A Guide to Developing Marketing Research for Highway Innovations

HIGHWAYS FOR LIFE

Accelerating Innovation for the American Driving Experience.

→ Foreword

The purpose of the Highways for LIFE (HfL) pilot program is to accelerate the use of innovations that improve highway safety and quality while reducing congestion caused by construction. **LIFE** is an acronym for **L**onger-lasting highway infrastructure using **I**nnovations to accomplish the **F**ast construction of **E**fficient and safe highways and bridges.

Specifically, HfL focuses on speeding up the widespread adoption of proven innovations in the highway community. Such innovations include technologies, materials, tools, equipment, procedures, specifications, methodologies, processes, and practices used to finance, design, or construct highways. HfL is based on the recognition that innovations are available that, if widely and rapidly implemented, would result in significant benefits to road users and highway agencies.

Although innovations themselves are important, HfL is as much about changing the highway community's culture from one that considers innovation something that only adds to the workload, delays projects, raises costs, or increases risk to one that sees it as an opportunity to provide better highway transportation service. HfL is also an effort to change the way highway community decision makers and participants perceive their jobs and the service they provide.

Additional information on the HfL program is at www.fhwa.dot.gov/hfl.

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16. Abstract

Highways for LIFE (HfL) focuses on speeding up the widespread adoption of proven innovations in the highway community. Such innovations include technologies, materials, tools, equipment, procedures, specifications, methodologies, processes, and practices used to finance, design, or construct highways. HfL is based on the recognition that innovations are available that, if widely and rapidly implemented, would result in significant benefits to road users and highway agencies. This guide addresses how to use marketing research to deploy technologies and how it has been used for understanding public perception of the organization. It can help an agency better manage its funding, because good marketing research in the form of a customer satisfaction survey can reveal what areas are important to customers.

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A Guide to Developing Marketing Research for Highway Innovations

Introduction

When transportation specialists decide to build a highway or bridge, much effort goes into planning. There are site studies, outreach to residents of the area, environmental impact assessments, feasibility studies, and on and on. Planning likewise needs to be part of any effort to implement any innovation. In 2007, a Highways for LIFE (HfL) publication was developed to assist in creating a planning document. The Guide to Creating an Effective Marketing Plan outlines how to define target audiences, craft a clear value proposition, and identify the appropriate marketing delivery channels. In 2009, another helpful tool, a 2-day training course titled Leap Not Creep, was introduced. Both tools have proven useful to implementation teams. Yet, a gap existed.

Teams that went through the training course often went immediately into a retreat to create their implementation or marketing plans. And, whether it was because of a short schedule or a lack of awareness that additional input was needed, those plans were often light on true marketing research and heavy on intuition and gut feeling. In some cases, such as with Federal agencies, it was the daunting task of obtaining approvals for undertaking such basic research tools as surveys and focus groups that accounted for the missed step. Clearly, there was a need for more information on marketing research and how to go about acquiring it. This guide addresses more than simply how to use marketing research to deploy technologies; it shows how marketing research has been used for understanding public perception of an organization. It can help an agency better manage its funding, because good marketing research in the form of a customer satisfaction survey can reveal what areas are important to customers and what areas are considered nice, but not essential.

A key goal of the Federal Highway Administration (FHWA) HfL initiative is to mainstream innovation use in satisfying motorists' desire for a good driving experience. Surveys of projects completed under the initiative show that using innovation to build projects faster, more safely, with less disruption of traffic during construction, and with higher quality can definitely improve user satisfaction.

The overall purpose of this guide is to enable public-sector transportation agencies to understand the needs, wants, and values of their existing and potential customers and use that information to make better decisions. The aim is to arm agency personnel with ways to conduct marketing research in order to drive decisions.

> "We carried on, from that time, a steady investigation of what was going on in the United States in the matter of road building (1897). This country is so big that a great deal goes on that we don't all know about (1894). What we [did] in Washington is simply to set up a watch, to keep an eye on the whole country, and report what is going on (1894). It simply furnishes a rallying point for the friends of the reform and a signal tower from which its progress can be watched and reported day by day (1894). We are ready through that office to furnish facts and arguments showing why good roads are necessary, how they can be built, and how they are being built in many parts of this great country (1897)."
>
> ~ Comments by General Roy Stone, head of FHWA's predecessor agency, the U.S. Office of Road Inquiry

This guide should be of interest to department of transportation (DOT) managers, marketing professionals, planners, and others interested in the implementation of research strategies that can be applied to highway innovations. This guide provides an overview of marketing research: what it is and why it is relevant to the acceleration of highway innovations. It serves as an introduction to the basic concepts and approaches of marketing research and provides key information for marketers or market researchers who have the responsibility for implementing marketing research. It contains tips and suggestions for agencies to use the knowledge gained through market research to meet their overall service goals. In addition, the guide provides examples of marketing research done for highway-related activities and case studies conducted in Indiana, Georgia, Minnesota, Missouri, Utah, Texas, and Wisconsin, and the value of the research in driving decision-making.

This report does not provide detailed guidance on how to design and conduct a research study or a step-by-step set of instructions for meeting industry research standards. Rather, it is an overview, providing resources and research practices that have been found to be most useful to agencies and the most relevant to accelerating highway innovation use.

The Importance of Getting Innovations into Common Use

Our highway system is the backbone of our economy, handling 70 percent of the total value of all shipped goods. But this national treasure is no longer pristine, nor is it operating at the level it once did. Highways are typically built to last 20 to 25 years, and bridges about twice that. Much of this valuable infrastructure, begun in the middle of the last century, is crumbling. A headline in the May 9, 2007, issue of *The Wall Street Journal* summed it up: "U.S. Infrastructure Found to Be in Disrepair." Even where the structural integrity has remained, the system's designs may not be up to current safety standards.

How do you bring a vast highway system up to modern standards? The transportation agencies of this country are now attempting to do just that, but the techniques being used can sometimes cause as many problems as they alleviate. For example, widening a highway to meet the demands of congestion can mean making congestion worse through work zones, which close off lanes or severely slow traffic flow. In addition, both construction workers and motorists are subjected to increased safety hazards in work zones.

▍*The History of Technology Deployment in FHWA*

From accelerated bridge replacements, to the introduction of roundabouts, to pavement smoothness initiatives, dozens of innovations and technologies currently exist; some are more complex and challenging to deploy than others. If implemented, they would result in noticeably faster construction and higher levels of safety. Using innovative methods, we would end up with longer life cycles for highways, often at a lower cost than if traditional methods were used. Unfortunately, the process of moving those new approaches from state-of-the-art to state-of-the-practice is painfully slow. The real issue revolves not so much around technologies as it does around accelerating the deployment process.

FHWA has been developing innovations and championing those of others for many years. As a matter of fact, the deployment and implementation of technology and innovation is one of FHWA's key business processes. Over the past decade, technology deployment has become increasingly critical. In the early 1990s, the FHWA Office of Technology Applications (OTA) was formed to lead technology deployment. The OTA was dissolved in 1999 when FHWA reorganized, and each individual office within the agency (Office of Infrastructure, Office of Safety, Office of Environment and Planning, etc.) was then charged with deploying its own innovations. FHWA now has a Resource Center with five locations and Division Offices across the nation, which enhances rapid deployment and implementation on the Federal, State, and local levels. The FHWA is known to advance technology and innovation from all possible sources.

FHWA also plays a leadership role in shaping and executing a national Research and Technology (R&T) program. In many cases, FHWA acts as convener, bringing the R&T community together to define priorities and future directions. By advocating technology and innovation, tracking its benefits, and communicating those benefits to key decision makers, FHWA also exercises leadership.

In fact, FHWA's leadership role in R&T begins with the mission of "enhancing mobility through innovation, leadership, and public service," and grows from the role that FHWA defined for itself, to be "innovators for a better future." Taking such a leadership role does not exempt FHWA from working collaboratively with its partners. On the contrary, in today's customer-driven atmosphere, it implies an even greater responsibility to work with partners in defining the direction of and developing the roadmaps needed to achieve results, especially because many times these partners will be implementing the technologies and innovations.

Innovation in Pennsylvania DOT

PennDOT's Research and Innovation Implementations System is a systems approach for advancing winning innovation. Examples furthered through the system include:

- Safety Circles are high-visibility, fatigue-reducing, yellow, rubberized round mats that flaggers stand on while they direct work zone traffic.

- A form for channel beams is used to fabricate concrete and steel structural components for bridges are be replicated locally and result in significant savings, compared with the cost of vendor purchase.

- A salt brine maker is a custom-built, automated processing plant for high-volume and high-quality brine production for winter operations. It generated interest for its potential for savings through in-house production of brine.

~ **From How to Build a System to Implement Research and Innovation: Lessons Learned in Pennsylvania, Transportation Research Record 2211**
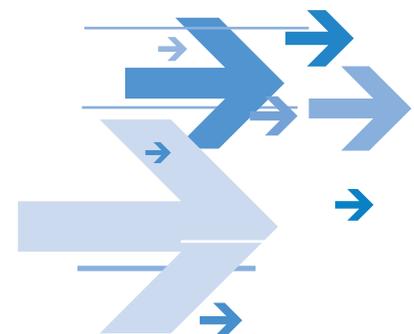
❚ *Highways for LIFE*

Congress authorized the HfL pilot program to facilitate accelerating the deployment process. The "LIFE" in the name is an acronym designed to call to mind the benefits of those new approaches: **L**ong-lasting, **I**nnovative, **F**ast construction, and **E**fficient and safe. HfL focuses on providing information, training, and tools to increase the likelihood of the highway community to quickly apply innovative technologies. The program uses a variety of means to make that happen, including sponsoring the implementation of several individual technologies as examples for how the implementation process might ideally be done, providing funding for construction projects that include innovative approaches, administering training programs on technology deployment for highway professionals, and providing publicity aimed at raising awareness among both the highway community and the driving public.

❚ *Every Day Counts*

FHWA Administrator Victor Mendez noted that when he went through Senate confirmation, he was frequently asked why it takes so long to get a new highway built. In response to that concern, FHWA launched the Every Day Counts (EDC) initiative in 2009. It is designed to identify and deploy innovation aimed at shortening project delivery, enhancing safety, minimizing congestion (both during and after construction), and improving environmental sustainability.

"The list of challenges is really unprecedented. Because of our economy, our transportation system needs to work more efficiently," stated Mendez. "The public wants greater accountability in how tax dollars are spent. We need to find ways to make our roads safer. And we have an obligation to help preserve our planet for future generations." Using performance measures, EDC implementation teams are working with State, local, and industry partners to deploy a finite set of innovations.

Leap Not Creep

HfL, working with the National Highway Institute, developed a training course designed to provide the necessary tools to get innovations into use. Called, Leap not Creep: Accelerating Innovation Implementation, the course uses both in-class and Web-based training.

This course provides transportation employees with the tools to implement innovations quickly and successfully, and to mainstream the innovations into an agency's standard practice. Specifically, the course targets those leading a team or preparing to lead a team, those responsible for deploying an innovation, those selecting innovations that will be implemented within the organization, and those promoting the use of innovations within an organization.

The training discusses the features of successful implementations, provides information on the components of an implementation plan, lists resources for locating innovations and funding for implementation, and discusses strategies for identifying and neutralizing challenges to implementing innovations.

Taught in a blended format, course participants first attend a 2-hour Web conference that introduces the course and sets expectations. One to 2 weeks following the Web conference, participants attend 2 days of classroom training to complete the course.

Upon completion of the course, participants are able to:

- Identify the benefits of implementing innovations.
- Describe the evolution of an innovation from the identification of a need to mainstreaming an innovation into standard practice.
- Describe the key factors of successful innovation implementation.
- Develop a deployment plan for implementing an innovation.
- List three strategies that could be employed by agency decision-makers to support innovation implementation.
- Determine resources required to mainstream the innovation into standard practice.
- Identify strategies for overcoming barriers to implementing an innovation.
- Locate resources to support the deployment of innovations, such as funding resources.

For more information about the Leap Not Creep course, go to:

http://www.nhi.fhwa.dot.gov/training/course_detail.aspx?num=FHWA-NHI-134073&topicnum=134.

Guide to Creating an Effective Marketing Plan

In 2006, HfL selected three innovations with national significance as pilots and designated them "vanguard technologies" because of the innovative groundbreaking approach they were to take: (1) Prefabricated Bridge Elements and Systems (PBES), (2) Road Safety Audit, and (3) Making Work Zones Work Better. For each of these technologies, a dedicated deployment team was established, using individuals from throughout the FHWA as partners. The team's first task was to develop a marketing plan, complete with their first year's strategies and budget. The approach to developing a marketing plan came from that effort. To access the Guide to Creating an Effective Marketing Plan, go to: http://www.fhwa.dot.gov/hfl/091013/index.cfm. ➜

→ Section 1: Overview

❚ *What Is Marketing?*

Some people think that marketing is only about the advertising and/or personal selling of goods and services. Advertising and personal selling, however, are just two of many activities that fall under the marketing umbrella.

> *"Marketing is no longer a function—it is an educational process."*
>
> **~ American Marketing Association**

According to the American Marketing Association, marketing is "an organizational function and a set of processes for creating, communicating and delivering value to customers and for managing customer relationships in ways that benefit the organization and its stakeholders." In general, marketing is identifying the particular wants and needs of a target audience, and then going about satisfying those needs. More simply, marketing is finding a need and filling it by identifying your target audience(s), analyzing their needs through research, and then determining strategies and allocating resources to solve their problems with your innovation.

In many organizations, marketing is seen as a service function, providing nothing more than support materials such as brochures, videos, and other communication tools. But marketing is much more than that; in reality, marketing focuses first on discovering what is important to the customer and then positioning products or services based on those distinct needs.

