form an implementation infrastructure. The implementation infrastructure will in turn promote more effective application of research results thus fostering innovation and improvements and enhancing a traffic safety culture for this nation.

The goal of establishing an implementation infrastructure is to realize research benefits more efficiently and more effectively. Creating an infrastructure to address implementation processes allows the implementation to occur in a more rational and comprehensive manner. The infrastructure contains five primary elements: technology, people, marketing and communications, and implementation tools as well as levers that increase the effectiveness of the other four elements. Each of the elements of the implementation infrastructure is composed of well proven strategies for implementation.

These elements and strategies are:

- Technology
 - The technology “push”
 - Demonstrations and pilots
 - Benefits of the research result—meeting users’ needs

- People
 - Champions
 - Qualified people in lead roles
 - Early involvement of the users
- Marketing and communications
 - Message
 - Networks/established channels
- Implementation tools
 - Implementation plan
 - Identifying successful innovations
 - Web portal
 - Implementation packages
- Levers
 - Partnerships and alliances
 - Committed funding
 - Coordinating function
 - Senior management support

Each of the strategies is a best practice method for increasing the potential for successful implementation of research results. The strategies are provided so that traffic safety research activities can incorporate practical implementation methods from the earliest stages of the research, thus maximizing the use of research findings.

Every research sponsor can be a positive factor in promoting implementation of research results. Through sponsors applying the strategies that are discussed in this paper, an implementation infrastructure will emerge. This infrastructure will enable the advancement of application of innovations and improvements thus advancing the culture of safety.

Sponsors of research can review the infrastructure strategies and determine the extent to which they can provide the necessary resources and procedures that will promote implementation. Federal agencies sponsoring traffic safety research such as the Federal Highway Administration or the National Highway Traffic Safety Administration are in excellent positions to enhance their present efforts or to incorporate the implementation strategies discussed in this paper into their programs. These agencies can contribute substantially by setting the example for requiring implementation strategies to be accomplished in association with the research they sponsor or results they promote. Organizations such as the AAA Foundation for Traffic Safety can provide valuable leadership by encouraging systematic implementation practices.

An implementation infrastructure will promote more effective implementation of research results. In addition, the implementation infrastructure will increase the potential for worthy research results to be applied to problem areas within traffic safety. This will promote changed behaviors through adoption of new products, processes, and methods that will address the dramatic need for improvement within traffic safety today.

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Biographical statement

Barbara Thomas Harder specializes in research and technology management, and one of her focus areas is implementation of research results and innovations. As a consultant she has been a contributing author to studies examining research implementation activities in public-sector transportation for nearly twenty years. Ms. Harder currently is part of a team preparing an innovation infrastructure for the Pennsylvania Department of Transportation (PennDOT) Research Division; she works with FHWA to facilitate the Turner-Fairbank Highway Research Center laboratory expert/peer review meetings and recently completed the National Cooperative Highway Research Program (NCHRP) Synthesis 355, Technology Transfer Successes, Challenges, and Needs with Robert Benke. In the recent past she has performed work on research partnerships, information management, and NCHRP Synthesis 280—7 Keys to Building a Robust Research Program with Thomas Deen.

Prior to 1988, Ms. Harder was PennDOT's Director of Research and Special Studies and worked for a transportation consulting firm and a large-scale computer systems manufacturer and vendor. She has an MBA in Technology Management and a BA in Mathematics with a concentration in Physics. She is a member of Transportation Research Board (TRB) Committees on Conduct of Research, Strategic Planning, and Library and Information Science for Transportation; in January 2006, Ms. Harder was recognized by the TRB Technology Transfer Committee for her contribution to the development of technology transfer tools. Ms. Harder is also a member of the Women's Transportation Seminar, an associate member of ASCE, and a member of its Transportation and Development Institute Research Committee.