❚ *There Is a Difference between "Market Research" and "Marketing Research"*

Market research and marketing research are often confused. Market research is simply research into a specific market—it is a very narrow concept. Marketing research is much broader. For example, if Ford Motor Company were to consider moving into another type of business and manufactured motorcycles in addition to cars, they would conduct market research on the motorcycle market, looking at how many units are sold, what percent of market share other manufacturers hold, how much capital investment would be required for setting up new assembly plants, and so forth. Market research includes an analysis of such market factors as government regulations, established competitors, and trends in consumer behavior. On the other hand, if Ford Motor Company required qualified data on products, services, or actual motorcycle customers, then it would be more appropriate to conduct marketing research. Market research is frequently a component of marketing research. It is important to note, however, that although there is a clear technical distinction between the two terms, they often are used interchangeably in common conversation.
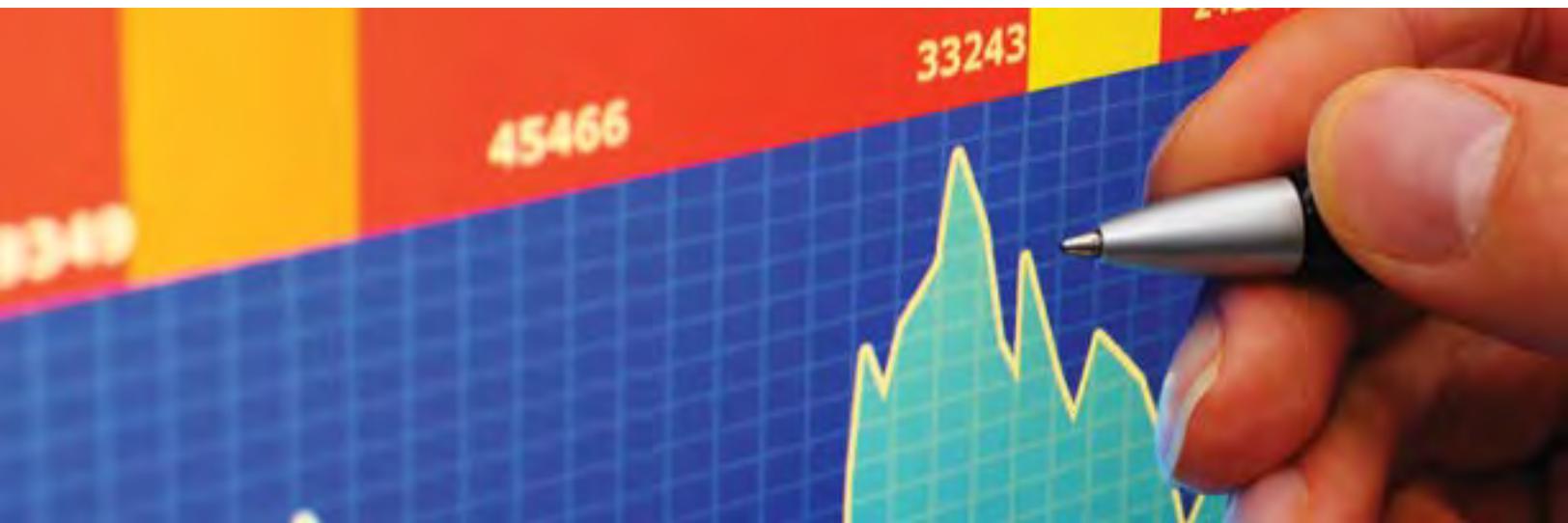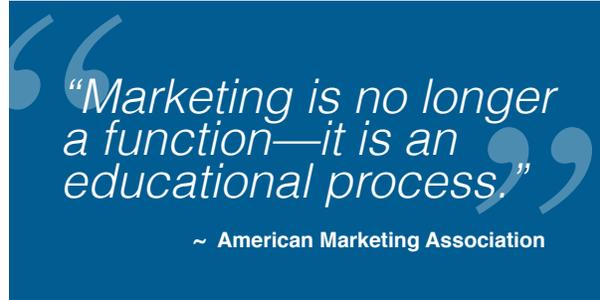
❚ Why Conduct Marketing Research?

The Benefits of Marketing Research in Accelerating Innovation Use

Marketing research is useful for improving decisions by gaining insight into customers' needs and perceptions. *In the National Cooperative Highway Research Program (NCHRP) report, Using Customer Needs to Drive Transportation Decisions (NCHRP Report 487), certain principles concerning information on customer needs emerged, including:*

- State and local transportation agencies are using customer needs to drive decision-making.

- Agencies can demonstrate links between what customers want and what can be delivered.

- Awareness of customer needs brings more positive customer relationships.

- Research techniques are increasingly matching those of private-sector marketing organizations.

- Working with customers can start at any time.

- Agencies rely on both quantitative and qualitative surveys of customer behavior and opinion.

- Agencies are innovating in their use of customer segmentation practices.

- An agency's customer initiatives can be very cost-effective.

❚ Use of Marketing Research in the Private Sector

Marketing research can be tremendously effective in identifying obstacles to the adoption of an innovation, for example, how the right technology solutions could help stakeholders, where the obstacles lie, and what it would take to remove those obstacles. In addition, marketing research can help identify opportunities in the industry that create a favorable climate for the adoption of an innovation or new technology.

The private sector has a long history of successes because of marketing research. Ford's consumer testing of the Taurus in the 1980s illustrates how marketing research can pay off. Ford left little to chance, spending over 2 years on marketing studies, including 100,000 miles of driving tests with drivers of all ages. Today the Taurus is one of America's best-selling automobiles.[1]

Many large companies use marketing research to find out as much possible about their customers to determine what influences their buying decisions. Philip Kotler, author and economist, wrote in *Marketing Management*[2], "Coke knows that we put 3.2 ice cubes in a glass, see 69 of its commercials every year, and prefer cans to pop out of vending machines at a temperature of 35 degrees. . . . We each spend $20 per year on flowers; Arkansas has the lowest consumption of peanut butter in the United States; 51 percent of all males put their left pants leg on first, whereas 65 percent of women start with the right leg; and . . .P&G once conducted a study to find out whether most of us fold or crumple our toilet paper. . .." As in the private sector, data about customer attitudes and behaviors can often help drive better decisions in the diffusion of highway innovations.➜

BMW Goes Mini

In the early 1990s, in response to shifts in the attitudes and values of luxury-car buyers, BMW initiated a market research effort to ensure its brand's position matched an understanding of future customer needs. With a focus strictly on premium-priced cars, customer research was used to classify their prospective customers into four segments from which they matched product development—by introducing a car to match three of them: "upper liberals," "Post-moderns," "upper conservatives," and "modern mainstreams." Armed with this customer insight, BMW launched the Mini in 2001, allowing the company to enter a new segment of the auto market without reducing the risk of affecting perceptions of their existing brand.[3]

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1   Lappin, Figoni, Simmons, Sloan, Primer on Consumer Marketing Research, Page 1 (Volpe Center, 1994).
2   U.S. Chamber of Commerce Market Research Toolkit
3   Neal E. Boudette, Navigating Curves BMW's Push to Broaden Line Hits Some Bumps in the Road , The Wall Street Journal January 10, 2005; Page A1.

→ Section 2: Getting Started

Each marketing research project has its own challenges and approach, but researchers tend to use the same general steps in designing any study. Because the steps are closely related, a change made at one stage of the process often requires that revisions be made to other stages. Once the data are collected, however, no further revisions are possible. The researcher should plan the entire research project before any data are actually collected.

This section reviews three key steps to getting started with a marketing research project: (1) determining the research goal or objective, (2) identifying the type of data or information needed to meet the research objective, and (3) compiling a team for conducting the research.

▌ *Determining the Need for Research*

One of the most important steps in the marketing research process is determining the need for research or defining the research problem, which typically entails a thorough analysis of the transportation issue or product innovation that is the focus of the research. It is critical to examine the full background on the research topic to inform the design. Answers to the following questions can help set the objectives for and shape the scope of a research project:

1. What is the problem or issue you are facing?

2. Why is the research necessary? What are the business or operational decisions the data will inform?

3. What information do you need to inform the decision or help you understand the issue?

4. From whom (what audience) do you need to get information? What audience(s) does the issue affect?

5. How will the data be used or analyzed?

When the Tennessee DOT completed its first comprehensive customer satisfaction survey in July 2006, the goals were defined to (1) help identify and prioritize the transportation services and improvements that were most important to Tennesseans, and (2) assess the DOT's overall performance. The survey was planned and designed with these goals in mind, and the survey results were to be used to help evaluate the effectiveness of the Tennessee DOT's strategic plan.

Without clearly defined research objectives, time will be spent formulating a research plan without an end goal, and the result could be data that are not relevant or ultimately, not credible.

Linking Survey Objectives with Outcomes

In 2006, the Michigan Department of Transportation conducted a customer survey with the goal of measuring both driver and community member perceptions of painted rumble strips—specifically which test strips of edge line pavement were preferred by highway users. The survey results indicated that drivers, as did agency planners and construction engineers, all had the same goals in mind, namely public safety. The specific marking pattern and technical terminology had little meaning to the general public.

How to Determine What Type of Marketing Research Data Is Needed

There are two main types of data sources—primary and secondary. Primary research is the collection of original data to solve a specific problem or provide insight on a policy or program issue. It can be obtained through interviews, surveys, or observation. Secondary research is the review of data or information that already has been collected for other purposes. Because marketing research generally requires substantial investment in time and money, it makes sense to determine whether information or data are already available from existing or published sources. These sources can be internal to an agency (customer databases, historical files, letters from customers, etc.) or external (which would involve searches for published information or data, such as newspapers, trade publications, associations, industry reports, and the Internet).

Do-It-Yourself Versus Hiring a Consultant

Examples of Secondary Research Sources

- Census Bureau material
- Population, housing, economic, county business patterns
- Statistical Abstracts
- Topically Integrated Geographic Encoding and Referencing (TIGER) databases
- US Department of Transportation Data Sources
- National Household Travel Survey
- Commodity Flow Survey
- Census Transportation Planning Products
- Fatality Analysis Reporting System
- State DOTs' publications and Websites
- Dun & Bradstreet
- Trade journals, newsletters
- Transportation Research Board (TRB)/ National Cooperative Highway Research Program (NCHRP) Reports

Some organizations are fortunate to have internal research departments staffed with specialists in marketing research and can plan, execute, and manage a research project in-house. Others look elsewhere for their research expertise such as other organizations, universities or by hiring a consultant for the entire research effort or for help in certain areas. A consultant can be hired as an advisor for part or all of a research project. Hiring a consultant for part of your research is beneficial when there are budget constraints or the organization lacks the internal expertise, as was the case for the Nebraska Department of Roads (NDOR). NDOR used a combination of a multi-functional team drawn from within the organization and a University consultant when conducting a Resident Satisfaction Survey to assess customer satisfaction with overall performance. The NDOR in-house team identified the research needs, developed the survey questions, analyzed the data and compiled the report. The Bureau of Sociological Research at the University of Nebraska-Lincoln collected the data and delivered a raw data file to NDOR for analysis.

Often, private companies are contracted to design and execute marketing research in its entirety. Aside from not having the in-house research expertise, there are many reasons why you may choose to outsource marketing research:

- The project is complex and requires trained marketing research professionals to conduct the research.
- Internal department workload would make it difficult for you and/or your department to complete within the necessary timeframe.
- Some internal resources are available, but none will be dedicated to getting this work done to your satisfaction.
- The project demands accurate, reliable information to support major decisions.
- An objective perspective is required to get unbiased answers.
- Findings will be reported to external stakeholders, so you need a recognized, external authority.
- Research may not have any internal credibility if done in-house.
- The organization may not want its identity or that of its product/service known to the subjects.➔

Section 3: Preliminary Marketing Results

With a research goal and resources in place, and before you embark on developing a research plan, conducting preliminary marketing research is a critical step for formulating a complete picture and understanding of your research topic. This, in turn, informs your research design by:

- Providing insights for developing the survey questions.

- Offering understanding of the target research population (your target audience) from whom you need to collect input from.

- Helping you make decisions about the right research method to reach your target audience.

This section details approaches for conducting background research and then offers guidance on how to use the information gathered.

Product and Situational Analysis

Sometimes referred to as an "environmental scan," a product or situational analysis typically entails a thorough analysis of the transportation issue or product innovation that is the focus of your research. Without a complete picture or the full background on the research, you'll spend time formulating a research plan without an end goal. Or worse, you may end up with data that doesn't meet your needs.

Options to consider when conducting a situational analysis or environmental scan include:

- Internal knowledge and understanding about a program or product innovation from the perspective of colleagues in your agency, program, or team; you may also draw from historical data your program has previously collected. You would also want to include discussions with management, key decision-makers in your agency, and even stakeholders and industry experts to get their perspectives on the research definition.

- Mining secondary data collected by other agencies for other purposes, such as traffic counts, vehicle miles traveled, or highway crash and fatality numbers, all of which are drawn from existing databases.

- Conducting a literature search or product review using TRIS Online (Transportation Research Information Service), NTIS (National Technical Information Service), an agency library, conference proceedings and published articles, and product reviews.

Using this information, the context of the research topic can be defined from the perspective and needs of your program or agency. This way, you can "connect the dots" regarding the research needed to resolve issues or problems to make informed decisions. Once you have your research need defined, you can begin to build the overall research framework.

Determining the Target Audience

Define your target audience by determining who to contact to collect the information you need. The target population must be precisely defined, or else the research effort would be ineffective and the results misleading.

There is an adage in marketing: start where your audience is. The advice is simple to follow, but only if you know who your audience is. Many transportation agencies consider their audience to be "the general public." When you watch an organization's advertisement on the evening news, it often appears they are talking to the general public. But the entire public is not watching the evening news. Studies show that those with college degrees and adults over the age of 55 watch the news more than anyone else. Therefore, any organization that is featured on the evening news is most likely to reach college-educated people and senior adults. "The general public" is too broad a term, and targeting the general public is most often cost-prohibitive. Even large corporations do not attempt to target the general public. Instead, it is helpful to think about the public in segments, such as adult drivers, youth of driving age, urban youth of driving age, urban young women of driving age, etc. This process of refinement helps you hone in on your target audience.

If your research objective is to measure how customers perceive road conditions on State highways, it makes sense that the research population would be State highway users—or drivers—and you could stop there. However, if you wanted to differentiate between different types of drivers, you might further segment your study population by those who drive trucks, State residents who drive vehicles, and visitors to the State. You can define customer groups broadly or very specifically, depending on your research objectives:

- Broadly defined customer groups include active voters, households, winter residents, statewide residents, residents aged 18 and older, and licensed drivers.

- Specifically defined customer groups include commercial drivers, local government officials, statewide residents who have driven 200 miles on State highways in the past month, and licensed drivers who live within 1 mile from a highway corridor.

Market Segmentation

Market segmentation divides a market into distinct groups of people with similar characteristics. The benefit of market segmentation is to obtain meaningful data from each of the customer segments. Considerations include:

- Behavior (licensed drivers, highway usage patterns, attitudes, vehicle miles traveled).

- Demography (age, ethnicity, vehicle ownership).

- Geography (regions, proximity to a highway or corridor, suburban/rural).

Gathering more conclusive lifestyle and demographic information allows a greater depth of knowledge of the target audience. ➔

To combat a significant littering problem, the Texas DOT exerted a great deal of effort to determine their target audience for the "Don't Mess With Texas" communications campaign. The DOT analyzed trash collected from roadsides and medians, and they conducted intercept surveys and in-depth interviews. Researchers were able to determine the primary culprits: males between the ages of 18 and 34. Once the target audience was identified, the DOT's ad agency developed the campaign specifically for this audience, rather than attempting to appeal to the public at large. The result was one of the most successful and memorable governmental media campaigns in U.S. history.

Section 4: Research and Sampling Approaches

Primary research is divided into two categories: qualitative and quantitative research. In essence, qualitative research addresses attitudes and behaviors, while quantitative research is based on reason or logic. When planning a study or defining its objectives, first determine which approach is best suited—qualitative or quantitative. In some cases, only one will suffice; other times, both are needed. Once determined, the most appropriate methodology needs to be chosen. The most commonly used qualitative and quantitative research and sampling methods are summarized in this section.

▌ Qualitative Research Methods

Qualitative research methods provide insights and understanding of the research problem. The outcome is typically a better understanding about the topic itself.

Examples of qualitative research include focus groups, structured or in-depth interviews, which are typically conducted as one-on-one, in-person or telephone interviews. Because the sample is generally small (for instance, 6 to 10 people typically participate in a single focus group), qualitative research is rarely, if ever, regarded conclusive; therefore, qualitative research is not used to make generalizations to the population of interest.

The cost of this type of research varies depending on the size of the group or number of one-on-one interviews, the location of (or the need for travel to conduct) the interviews, and the number of interviewers. For instance, the costs of conducting focus groups can increase if they involve a hard-to-reach population (which is typically more difficult to recruit), paid moderator, and focus group facility fees. Qualitative research is inexpensive compared to quantitative research, but industry standards require that more than one focus group or interview be conducted.

▌ Data Collection for Qualitative Analysis

Focus Groups

A popular exploratory technique, focus group research usually involves 6 to 12 individuals brought together to discuss a given topic. Fo-

Research Methods

Qualitative—*directional insights; exploratory*

- Tests ideas, designs or prototypes, branding
- Understand target population opinions/attitudes about programs/products
- Pretest survey instruments
- Explores survey findings

Quantitative—*confirmatory*

- Point-in-time measure of attitudes, behaviors, opinions
- Establishes baselines
- Measures shifts over time (trending)

cus groups are used when in-depth probing or focused discussions are needed to develop new ideas. Focus groups are often used in conjunction with a survey. They are used to gather information about how a product or service is used or perceived in preparation for the development of a survey questionnaire. They can also be used after a survey is administered to explore a survey finding that needs additional exploration or insight. This form of qualitative research is relatively inexpensive, fast, and flexible compared to individual interviews or other, more conclusive, quantitative methods.

Features of successful focus groups include:

- The preparation, beforehand, of a participant recruitment guide that includes the questions or criteria for screening qualified participants, as well as a moderator's discussion guide that includes information on the objectives of the study, specific topics to probe, and the general sequence of questions.

- The presence of a moderator who can stimulate and direct a discussion toward areas that will provide meaningful insights for analysis.

- Group members recruited to be as homogeneous as possible, permitting clearer comparisons among groups (useful in market segmentation).

- Group members who have been carefully screened to eliminate those with insufficient exposure to the subject at hand.

- One or more groups representing each market segment under study.

- Group sessions lasting long enough for the group to build rapport and explore the discussion topic adequately (usually 90 minutes to 2 hours).

- Ideally, focus groups are conducted in well-equipped facilities (e.g., audiovisual equipment, two-way mirrors that allow market researchers to observe the discussion without disturbing the participants).

Focus group sessions are not foolproof; the most common reason for a session to fail is when one person dominates the discussion. It takes a skilled moderator to control such individuals and maintain an atmosphere that encourages free expression and lively and thoughtful discussion.

Focus Groups on Slugging and Body Snatching

In the summer of 2012, FHWA's Exploratory Research Program conducted a series of nine focus groups to explore the unique form of ridesharing coined as "casual carpooling" or "slugging." The 2-hour focus groups, each consisting of 7 to 10 participants, were held in Washington, Houston, and San Francisco with drivers (body snatchers) or passengers (slugs). The interviews shed light on the user-run, informal system of forming impromptu carpools of two or more commuters per vehicles to take advantage of high-occupancy vehicle (HOV) lanes to get to a common employment center. The research revealed a key to success is the unstructured nature of the system and the "win-win" benefits the drivers and passengers receive: qualifying to use the HOV lanes (drivers) and traveling to work without paying for transportation or parking (passengers).

Strengths	Limitations
• Result in deep insights and wide range of ideas	• Results are exploratory, not conclusive
• Group setting is comfortable and participants are likely to be highly engaged	• Results cannot be generalized to the population as a whole
• Allows observation by viewers and sessions can be recorded	• Susceptible to client/researcher bias
• Can be conducted quickly	• Require a professional and neutral moderator
	• Unstructured data makes analysis time consuming

In-Depth Interviews

In contrast to group interviews, in-depth (or "depth") interviews are conducted with an individual or a small number of people within the same customer group or audience. These are often called personal interviews when they are conducted face-to-face; interviews can also be conducted over the telephone.

In-depth interviews follow the same pattern as a focus group, where an interviewer writes the answers on a standard coding sheet. Ideally, the interview should consist of the following:

- The same questions should be asked of every respondent. The questions must be asked in the same context, and the purpose of the research must be explained to the respondent in the same manner.

- The interviewer must make the effort to ensure that each question is understood in the same way by all respondents in order to avoid false data due to misunderstood questions.

- The interviewer must be able to act as a coder, meaning that the answers are written down in a standardized form, by the interviewer, not by the respondent.

- The face-to-face interview offers the possibility of dispelling ambiguity because the interview is conducted in person.

- It is extremely important that the interviewer be trained in asking the questions in a non-leading way. In addition, the interviewer must use non-leading prompts when trying to elicit answers or when trying to find out if the question was correctly understood. Ideally, interviewers must attempt to maintain an atmosphere of "conversation," while maintaining a standard format.

Strengths

- Interview length can be tailored to the interviewee's availability
- Permits face-to-face contact with interviewees
- Explore topics in depth
- Flexibility in conducting the interview to the interviewee's particular circumstances

Limitations

- Expensive and time-consuming
- Requires well qualified, highly trained interviewers
- Flexibility can result in inconsistencies across interviews

▌ *Quantitative Research Methods*

Quantitative techniques are applied to generate meaningful metrics that clearly define the magnitude of a response. For example, qualitative research would uncover how people feel about an issue, whereas quantitative research would measure how strongly they feel about it.

Quantitative research aims to quantify the information that is collected and therefore typically applies some form of statistical analysis. The outcome is usually a recommended course of action or a hard measure of opinion, attitude, or behavior. Sample sizes are typically significantly larger because the research participants are generally drawn using a probability-based sampling approach (one in which everyone in the sample frame has an equal chance of being invited to participate). Therefore, the research data are considered representative of the population of interest. The major difference between quantitative and qualitative research is the statistical validity of the data collected—this, in turn, affects the ability to draw inferences to a population as a whole (i.e., the findings can be generalized to the target population).

The industry standard for a statistically valid survey is N=400, which provides a margin of error of plus or minus 5 percent. The number of completed interviews (N) depends on your research needs, how much margin of error you are willing to accept, and your budget. As N grows larger, the margin of error decreases, but the cost of collecting the data likely increases.

The costs of quantitative research are highly variable and depend on factors such as the research method, the complexity of sampling, the survey length, and the budget. For example, a 10 or 12 minute telephone survey of 400 residents 18 and older will costs about $35,000 to $45,000 to conduct (depending on the complexity of the sampling or survey questions).

▌ *Data Collection for Quantitative Analysis*

Telephone Surveys

A variation of the in-depth interview is the telephone survey. The disadvantage of the telephone survey is that the interviewer loses the respondents' non-verbal cues, such a body language and facial expressions, which would be picked up in a face-to-face interview. However, it has very similar advantages to the traditional face-to-face interview in terms of social interaction and ability to dispel ambiguity. Telephone surveys are often used when the research effort requires a sample of the general population.

In recent years, telephone research costs have increased in tandem with declining response rates due to the frustration of receiving calls from unknown or suspected marketing callers, technology such as answering machines and caller ID, and the trend in prevalence of cell phone ownership among the American public. The survey research industry is addressing these issues with a more complex survey design that makes use of dual-mode data collection (mail and telephone), cell phone sampling, and address-based sampling, among others. Other contributing factors to the cost of telephone surveys include survey length, sample size and customer segmentation, and analysis.

To illustrate the variability of research costs, the following table summarizes the costs of recent surveys conducted for four State DOTs.

Telephone Survey Costs

State DOT	Survey Description	Sample Size	Cost	Distinguishing Features
Florida	Statewide Customer Satisfaction Survey	5,000	$175,000	Six customer segments; analysis on statewide and district levels.
Maryland	External Customer Survey	2,300	$100,000	Statewide and district level analysis
Minnesota	Business Planning Maintenance Products and Service Survey	1,000	$40,000 to $50,000	Gap analysis of customer opinions on perceived acceptable versus actual performance.
Missouri	Statewide Customer Satisfaction Survey	3,500	$75,000	District level sampling and analysis.

Pooling Resources

The Minnesota DOT's research unit provides survey research services for the entire agency. Most departments typically do not have line items for research in their budgets to fully support the effort. In these cases, MnDOT recommends partnering with other districts or divisions. The primary benefit to pooling resources for research is that the number of completed interviews can be increased, making the survey more representative of the customers and strengthening the statistical significance of the results.

Strengths
- Reach a majority of households (landline and cell phone coverage)
- Fast turnaround
- High response rates
- Low non-response (skipped question) rate
- Interviewers can ask for clarification

Limitations
- Generally, higher cost
- Respondents may "screen" telephone calls (caller ID)
- Interrupts respondents' free time
- Not including cell phone sample or those who have no phones may cause sampling bias

Mail Surveys

The mail survey, which has been a common marketing research method for decades, is often used to get information from people who are difficult to reach in person or who have an unusually high interest in the research topic. Some techniques for increasing response to mail surveys include an advanced notice to the recipient, a cover letter explaining the purpose of the study and the importance of the recipient's response, or some sort of incentive, such as a dollar bill, included with the letter.

Strengths	Limitations
• Relatively inexpensive	• No probing/clarification
• Reach households with address-based sample	• Low response rates and missing or item non response data
• Can be tested using a small sample of the overall database	• Less control over respondents
• Time convenience for respondents	• Slower turnaround
• Eliminates interviewer bias	• Length can decrease completion rates

Mail surveys are useful for asking questions that may not be easily answered on the telephone (e.g., those requiring visual prompts or conveying complex information).

Sampling

Samples are intended to represent a population of consumers; the emphasis should be on selecting appropriate sample members to represent the population. Four tasks must be accomplished before actual physical selection of the sample can occur:

1. Clearly define the target population. The defined population should be related to the product being tested or the market being explored. For instance, this might be licensed drivers, vehicle owners, or households near a specific highway corridor or bridge.

2. Determine the sampling "frame." The sampling frame is simply a list, often representing the universe or every single element in the target population from which the sample is taken. Examples include a drivers license database, a list of residential telephone exchanges, employer lists, city directories, and mailing lists. It is usually easier and more efficient to obtain a list from an outside source than it is to generate it internally, unless the sample size is small, simple, or highly specialized.

3. Determine the sampling method. This requires thoroughly understanding the basic principles of sampling to reduce error. Consider asking for professional help in approving and supervising your sampling procedures. Examples include a random sampling method or a stratified random sample (two or more random samples combined).

4. Draw the sample using the sampling frame and methods defined.

Rensis Likert and Using the Likert Scale

Rensis Likert (1903–1981) was an American educator and organizational psychologist best known for his research on management styles. He developed the Likert scale and the linking pin model.

The Likert Scale is an ordered, one-dimensional scale from which respondents choose one option that best aligns with their view. Typically there are between four and seven options, with five options the most common offering. There is much debate about how many choices should be offered. An odd number of choices allows people to sit on the fence; an even number forces people to make a choice, whether this reflects their true position or not. One of the most important advantages of using a Likert Scale is that it allows one to quantify the entire group's attitudes or understandings. If, for example, a survey uses a 5-point Likert Scale, all the answers can be totaled and divided by the number of respondents to get the overall average.

All options usually have labels, although sometimes only a few are offered and the others are implied.

A Likert-style survey commonly presents assertions with which the respondent may agree or disagree to varying degrees. In scoring, numbers are usually assigned to each option (such as 1 to 5). The Likert scale is also called the summative scale, as the result of a questionnaire is often achieved by summing numerical assignments to the responses given.

A benefit to this approach is that the questions used are usually easy to understand. A disadvantage of the Likert Scale is that it typically offers only a two-way option, rather than multidimensional ones. If only a few response options are offered, respondents may not feel like any of the options fully capture their desired response. However, a carefully selected set of questions or statements can act together to give a useful and coherent picture. Questions may be selected by a mathematical process as follows:

1. Generate a lot of questions (more than you need).

2. Get a group of colleagues or judges to score the questionnaire.

3. Sum the scores for all items.

4. Calculate the inter-correlations between all pairs of items.

5. Reject questions that have a low correlation with the sum of the scores.

One problem to asking questions in this way is that people can become influenced by the way they have answered previous questions. For example, if a respondent has agreed to several questions in a row, they may continue to agree. They may also deliberately break the pattern, disagreeing with a statement with which they might otherwise have agreed. This patterning can be broken up by asking reversal questions, where the sense of the question is reversed. Sometimes the "do not" is emphasized, to ensure people notice it, although this can cause bias. ➔

> "No amount of care in interviewing and analysis can remove the bias inherent in a bad sample."
>
> ~ Celinda C. Lake, Public Opinion Polling

# Section 5: New Approaches to Marketing Research

In tandem with the explosive growth of Internet use in the United States (see figure below), new approaches to marketing research using Web-based methods have been introduced in the past decade. Because the building blocks of qualitative and quantitative marketing research remain the same, innovative organizations and businesses are pushing the envelope by integrating the insights gleaned from traditional and emerging research techniques. This section first presents the benefits and limitations of using these new approaches and then addresses each individually.

Benefits and Limitations of the New Approaches

Web-based approaches have rapidly emerged as a research venue because they generally provide broader, faster access to target research populations. In addition to these clear benefits, Web-based surveys can be administered with lower overall costs than traditional marketing research approaches. Still, when considering whether to use a Web-based marketing research approach, there are limitations to consider. The most prominent limitations are the gaps that exist between those with and without access to Internet at home.

According to research conducted by the Pew Foundation's Internet and American Life Project, four of five, or nearly 80 percent, of American adults use the Internet. Still, there are gaps with regard to the representativeness of users in Internet adoption. Over the past decade, the gap between whites and minorities has mostly narrowed. But according to Pew, Internet access is lower among senior citizens, adults with less than a high school education, and those living in households earning less than $30,000 per year. Additionally, adults living with a disability in the United States (27 percent) are significantly less likely than adults without a disability to go online (54 percent versus 81 percent).

Internet adoption, 1995-2011

% of American adults (age 18+) who use the internet, over time.
As of August 2011, 78% of adults use the internet.
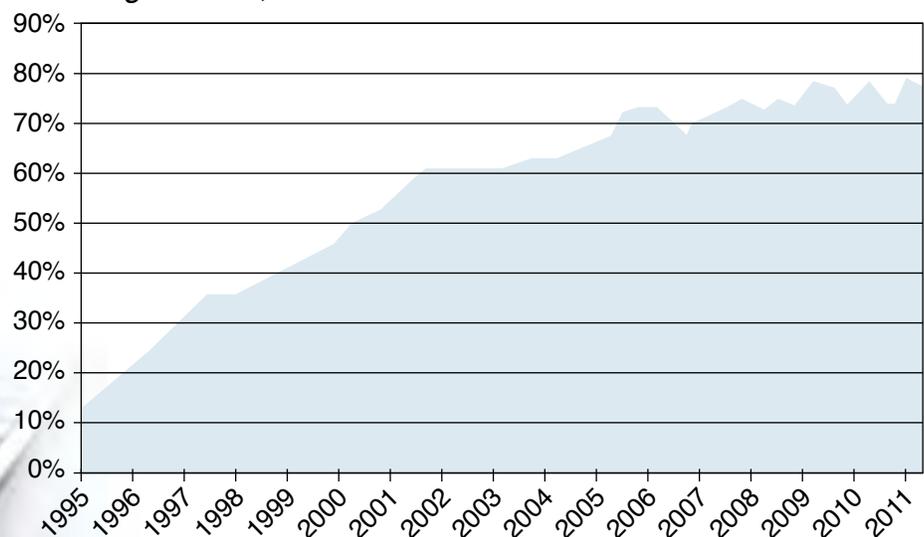
Source: Pew Internet & American Life Project Surveys, March 2000-August 2011.

The move towards mobile technology, including cell and smart phones, tablets, iPads, and even e-readers, is beginning to lessen the "digital divide." Nonetheless, when considering Web-based marketing research methods, users must keep these limitations in mind. If the objective is to collect data that are fully representative of the research target population, a Web-based approach may not be the best option. The exception to this would be if the Web-based approach recruited participants using a probability-based sample to ensure that participants were randomly selected to participate in the research.

Online Focus Groups

One of the latest innovations to the focus group format is the move to the Internet. Using chat and Web conferencing technology, the Web-based format has made it possible for people around the world to gather online, eliminating travel costs and other logistical problems associated with traditional face-to-face focus groups.

Strengths	Limitations
• Cost-effective, especially if recruitment is by email	• Initial investments in technology
• No travel required	• Limited group interactions and dynamics
• Turnaround time is fast	• No observation of non-verbal expressions
• More can participate at once	• Need a strong moderator skilled in verbally controlling discussions
• No hands-on involvement such as being able to touch, smell or come into contact with objects	• Online recruitment may skew representation of population targets
• May be more open and free to talk due to anonymity	

When online, participants tend to speak more freely because they are sitting at home and feel anonymous. Online focus groups allow qualitative research to be completed more quickly and at a lower cost. On the other hand, moderators cannot see the body language or facial expressions of online participants. Instead of the two-way mirrors often used to monitor traditional focus groups, online platforms allow clients to watch the online discussion from a "back room." Clients can "talk" among themselves, communicate with the moderator during the session, or add new discussion questions.

Many Web conferencing programs have been developed in the last few years. The programs often bundle tools already common to Internet communication to create an interactive meeting environment. Tools include chat and instant messaging technology, Webcams that send streaming video, and screen sharing that allows participants to view information from the moderator's desktop. These tools allow organizations to bring focus groups together at a lower cost and in a faster timeframe. Using Web conferencing programs, sessions can also be recorded for additional analysis or to share with colleagues.

Organizations will always need feedback from their targeted customers, and the focus group will continue to be a valuable tool. Web-conferencing advances make it easier to host focus groups, and other technological advances are sure to follow.

▍ *Online Surveys and Panels*

Online surveys bring the convenience of the Web to the survey venue, allowing customization, on the spot editing, and integration into Web sites. They also offer fast responses, are relatively inexpensive, and are quicker to administer than telephone or mail surveys. There are many free or inexpensive online survey tools that allow users to craft several kinds of questions for their surveys, and many offer templates of surveys preformatted with questions. For a listing of such services, see www.greenbook.org.

Online panels are often referred to as online communities and are a pre-recruited pool of the target population that have, in principal, agreed to participate in a series of online surveys or discussions.

When selecting an online survey or panel, keep the target population in mind and how the results will be used and applied. Online surveys and panels may not be representative of the general population if participants were not randomly sampled or recruited to participate.

There are other important limitations of online surveys and panels to consider. Generally, survey completion rates are lower than for traditional survey methods, especially for longer surveys. The use of a password or personal identification number (PIN) is recommended to access the survey so that people outside of your target population cannot respond to the survey. Because of this, they are best for targeting a specific population in which email addresses of respondents are known, such as in a workplace survey of employees with email addresses, or to survey visitors to a particular Web site.

Online surveys and panels are growing in popularity among transportation organizations, and the Minnesota DOT (MnDOT) is leading the way with its Web-based panel, The MnDOT Online Community. As a new strategy for obtaining continuous customer feedback, the Online Community supplements other methods for collecting public input, such as marketing research and public meetings. MnDOT maintains a panel of 600 Minnesotans who reflect the demographic diversity of the State. A private company built and manages the panel, and randomly recruits panel members to participate for a year.

In contrast to MnDOT's random recruitment for a representative sample of participants for its Online Community, the Washington State Transportation Commission invites residents to join the "Voice of Washington State Panel" by simply filling out a form on their Web site (www.voiceofwashington.org). Panel participants participate in surveys and online discussions; survey results inform the governor and State legislatures on transportation policy, taxes, and funding issues.

Representativeness of Web-based Panels

"Researcher should avoid non-probability online panels when one of the research objectives is to accurately estimate population values. There currently is no generally accepted theoretical basis from which to claim that survey results using samples from non-probability online panels are projectable to the general population. Thus, claims of "representativeness" should be avoided when using these sample sources."

— **from American Association for Public Opinion Research Report on Online Panels, March 2010.**

Strengths	Limitations
• Very low cost	• May not reflect population as a whole (not statistically valid if conducted as a population survey)
• Can be very fast	• Requires multiple emails to remind respondents to complete the survey
• Flexibility to respondent	• Unintended respondents may reply; passwords or PINs should be not provided to intended respondents
• Provided more detail on open-ended questions than other survey methods	• Low completion rates on longer surveys

MnDOT Online Community Informs SCorE WZARD

As a means for advancing Minnesota Department of Transportation's strategic directions of safety and mobility, the Safe Corridor Enhancements (SCorE) WZARD project was developed to reduce the potential for collisions between snow plows and vehicles during snow and ice operations along the I-94 corridor. The WZARD project uses new and existing technology on the corridor and combines real-time data from MnDOT maintenance vehicles with information gathered through the maintenance decision support system. The automated vehicle location (AVL)-equipped fleet vehicles "trigger" the posting of messages announcing vehicle presence as they enter into special zones along the corridor.

The SCorE WZARD project benefited from MnDOT's Online Community to gain insights on what types of messages should be displayed to motorists. About 250 responses were received from the Online Community. Survey respondents overwhelmingly preferred messages that used the words SNOW PLOW (as opposed to MAINTENANCE VEHICLE) because the message was explicit about what was ahead on the road. They also preferred two-phase messages because the "flashing effect" drew more attention to the sign message.

~ **from Inciter, Destination Innovation Project Safe Corridor Enhancements (SCorE) – Work Zone Application Reduction Deployment (WZARD)**

Fall 2011, Volume 28, Number 5.

▌ Social Media for Marketing Research Surveys

With the advent of social networking through venues such as Facebook, Twitter, LinkedIn, and the like, agencies can disseminate information and elicit feedback from their stakeholders and customers directly. Many companies have embraced social media as a data source, and it is becoming increasingly accepted by government agencies as a mechanism for measuring the frequency and sentiment of customer conversations. According to a 2012 survey conducted by the American Association of State and Highway Transportation Officials (AASHTO), many State DOTs are actively using Twitter, Facebook, and a variety of other social media tools to reach the public. Among the various new social media tools, respondents found Twitter (88 percent), YouTube/Vimeo or similar site (56 percent), and Facebook (76 percent) to be the most effective in reaching their primary audiences.

Using monitoring tools, text mining, and strong analytics and research expertise, agencies are gleaning meaningful analysis and actionable insights from social media data. In essence, social media research is becoming a proxy for qualitative or focus group research. It can complement other forms of research or be a stand-alone tool for researchers.

Social media research presents limitations similar to those associated with Web-based surveys and panels. Of predominant concern is the representativeness of the research. Because of this, social media-based research data is qualitative in nature, and it is often considered to be directional—it can provide valuable insight about a target audience's opinions and positions on issues. In addition, the massive amount of content generated by social media requires considerable skill with the techniques for analyzing comments and may give the impression that it can be quantified; however, the issues of data accuracy (correctly and adequately categorizing the information) and representativeness make this impossible.

A final consideration when weighing whether to use social media as a research method is that governmental regulations with respect to privacy, data protection, and intellectual property and social media sites

are still in formative stages. Meanwhile, the Council of American Survey Research Organizations has published social media research guidelines to address methodological issues developing in the wake of social media research's emergence (see http://www.casro.org/pdfs/1011/Social_Media_Research_Guidelines.pdf).

The MnDOT Web site is a good example of the effective use of social networking tools to conduct outreach and market research for both current and future projects. MnDOT includes a research section that provides links to existing articles, as well as an avenue to connect with MnDOT through the various networking sites. The following figure shows the MnDOT Transportation Research page.

Strengths	Limitations
• Can be a proxy for traditional qualitative methods such as focus groups • Requires little to no research logistics burden • Quick and efficient (no setup costs, travel or moderation) • Provides a snapshot of information from the past and in real-time	• Requires proficiency with social media tools and techniques for analyzing comments (sentiment and content analysis) • May not be representative of the research audience • Demographic and geographic data for participants are generally unavailable

Another example of social media as a marketing research mechanism is the Kansas Transportation Online Community, or K-TOC. The Kansas DOT launched K-TOC in 2009 as one of the nation's first government-sponsored online communities. The Web site-based community served as a virtual meeting place and conversation center for the Kansas transportation community for nearly 2 years. By 2011, the Web-based community was transferred to the Facebook venue after growing to over 1,100 active participants and playing a major role in several transportation initiatives, including raising awareness of Put the Brakes on Fatality days and National Work Zone Awareness Week.

Smartphones for Surveys

An emerging technology when it comes to market research and surveys, smartphones are slowly making their mark as a viable alternative to other methods. According to a Pew Foundation study, 46 percent of American adults are smartphone owners as of February 2012, and ownership of smartphones has now surpassed that of normal mobile phones. The proliferation of smartphones, tablet computers, and other wireless Internet-capable devices is among the reasons more States are looking to make their information more accessible to mobile devices. ASSHTO's 2012 Social Media Survey revealed that 62 percent of State DOTs' information is available in mobile-friendly formats. Nearly a third of States offer some kind of mobile device "app," for Apple devices, Android devices, or both. However, only 38 percent of State DOTs offer content that is optimized for mobile Web browsers. Mostly the mobile information is aimed at travelers, offering access to traffic information and 5-1-1 systems. *A note of caution:* Transportation agencies need to be careful about how they use Smartphones for Surveys, in that they don't want to appear to be encouraging people to be texting while they drive.

Smartphone surveys can be a quick and interactive way of engaging people in marketing research. Compared to normal mobile phones, smartphones provide a larger screen, run faster, and have an Internet connection as a built-in feature. Smartphone surveys are generally shorter than both online surveys using a desktop and telephone surveys. A smartphone survey consists of a few questions and smaller graphics; generally, there is only one question given on one page.

Quick response, or QR, codes are increasingly being used with smartphone surveys. This bar code technology offers the ability to embed a Web site link within a two-dimensional Rorschach test-like image. A person with a smartphone can snap a photo of the QR code and instantly open the phone's browser to a survey link.

Case Study: Blackberry Solution Used for Roadside Surveys on Child Seat Safety

Challenge: The team was tasked to create a mobile strategy for conducting a National Child Seat Safety Survey across Canada. The researchers needed a solution for AUTO21 students to be able to gather the data accurately and download the data automatically to an analytical database.

Solution: A custom, Web-based application was created by the AUTO21 team using the BlackBerry Enterprise® Solution already at the university. Students used BlackBerry® smartphones to complete the surveys, which were instantly uploaded to a database for analysis.

Benefits:

- Less time needed to complete surveys in the field.

- Saves data entry time and related costs for transporting and entering data.

- More robust data and insight into child seat safety.

- Can be applied to other uses.

Strengths

- Best for shorter length surveys and uncomplicated questions

- Good for surveys requiring mapping or geolocation features

- High completion rates if they survey is short and uncomplicated

Limitations

- Screen size makes longer surveys not very user-friendly and may take longer than a desktop online survey to complete

- Not useful for complicated question or visuals (grids, diagrams)

- Respondents must own a smartphone

- Respondent is often multitasking while on a smartphone; may not have full attention

F.R.O.G.—Jump on Board

The Washington State Transportation Commission is successfully leveraging the latest marketing research technology in survey panel management and digital surveys to better serve Washington State Ferry (WSF) riders and communities. The Ferry Riders Opinion Group (F.R.O.G.) was launched in 2010 as a means to continuously monitor rider experience. Passenger feedback is collected through a smartphone feedback system using quick response (QR) codes that allow riders to share their opinions of their ridership experience.

The Washington State Legislature was so impressed by the usefulness of F.R.O.G that a new statewide transportation survey panel was funded.

~ From How a F.R.O.G. Keeps Washington State Ferries Afloat: A ridership case study, Survey Analytics

▌*Geodemographics*

The science and practice of geodemographics are concerned with analyzing people, groups, and populations based on tight coupling of who they are and where they live. The "who" in this formula can provide information about an individual's likely economic profile, social status, potential political affiliation, and so forth, essentially classifying people into various socio-demographic and socio-economic bins. The "where" part of the equation identifies what part of a city, postal code, or neighborhood in which the individual resides, for the purposes of allying them to their neighboring property markets, crime statistics, retail landscapes, and so on, placing them in a particular spatial cluster.

Together, this information allows researchers to index populations by lifestyle types, situated in market catchment areas, and tagged with particular geodemographic targets or value-platforms. These tags are used to guide a host of activities, from drawing polling samples across the full range of geodemographic groups, to targeting mass-mailing campaigns or identifying advantageous placement of roadside billboards.

The increasing fusion of mobile telecommunications technologies with locative technologies based on geographic positioning systems (GPS) or positional triangulation from time of delivery (TOD) across cell towers and Wi-Fi access points opens up a new environment for mobile geodemographics.➔

➔ Section 6: Making the Most of the Information— Data Analysis and Tools

This section describes the classification of marketing research with regard to the end use of the data (i.e., how you intend to analyze and use the collected data). It presents a brief discussion and definitions of data types and measurement scales before reviewing several of the routine and higher-level analyses often used to put data to use.

Marketing research can be classified in one of three categories:

1. Exploratory research – useful for formulating problems precisely, clarifying concepts, gathering explanations, gaining insight, eliminating impractical ideas, and forming hypotheses.

2. Descriptive research – a more rigid form of research that seeks to describe users, determine the proportion of the population that uses the product/service, or predicts future demands. There are two types of descriptive research: (1) longitudinal studies, or time series analysis that makes repeated measurements of the same individuals, and (2) cross-sectional studies, which sample the population to make measurements of specific moments in time.

3. Casual research – seeks to find cause and affect relationships between variables through laboratory and field experiments.

❚ *Data Analysis*

Before data can be analyzed, raw data must be transformed into the right format as follows:

1. Edited for errors so they can be corrected or omitted.

2. Coded into numbers or symbols (and the coding method must be documented).

3. Tabulated using either basic or cross tabulations and analyzed.
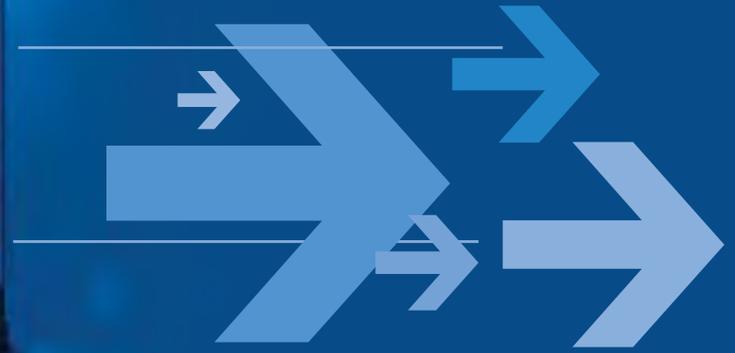
The following provides an overview of tabulations and higher-level analyses.

Basic tabulation counts the number of occurrences of each variable independently of other variables (for example, tabulation of data on U.S. population classified by one characteristic, income, or race).

Cross tabulation is the most common type of data analysis in marketing research. It is used to analyze relationships between two variables. If a questionnaire asks the respondent his or her (1) race, (3) gender, (3) level of education, and (4) opinion on the death penalty, analysts could determine people's opinions on the death penalty in those particular fields. Also, the more fields, the more detailed one might go, depending on the number of respondents in those fields. If, for example, there were only two or three Asian women with PhDs responding, it would be risky to assume that all Asians with PhDs felt the same way about the death penalty. If there were 200 such respondents, such assumptions would be more defendable.

▮ *Importance-Performance Analysis (IPA)*

IPA, also known as action grid analysis or top box analysis, is a popular, low-cost, easily understood way to organize information about the attributes of a product or service and provide strategies for businesses to set priorities for potential change or improvement. IPA involves gathering formal and informal data to help decision-makers define and achieve their goals. It uncovers several perspectives on a problem or opportunity, determining any and all drivers towards, or barriers to, successful performance and proposes a solution based on what is discovered. The IPA matrix is two-dimensional based on the following questions:

1. How important is the quality characteristic being measured?

2. How is the organization's performance with regard to the quality characteristic?

Once the importance and performance (typically measured as level of satisfaction with the quality characteristic) of each attribute have been plotted, the resulting importance-performance (IP) space is divided into four quadrants. The priorities for improving the attributes of the service are then inferred from the quadrant where each attribute (performance or satisfaction, and importance point) is located.

By examining the points in each quadrant, a decision-maker may infer which attributes customers feel should be the highest and lowest priorities for improvement. The decision-maker can then consider the costs of various improvements and develop an action plan. Thus, IPA provides a simple graphical representation of how customers feel about the business, service, or product, and some direction for improvement. See a sample IPA matrix on the following page.

Importance-Performance Analysis Matrix

QUADRANT I Concentrate Here High Importance Low Satisfaction	**QUADRANT II** Keep up the good work High Importance High Satisfaction
QUADRANT III Low Priority Low Importance Low Satisfaction	**QUADRANT IV** Possible Overkill Low Importance High Satisfaction

Gridline: Overall Mean for Importance (vertical axis label)

Gridline: Overall Mean for Satisfaction
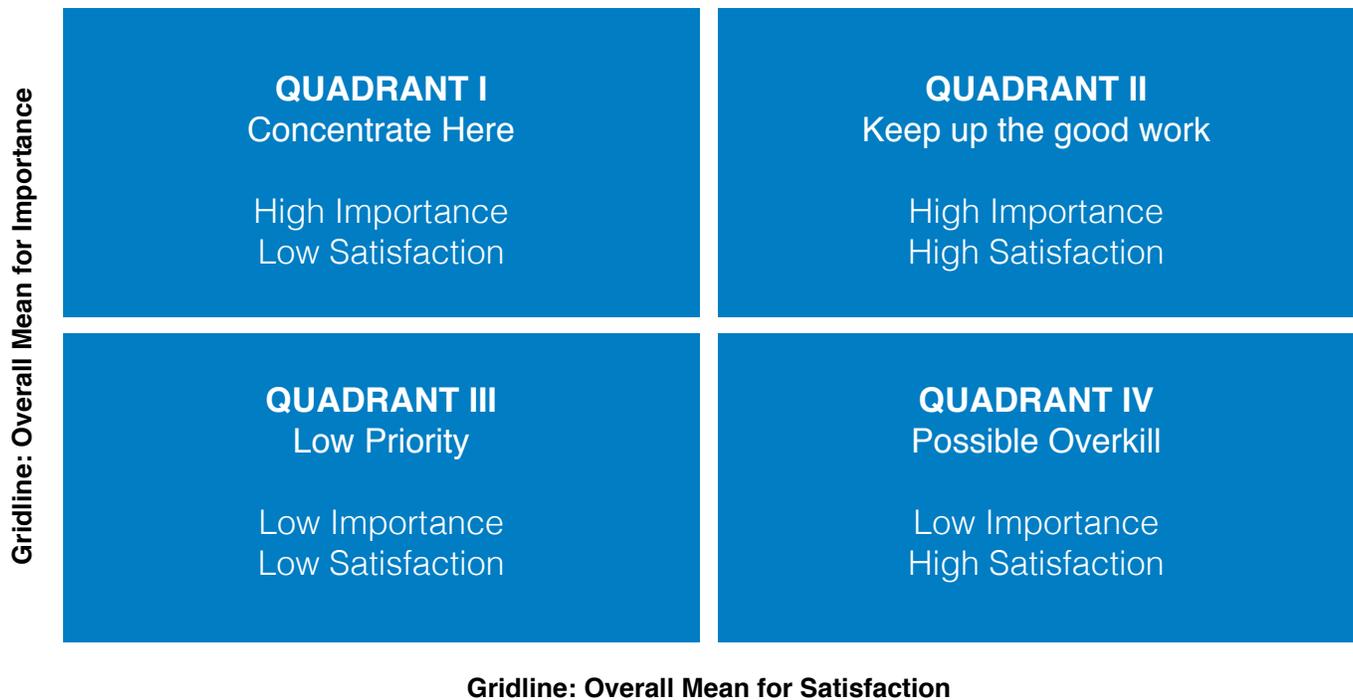
Quadrant I: Attributes are perceived to be very important to respondents, but performance levels are fairly low. This suggests that improvement efforts should be concentrated here.

Quadrant II: Attributes are perceived to be very important to respondents, and at the same time, the organization seems to have high levels of performance in these activities. The message here is to keep up the good work.

Quadrant III: Attributes here are rated as having low importance and low performance. Although performance levels may be low in this cell, managers should not be overly concerned, since the attributes in this cell are not perceived to be very important. Limited resources should be expended on this low priority cell.

Quadrant IV: This cell contains attributes of low importance, but where performance is relatively high. Respondents are satisfied with the performance of the organization, but managers should consider present efforts on the attributes of this cell as being superfluous / unnecessary.

Regression Analysis

Regression analysis is a statistical tool for the investigation of relationships between variables, and it is used to assess the importance of certain variables in explaining interpersonal variations in behaviors or attitudes. For example, how does a price increase affect demand, or how do changes in the money supply drive the inflation rate? To explore such issues, data are assembled on the underlying variables of interest, and regression is employed to estimate the quantitative effect of the causal variables upon the variable that they influence. Typically, "statistical significance" of the estimated relationships is also assessed; that is, the degree of confidence that the true relationship is close to the estimated relationship.

Conjoint Analysis

Conjoint analysis is used to determine what features a new product should have and how it should be priced. By understanding precisely how people make decisions and what attributes they value, decisions can be made that balance value to the customer against project cost. Conjoint analysis was first used in the 1970s and became popular because it was far less expensive and more flexible than concept testing. It is well suited for defining a new product or improving an existing one.

The principle behind conjoint analysis is to break a product or service down into its constituent parts to test combinations of these parts by looking at what customers prefer. By designing the study appropriately, it is possible to use statistical analysis to determine the value of each part in driving the subject's decision. For example, a computer may be described in terms of attributes such as processor type, hard disk size, and amount of memory, with each attribute broken down into levels (such as memory size, which is described as 1GB, 2GB, 3GB, and 4GB).

These attributes and levels can be used to define different products or product profiles. The first stage in conjoint analysis is to create a set of product profiles, which customers or respondents are then asked to compare and choose from. The number of potential profiles increases rapidly for every new attribute, so there are techniques to simplify both the number of profiles to be tested and the way in which preferences are discovered.

Psychographic Market Segmentation

Psychographic segmentation groups audiences according to their lifestyle. Activities, interests, and opinions (AIO) surveys are one tool for measuring lifestyle. ➔

Section 7: What State DOTs Are Doing with Marketing Research

Highways for LIFE projects have demonstrated that when highway agencies focus on the expressed needs and wants of highway users, their projects are more likely to be successful.

A focus on highway users can lead to

1. Increased safety for motorists and workers.

2. Accelerated construction and minimize delays.

3. Improved quality of products.

4. Enhanced user satisfaction.

5. Cost Savings

The user satisfaction goal is designed to assess how satisfied users are with the completed project compared to its previous condition, as well as with the approach the highway agency used to minimize disruption during construction. The HfL goal is a measurement of 4-plus on a 7-point Likert scale. Two examples follow.

The Oregon DOT used prefabricated bridge elements made with high-performance concrete to replace five bridges on Oregon 38. The agency accelerated construction by building the new bridges next to the existing structures and sliding them into place overnight on a rail system. It also used a public involvement program that focused on schools, civic organizations, and businesses to build support for the project and keep it moving forward smoothly. An after-the-fact survey found that 96 percent of respondents were somewhat to very satisfied with the project approach, while 95 percent were satisfied with the final product.

MnDOT used a full-road closure to rebuild part of a major road and busy interstate interchange in North St. Paul. A survey conducted afterwards found that 90 percent of residents and 83 percent of businesses had a positive overall opinion of the project. A comparison of pre- and post-construction surveys showed that two of five respondents changed their opinion on the full road closure approach from negative to positive.

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Indiana Department of Transportation Market Research Project, 2000

The Indiana DOT contracted with an outside agency to conduct market research regarding transportation issues important to the general public and other stakeholders. The results of the study were used to update Indiana's long-term policy plan. The summary of this effort can be viewed in appendix A.

Georgia Department of Transportation

The Georgia DOT's project to build a new interchange on I-85 used a design-build approach with prefabricated bridge elements to speed construction and cut construction-related traffic congestion. The agency set a goal of 80 percent user satisfaction and conducted surveys at the quarter points of project completion. The first survey showed that just 65 percent of users were somewhat to very satisfied with the project, while 35 percent were somewhat to very dissatisfied. The survey also found that respondents who had received information on the project were more satisfied. The agency increased its communication activities, including updating messages on the project hotline, mailing postcards to residents on upcoming lane closures and construction work, installing portable message boards in the project area, and distributing a news release. The final survey determined that user satisfaction had increased to 91 percent.

Minnesota Department of Transportation

The MnDOT Office of Policy, Analysis, Research and Innovation employs several effective marketing research efforts to assist in the planning and decision-making processes for future projects. For example, MnDOT conducted market research during the reconstruction of Trunk Highway 36 in the spring of 2007. The research allowed MnDOT to evaluate the impact of this full-road closure project through real-time data collection and comparison with partial closure projects. What made this project successful was that the goals were clearly defined upfront. During the project, researchers tracked the percentage volume difference in traffic on alternative routes during the time TH-36 was closed. After the project was completed, researchers interviewed key stakeholders to get their input on the project regarding planning and execution, public relations and reaction, and overall lessons learned. As a result of this approach, MnDOT found that full closure is a viable, cost-effective alternative under certain circumstances, like the TH-36 project. They also gained valuable knowledge and tools that can be used to evaluate future project alternatives.

MnDOT also reached out to its customer base for the Bare Pavement Survey, which focuses on snow and ice removal. A 1999 survey determined that drivers were willing to accept a level of snow removal that was less stringent than what had been called for in the DOT's guidelines; as a result, the guidelines were revised. The survey was conducted again in 2007 to determine if the guidelines were still acceptable to drivers. For the 2007 survey, MnDOT added focus groups to the methodology to further explore the reasons behind the quantitative findings in 1999. During the focus groups, participants were shown videos of various highway conditions and recorded their reactions to each video on self-administered questionnaires assuming a certain set of driv-

ing conditions (e.g., inches of snow, time of snowfall, and wind conditions). The survey results indicated that current guidelines of bare pavement were appropriate for all roadway types if achieved within 3 hours of the snowfall; after 5 hours, the acceptability level dropped considerably. Using this quantitative approach, MnDOT was able to successfully gauge their customers' perceptions of acceptable road and driving conditions. The further inclusion of videos to accurately portray these conditions allowed MnDOT to determine the level of service and resources required to meet or exceed customer expectations.

▎ *Utah Department of Transportation*

The Utah DOT strongly encourages public involvement as part of their planning and decision-making processes. In fact, Utah's Context Sensitive Solutions (CSS) is a philosophy that guides the Department wherein safe transportation solutions are planned, designed, constructed, and maintained in harmony with the community and the environment. CSS balance safety, mobility, and transportation needs while preserving scenic, aesthetic, historic, cultural, environmental, and community values. The CSS section of their Web site includes a link to specific case studies where community outreach and research was conducted in the form of neighborhood/town hall meetings, Web site surveys, printed comment cards, project phone lines, etc. The results of this research have allowed the DOT to maintain a positive relationship with the community throughout all phases of construction, from planning and design to implementation. For more information on Utah DOT's Research Division and community outreach programs, visit http://www.udot.utah.gov.

▎ *Massachusetts Department of Transportation, I-93 Fast 14 Survey*

Between June and August 2011, the Massachusetts DOT (MassDOT) initiated a historic project to replace 14 bridges in Medford over 10 weekends. The project, known as 93 Fast 14, was conducted on I-93—one of the most heavily traveled roads in New England. This is considered to be one of the most ambitious and successful bridge replacement projects in the country.[1]

MassDOT used cutting-edge accelerated bridge construction techniques and materials to replace the bridges. All associated work was completed in less than a year. Using conventional methods, it would have taken 4 years or more years to replace all 14 bridges, and drivers would have had to endure long-term lane closures. In addition, MassDOT executed a traffic management plan and a comprehensive communications plan to minimize construction-related congestion and community impacts during construction (which was limited to off-peak hours).

With the support of the HfL program, MassDOT implemented a post-construction survey of customers affected by the roadway construction within the immediate vicinity of Medford. The survey assessed community residents' and drivers' overall satisfaction with the construction effort, elicited their opinions regarding the impact of the construction on their community and their use of the highway, and measured the effectiveness of communications throughout the construction period. The full I-93 Fast 14 Survey Final Report can be found in appendix B.➔

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1   For details on 93 Fast 14, see http://93fast14.dot.state.ma.us/

Appendix A: Examples of Marketing Research Done for Highway-Related Activities

Federal Highway Administration 2005 Traveler Opinion and Perception (TOP) Survey, November 2005

For a number of years, FHWA undertook a national highway user survey every five years. The most recent such survey was conducted in 2005, with the report published in November of that year. The survey results can be used to identify areas of improvement with regard to traveler satisfaction. The 2005 survey was conducted via telephone. The full report can be viewed at http://www.fhwa.dot.gov/reports/traveleropinions/index.htm .

Putting Customer Research into Practice (NCHRP Project 20-07/Task 260), December 2009

The objective of this research was to integrate existing highway maintenance-related market research and customer survey activities, as well as to provide illustrative examples. The final report includes the following:

1. Documentation of current customer survey practices at State DOTs related to highway maintenance, including cost.

2. What customers are being surveyed—for example, different modal users such as truckers, bicyclists, etc.

3. Current strategies of market research: focus groups, phone surveys, etc.

4. How States are interpreting, reporting (both internally within the DOT and externally as part of public outreach), and internally using the data collected.

5. How market research results have impacted DOT decision-making in terms of how funds were allocated to the various programs.

The case studies chosen as examples in the final report had to meet the following selection criteria:

(1) the candidate has "institutionalized" customer research within their maintenance operations and are conducting customer research on a "continuous" or regular basis (a repeat of the same or similar research every few years), (2) the candidate state's survey of focus follows good research practices, and/or (3) the candidate has overcome issues or obstacles in conducting customer research and/or has applied research data to program decision making.

Based on these criteria, the following six programs were selected as having "institutionalized" customer research into maintenance operations:

1. Florida Department of Transportation: Since 2000, Florida DOT has engaged customer input using a cycle of qualitative and quantitative research as part of its performance measurement program. The agency has clearly delineated six customer segments: residential travelers, commercial customers, government officials, visitors, special needs customers, and property owners affected by transportation construction. Customers are further segmented geographically (northern, central, and southern parts of the State). The process for integrating customer research into performance measurement has been documented in many case studies.

2. Maryland State Highway Administration Customer Survey: The Maryland State Highway Administration conducts a biennial customer survey to assess customer satisfaction with agency operations. In doing so, the agency has purposefully worked with its maintenance program to craft questions included in the survey on maintenance operations. Furthermore, the maintenance program has routinely used the results of the survey to track performance and to make budgetary decisions regarding program improvements and set priorities.

3. Minnesota Department of Transportation: To incorporate the customer voice into maintenance operations, MnDOT has built significant internal capacity to conduct research and has instituted and conducted a number of customer research efforts focused on maintenance, including an annual survey and focus groups on maintenance practices and intercept and personal interviews with roadway users and employees.

4. Missouri Department of Transportation's Transportation Customer Survey: The Missouri DOT conducts a number of customer surveys including a statewide survey since 2000. The survey measures customer satisfaction on the organization's performance on a whole, but also includes questions specific to the maintenance division's needs. The survey was refined in 2003.Conducting this and other surveys (rest stop, parking lot) contributed to the creation of the agency's performance management system, which directs budgets, monitors progress on maintenance operations, and forecasts needs.

5. Pennsylvania Department of Transportation Customer Surveys: With a long history of putting customers first and considering their needs, the Pennsylvania DOT uses customer information to drive its decision making in a number of ways. While many case studies already review how the agency's customer research has evolved over the past 20 years; this case study focuses on those efforts specifically targeting highway maintenance operations and how this well developed process has impacted maintenance operations and resource decisions.

6. Washington Department of Transportation Maintenance Customer Surveys: The Washington State DOT has collected customer data focused on maintenance operations beginning in 1997. The DOT was motivated to conduct customer research as a result of a study recommendation, which led to the development of the organization's Maintenance Accountability Program (MAP). The first survey set MAP level of service targets, and subsequent surveys have assessed customer satisfaction against the baseline data and tracked trends.

The NCHRP final report and an appendix are posted at:

http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP20-07(260)_FR_Volume1.pdf

http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP20-07(260)_FR_Volume2.pdf

➔ Appendix B: I-93 Fast 14 Survey

Methodology

Background

Between June and August 2011, the Massachusetts Department of Transportation (MassDOT) initiated a historic project to replace 14 bridges in Medford over 10 weekends. The project, known as 93 Fast 14, was conducted on I-93—one of the most heavily traveled roads in New England. This is considered to be one of the most ambitious and successful bridge replacement projects in the country.

MassDOT used cutting-edge accelerated bridge construction (ABC) techniques and materials to replace the bridges. All associated work was completed in less than a year. Using conventional methods, it would have taken 4 years or more years to replace all 14 bridges, and drivers would have had to endure long-term lane closures. In addition, MassDOT executed a traffic management plan and a comprehensive communications plan to minimize construction-related congestion and community impacts during construction (which was limited to off-peak hours).

With the support of the Federal Highways Administration (FHWA) Highways for LIFE (HfL) program, MassDOT implemented a post-construction survey of customers affected by the roadway construction within the immediate vicinity of Medford. The survey assessed community residents' and drivers' overall satisfaction with the construction effort, elicited their opinions regarding the impact of the construction on their community and their use of the highway, and measured the effectiveness of communications throughout the construction period.

Study Design

Questionnaire Design

The questionnaire included two critical questions that the HfL program recommends for customer satisfaction assessments:

1. How satisfied is the user with the new facility, compared with its previous condition?

2. How satisfied is the user with the approach used to construct the new facility, in terms of minimizing disruption?

The questionnaire also covered respondent perceptions of construction-related impacts on day-to-day living and driving, construction-related communications, and basic demographics. The online and print versions of the questionnaire are included in the appendix to this report.

Sample Population

A challenge with this study was determining who to survey. The research team sought to identify a study population which was clearly or possibly affected by the construction. Due to the highly urban setting of the construction project, the study population was designed to include regular drivers (local residents and businesses, regular commuters), irregular drivers (vacationers, intrastate route truck drivers, etc.), bus riders, and local residents who may not necessarily use the roadway.

Survey Mode

The most practical method for administering the survey was using self-administration via online and paper modes. This allowed for the use of a non-probability based sampling approach in which study participants could be invited to participate in the survey by (1) sending invitations via e-mail to a MassDOT list of approximately 2,000 stakeholders, (2) placing a "take this poll" or "tell us what you think" box on the MassDOT I-93 Fast 14 website and other locations, and (3) handing out survey forms (postage paid returned mail) at public events, meetings, or other public locations.

Data Collection

Data were collected between December 2011 and June 2012. A total of 421 surveys were completed.

Limitations

As a non-probability based sample, the probability of selecting a given respondent is unknown, and there is no way to know how well or how badly the sample represented the views of the total population. The "sample" is people who happened to be on that website or received a paper version of the survey and decided to answer the questions. There is no way to know who answered and who opted not to answer, and therefore, there is no way to know what the "total population" would be. Therefore, these survey findings are representative of those who participated in the survey and may not necessarily represent the total population.

Respondent Characteristics

Age

As shown in Table 1, most survey participants were between the ages of 45 and 64. Only 2 percent of survey participants were between 18 and 24 years old.

Gender

As shown in Table 2, over 60 percent of survey participants were male. About 5 percent declined to provide gender information.

Table 1. Respondent age.

Age	Count	Percent
18-24 years	8	2
25-34 years	35	8
35-44 years	69	16
45-54 years	128	31
55-64 years	94	23
65 years and older	82	20
Total	416	100

Table 2. Respondent gender.

Gender	Count	Percent
Male	253	60
Female	148	35
Declined to identify	20	5
Total	421	100

Residence by Zip Code

Figure 1 is a map showing the locations of home zip codes reported by survey participants, with zones indicating distance from the centroid of the respondent's zip code to the construction location (zip code 02115).

Survey participants were classified by their home zip codes into one of four zones. As shown in Table 3, the majority (41 percent) lived within the centroid zip code (02115) or within 5 miles of the centroid area (28 percent).

Table 3. Respondent residence by zone.

Gender	Count	Percent
Study area centroid (20115)	167	41
5-mile buffer from centroid	117	28
10-mile buffer from centroid	42	10
10+ miles from centroid	85	21
Total	411	100

Figure 1. Map. Survey participants by home zip code.

Roadway Use

Overall, survey respondents were frequent users of the portion of I-93 going through Medford. As shown in Table 4, just under half of the respondents reported using this roadway almost every day (47 percent), and nearly a third (27 percent) used it several times a week. Only 1 percent said that they never use that portion of I-93.

Table 4. How often do you use I-93?

Response	Count	Percent
Almost every day	198	47
Several times a week	113	27
Once a week or less	66	16
Once a month or less	36	9
I never use this section of I-93	5	1
Total	418	100

Similarly, the majority of respondents were frequent users of local roads in Medford other than I-93 and excluding construction-related detours. As shown in Table 5, most use local roads almost every day (43 percent) or several times a week (20 percent).

Table 5. How often do you use local roads?

Response	Count	Percent
Almost every day	179	43
Several times a week	82	20
Once a week or less	59	14
Once a month or less	64	15
I never use local Medford roads	34	8
Total	418	100

Key Findings

Satisfaction Levels

As noted earlier, the user satisfaction survey was distributed after the I-93 construction was completed. Overall, participants indicated that they were satisfied with the condition of I-93 in Medford now, as compared to its previous condition. On a scale of 1 to 5, with 1 being very satisfied and 5 being very dissatisfied, the average rating was 1.3. Fewer than 7 percent of respondents indicated some level of dissatisfaction, as compared to 78 percent who indicated that they were very satisfied with conditions now. Figure 2 shows a breakdown of the survey responses.
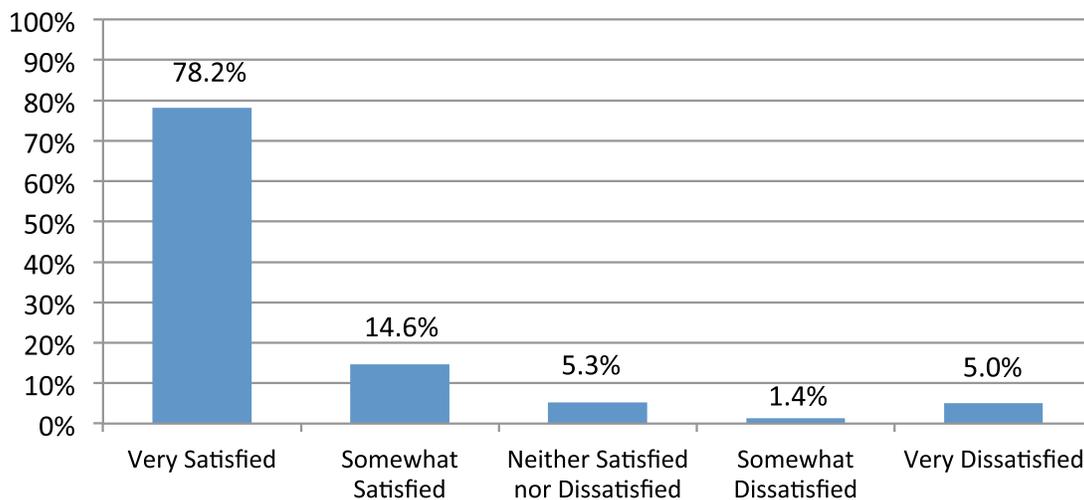
Figure 2. Chart. Overall satisfaction levels (N=418).

Similarly, frequent users of I-93 were the most likely to report high overall satisfaction with the condition of I-93 in Medford now as compared with its previous condition. These were also the only two cohorts in which any respondents reported being very dissatisfied with the condition of I-93 in Medford now, as compared with before the construction. See Figure 3 for a breakdown of satisfaction levels by frequency of I-93 use.

Those residing further from the construction tended to report a higher level of satisfaction with the project than those residing closer to the construction. Figure 4 provides a breakdown of responses by respondents' home zip code.
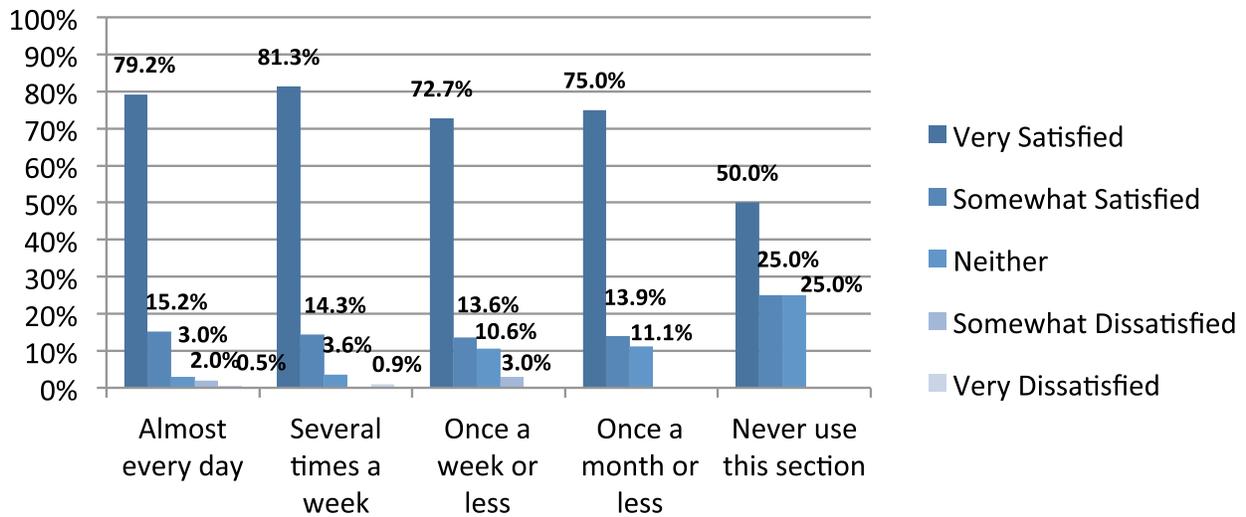
Figure 3. Chart. Satisfaction levels by frequency of I-93 roadway use.
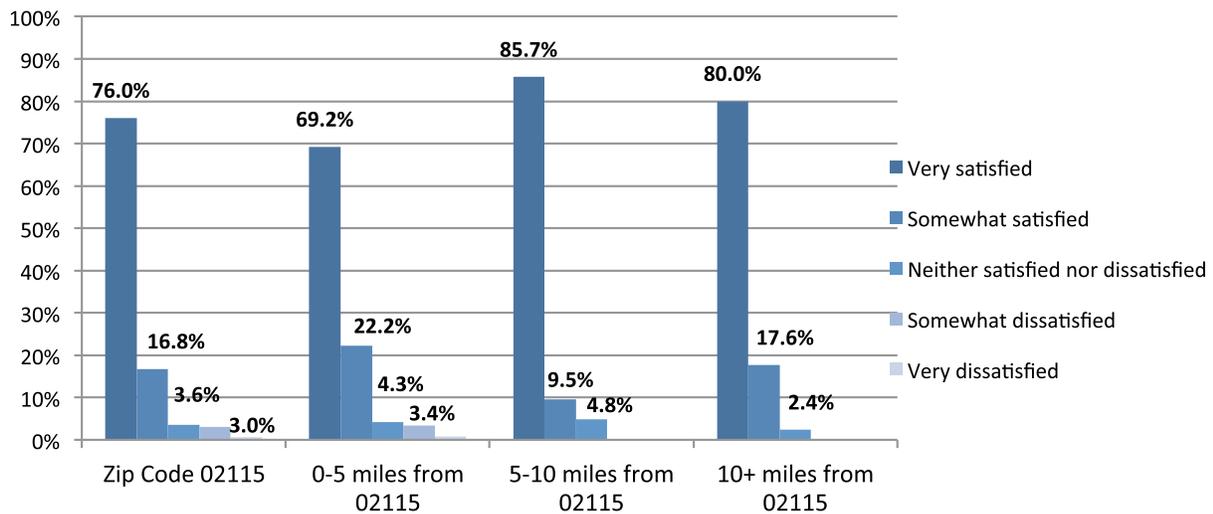
Figure 4. Chart. Satisfaction with the Fast 14 project by residence proximity to construction zone (N=411).

Opinions on Construction Methods

When presented with a brief description of the ABC and conventional construction methods and asked which construction method they would prefer, 83 percent said that they strongly prefer ABC and only 2 percent said they strongly prefer the conventional construction method (see Figure 5).
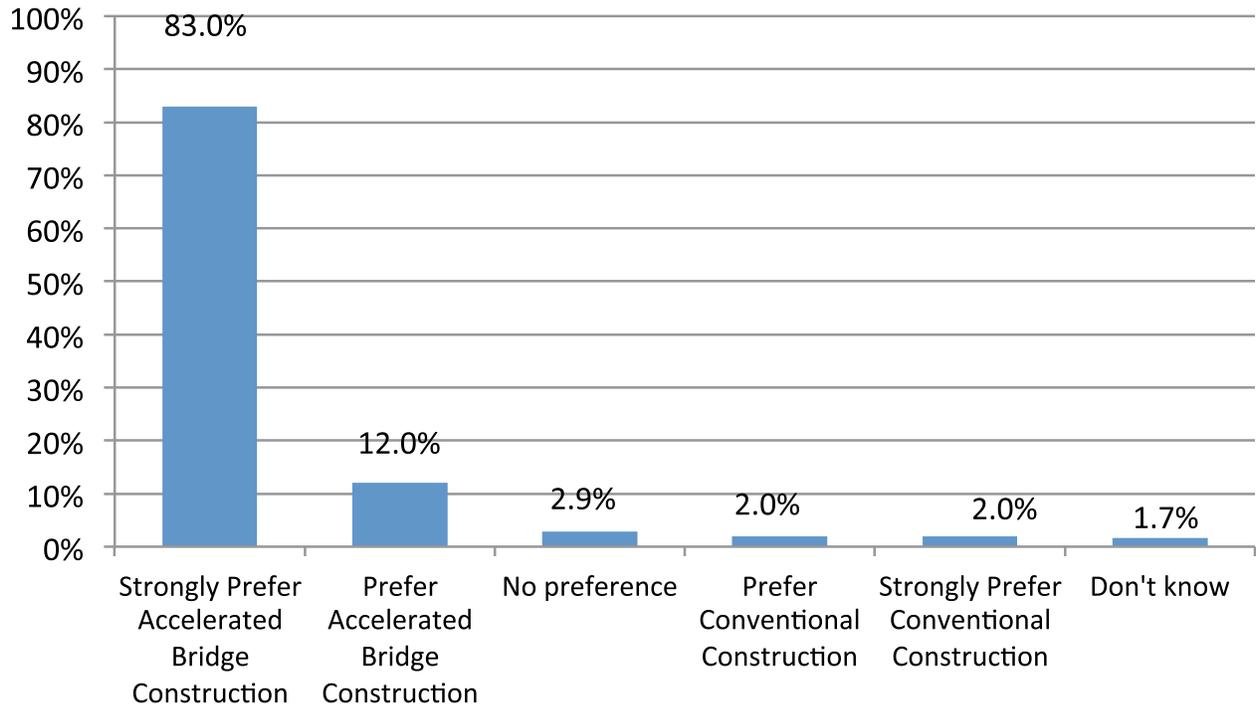
Figure 5. Chart. Construction method preference (N=417).

Those who preferred ABC were asked what they liked about it. As shown in Figure 6, the most common response was that ABC involves a "shorter timeframe," followed closely by "less disruption and/or delays.
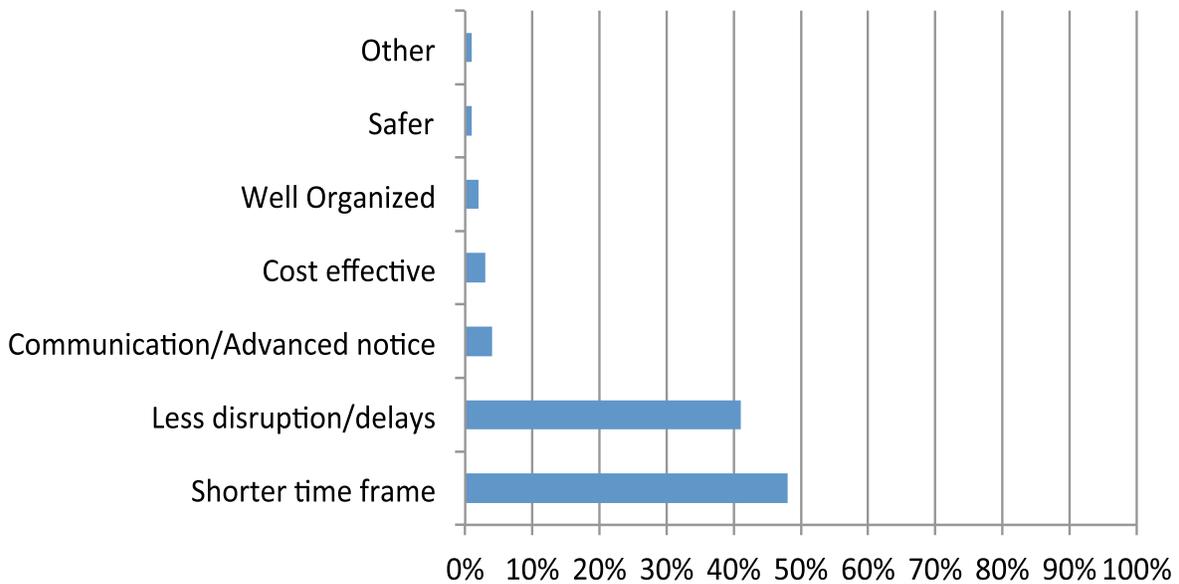
Figure 6. Chart. What do you like about accelerated bridge construction? (N=421)

Impact of I-93 Fast 14 Project on Daily Lives

Survey respondents were asked to rate the impact of the I-93 Fast 14 project on their lives. The reported impact was overwhelmingly positive, with over 77 percent of respondents indicating that the project had either a "very positive" or "somewhat positive" impact on their lives. Figure 7 provides a breakdown of these responses.
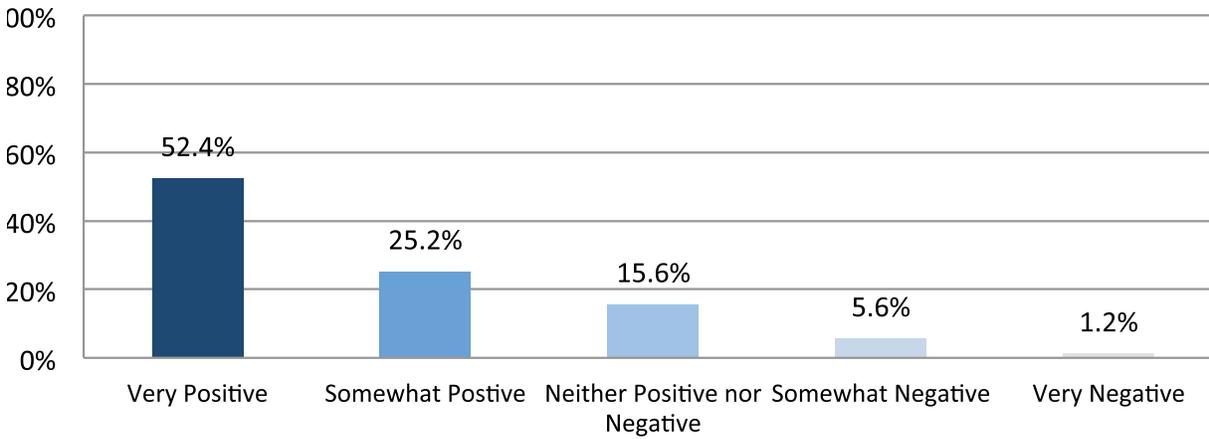
Figure 7. Chart. Impact of the I-93 Fast 14 project (N=416).

Those who indicated that the Fast 14 project has had a positive impact on their lives were asked to indicate the greatest positive impact. As shown in Figure 8, 24 percent thought the road now is less disruptive, 22 percent mentioned that the road is now safer, and 19 percent said that the I-92 corridor in Medford now has a better surface, creating a smooth ride.
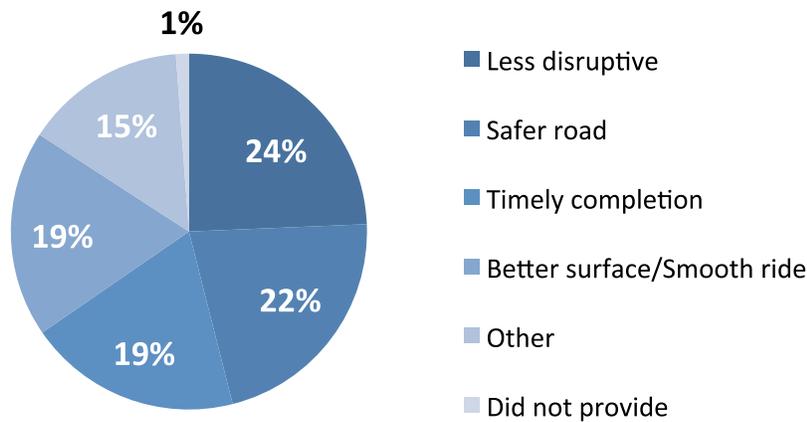
Figure 8. Chart. Distribution of largest positive impact (N=341).

Similarly those who indicated the Fast 14 project had a negative impact on their lives were asked to describe the greatest negative impact. As shown in Figure 9, traffic jams and delays were the most frequently reported negative impacts (36 percent), followed by having to learn the detour routes (21 percent) and the noise (20 percent).
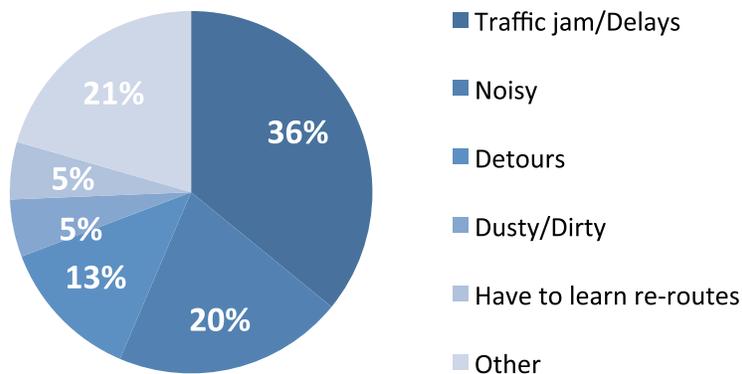
Figure 9. Chart. Distribution of largest negative impact (N=39).

I-93 Fast 14 Project Communications

MassDOT used several methods to get the news out about closings and detours so that local residents, business owners, and road users could be prepared. As shown in Table 6, most of the survey respondents encountered the project website and the electronic signage along the roadway, and about half received the e-mail from 93fast14.info@state.ma.us.

As shown in Figure 10, when asked about the source of information they used to stay informed about construction activities during the construction period (road closures, project schedule, etc.), most survey respondents reported they used the website, the e-mail from MassDOT, or the electronic signage along the roadway.

Table 6. Project-related information sources encountered (multiple response).

Response	Count of Responses	Percent of Respondents
The 93 Fast 14 website	282	70.9
Electronic signage along the roadway	273	68.6
E-mail from 93fast14.info@state.ma.us	198	49.7
Segments on local television news programs	145	36.4
Items in local newspapers	126	31.7
Traditional signage along the roadway	119	29.9
"Reverse 911" phone calls	110	27.6
Project coverage on the radio	87	21.9
FastLane reminder e-mail	66	16.6
Billboard	48	12.1
MassDOT blog	39	9.8
Public hearing or public information session	33	8.3
Article in newsletter (from any organization)	32	8.0
Flyer	30	7.5
Twitter	29	7.3
Other community meeting or stakeholder briefing	22	5.5
Information on public access television	18	4.5
511 or Sendza	13	3.3
YouTube	9	2.3
Flickr	8	2.0
Sign on bus or at bus stop	6	1.5
Handout at tollbooth	6	1.5
Poster at FastLane office or rest area	5	1.3
Through a place of worship	3	0.8
Other (specify)	15	3.8
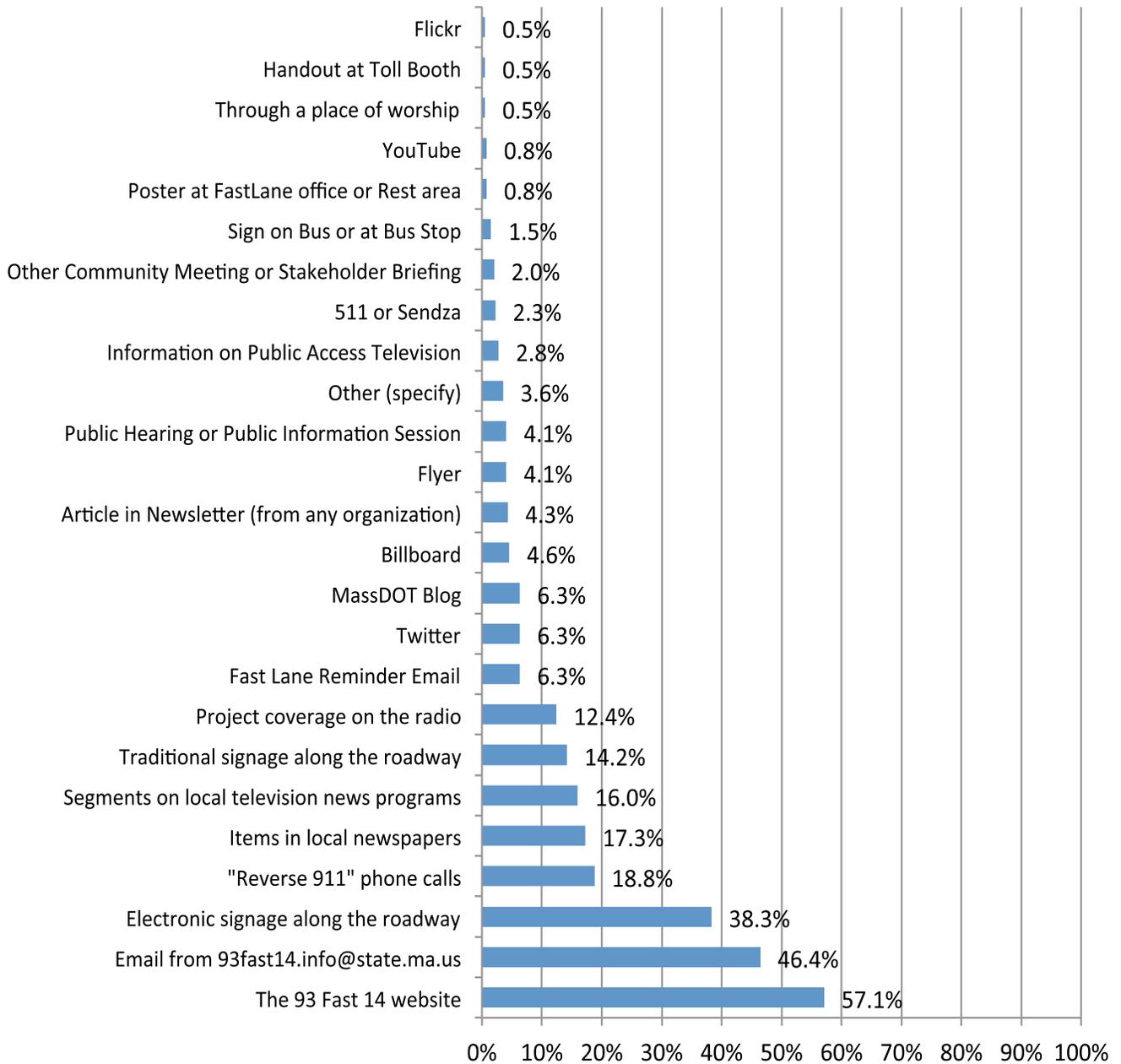
Figure 10. Chart. Information sources used to keep informed (multiple response).

Source	Percentage
Flickr	0.5%
Handout at Toll Booth	0.5%
Through a place of worship	0.5%
YouTube	0.8%
Poster at FastLane office or Rest area	0.8%
Sign on Bus or at Bus Stop	1.5%
Other Community Meeting or Stakeholder Briefing	2.0%
511 or Sendza	2.3%
Information on Public Access Television	2.8%
Other (specify)	3.6%
Public Hearing or Public Information Session	4.1%
Flyer	4.1%
Article in Newsletter (from any organization)	4.3%
Billboard	4.6%
MassDOT Blog	6.3%
Twitter	6.3%
Fast Lane Reminder Email	6.3%
Project coverage on the radio	12.4%
Traditional signage along the roadway	14.2%
Segments on local television news programs	16.0%
Items in local newspapers	17.3%
"Reverse 911" phone calls	18.8%
Electronic signage along the roadway	38.3%
Email from 93fast14.info@state.ma.us	46.4%
The 93 Fast 14 website	57.1%

As shown in Figure 11, the greatest number of respondents (38 percent) utilized project information to learn about road closures and traffic detours or to learn about the project schedule (26 percent).

Overall, residents reported being very satisfied with the information they received about the project. Fewer than 1 percent of survey participants indicated that they were very dissatisfied with the project information received. See Figure 12 for a breakdown of these responses.
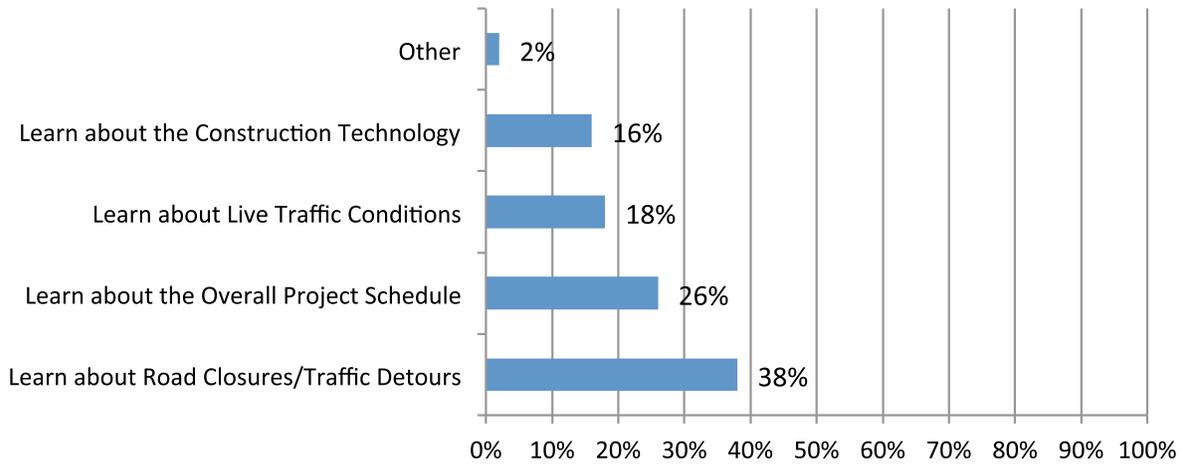
Figure 11. Chart. For what purposes did you utilize project information? (multiple response)
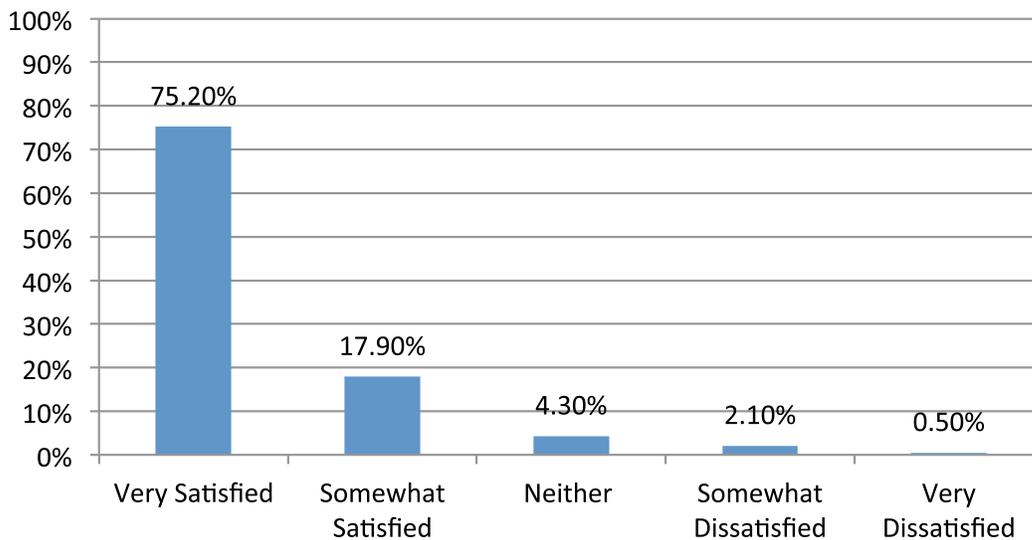
Figure 12. Chart. Satisfaction with project information (N=419).

When asked about the helpfulness of project information in terms of helping to prepare for construction, local road closures, detours, or traffic conditions, respondents indicated overwhelmingly that information was very helpful. As shown in Figure 13, just over 3 percent said that the information could have been more helpful.
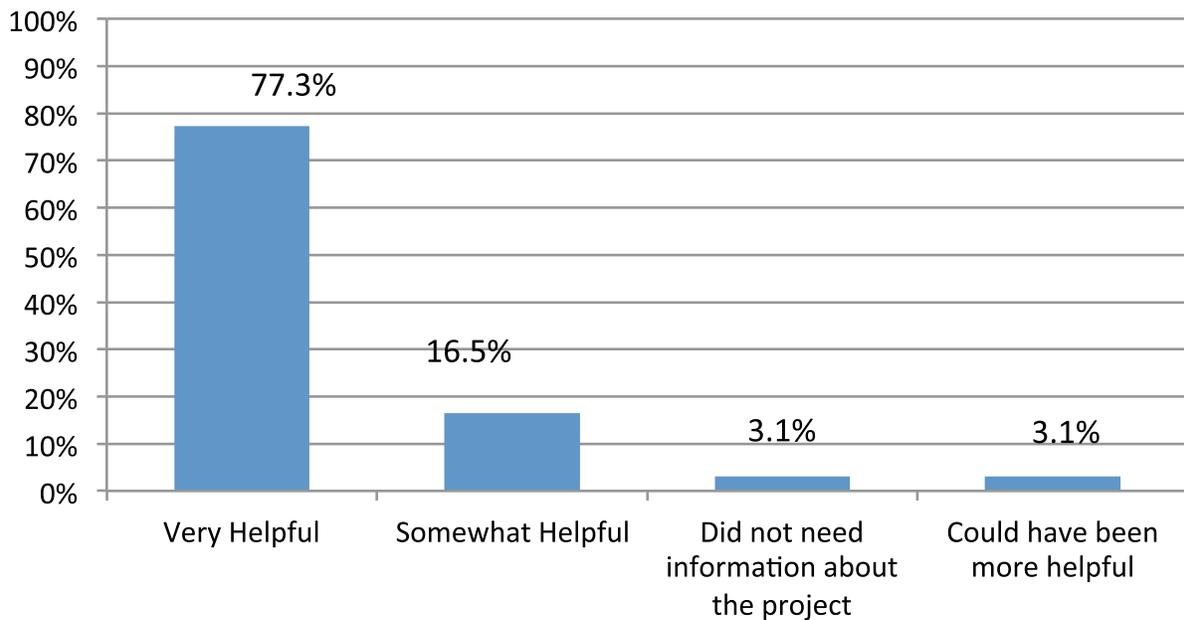
Figure 13. Chart. Helpfulness of project information (N=419).

As shown in Figure 14, participants residing farther from the construction reported that the project information provided was very useful. Four percent of those living within the same zip code, and 4 percent residing up to 5 miles from the construction, reported that the information could have been more helpful.
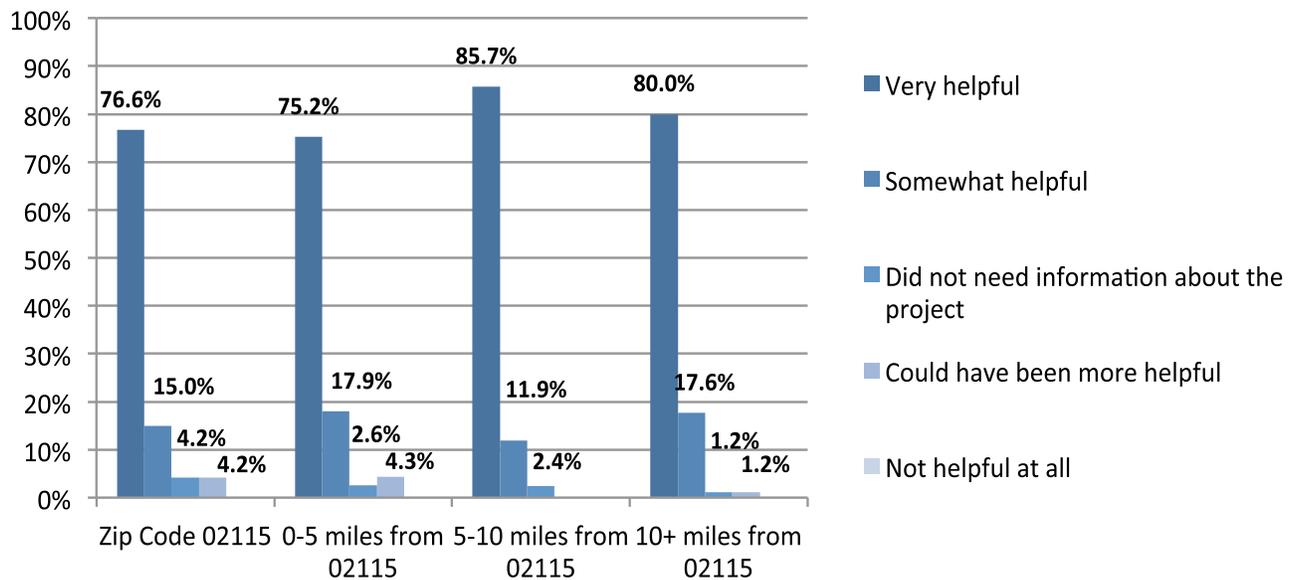
Figure 14. Chart. Perception of project information by residence proximity to construction zone (N=411).

Summary

Most of the survey respondents were frequent users of I-93, and of those, most used this portion of I-93 for driving through Medford.

Overall, survey participants reacted positively to the Fast 14 project and the results of the roadway improvements. Seventy-eight percent reported being very satisfied, and only 1 percent indicated they were very dissatisfied with the condition of I-93 in Medford now, compared to its previous condition.

Nearly all participants indicated a strong preference for ABC methods over the conventional construction approach. The only residents who gave any level preference for the conventional construction were residents from within the 02115 zip code, or those residing up to 5 miles from zip code 02115.

MassDOT undertook a comprehensive plan for informing area residents, businesses, and users of I-93 about the construction project, delays, schedule, etc. The survey results showed that 75 percent of respondents were very satisfied with the project-related information they received. The perceived usefulness of this information seemed to correlate with the distance between the respondent's zip code and the construction. Participants residing between 5 and 10 miles from the construction site reported that the project information provided was very useful. In contrast, 4 percent of those living within the same zip code, and 4 percent residing up to 5 miles from the construction, reported that the information could have been more helpful.

The survey showed that the most encountered information outlets were the Fast 14 website, the electronic signage along the roadway, and an e-mail sent from MassDOT. Primarily, respondents used the information provided to learn about road closures and traffic detours.

Survey Instruments (Web and Paper)

I-93 FAST 14 SURVEY, WEB VERSION

INTRO	Thank you for taking the time to complete this short survey about recent bridge reconstruction along I-93 in Medford, MA. The project is known as 93 Fast 14. Your responses are valuable for guiding MassDOT's future construction planning. This survey should take less than 5 minutes to complete.

Q01   Now that the construction is complete, overall how satisfied are you with the condition of I-93 in Medford now compared to its previous condition?

1. Very satisfied

2. Somewhat satisfied

3. Neither satisfied nor dissatisfied

4. Somewhat dissatisfied

5. Very dissatisfied

Q02   This project used an innovative construction method called Accelerated Bridge Construction. Please read the following and let us know which construction method you prefer.

- Accelerated Bridge Construction enabled MassDOT to perform all work on I-93 during off-peak hours. The bridges were demolished and replaced during ten weekends, requiring closure on half the highway in Medford between 8 PM on Fridays and 5 AM on Mondays. All other bridge work, such as paving, was completed in nine months.

- Conventional Construction, which was not used, would have taken at least four years, during which traffic would have been continually disrupted—including during rush hours—by shifting lanes, narrowed lanes, ramp closures, and work zones within the highway.

1. Strongly prefer Accelerated Bridge Construction **>** Continue to Q04

2. Prefer Accelerated Bridge Construction **>** Continue to Q04

3. I don't have a preference **>** Skip to Q05

4. Prefer Conventional Construction **>** Skip to Q03

5. Strongly prefer Conventional Construction **>** Skip to Q03

6. I do not know which I prefer. **>** Skip to Q05

Q03   What is it that you like about Conventional Construction compared to Accelerated Bridge
            Construction?

            1   VERBATIM **>** Skip to Q05

Q04   What is it that you like about Accelerated Bridge Construction compared to Conventional
            Construction?

            1   VERBATIM **>** Continue to Q05

Q05   Which best describes how often you use the portion of I-93 that goes through Medford,
            Massachusetts?

            1   Almost every day

            2   Several times a week

            3   Once a week or less

            4   Once a month or less

            5   I never use this section of I-93 **>** Skip to Q07

Q06   Which best describes the reason you use the portion of I-93 that goes through Medford,
            Massachusetts?

            1   I use it primarily for local travel within Medford and the surrounding communities

            2   I use it regularly for travel through Medford to somewhere else as part of my daily
                 life (such as commuting, going to school, etc.)

            3   I use this it irregularly for travel through Medford to somewhere else (recreational
                 travel, visiting family, vacation travel, etc.)

            4   I use it as part of my job or for my business. I am a commercial driver or local
                 business owner.

            5   I ride a bus that travels on I-93 in Medford

            6   I don't use I-93, but I live near it in Medford

            7   I don't use I-93 or live in Medford

Q07   Which best describes how often you drive on local roads (not I-93) in Medford, excluding construction related detours?

    1   Almost every day

    2   Several times a week

    3   Once a week or less

    4   Once a month or less

    5   I never use local Medford roads **>** Skip to Q09

Q08   Which best describes how you use local roads (not I-93) in Medford, excluding construction related detours?

    1   I use them primarily for local travel within Medford and the surrounding communities

    2   I use them regularly for travel through Medford to somewhere else as part of my daily life (such as commuting, going to school, etc.)

    3   I use them irregularly for travel through Medford to somewhere else (recreational travel, visiting family, vacation travel, etc.)

    4   I use them as part of my job or for my business. I am a commercial driver or local business owner

    5   I ride a bus that uses local roads in Medford

    6   I don't use local roads much, but do live in Medford

    7   I don't use local roads or live in Medford

Q09   How would you rate the impact of the 93 Fast 14 project on your life?

    1   Very positive **>** Continue to Q10

    2   Somewhat positive **>** Continue to Q10

    3   Neither positive nor negative **>** Skip to Q12

    4   Somewhat negative **>** Skip to Q11

    5   Very negative **>** Skip to Q11

Q10   What was the largest positive impact?

    1   VERBATIM **>** Skip to Q12

Q11   What was the largest negative impact?

        1   VERBATIM **>** Continue to Q12

Q12   MassDOT used several methods to get the news out about closings and detours so that local residents, business owners and road users could be prepared. Which of the following sources f project information did you encounter? (Check all that apply)

        1   The 93 Fast 14 website

        2   Segments on local television news programs

        3   Items in local newspapers

        4   Project coverage on the radio

        5   Electronic signage along the roadway

        6   Traditional signage along the roadway

        7   Flyer

        8   Information on Public Access Television

        9   "Reverse 911" phone calls

        10 Public Hearing or Public Information Session

        11 Other Community Meeting or Stakeholder Briefing

        12 Email from 93fast14.info@state.ma.us

        13 Billboard

        14 Fast Lane Reminder Email

        15 Article in Newsletter (from any organization)

        16 511 or Sendza

        17 Sign on Bus or at Bus Stop

        18 Through a place of worship

        19 Poster at FastLane office or Rest area

        20 Handout at Toll Booth

        21 Twitter

        22 YouTube

        23 Flickr

        24 MassDOT Blog

        97 Other (specify)

Q13   Which, if any, did you use to keep informed about construction activities (road closures, project schedule, etc.) during the construction period?

CHECK ALL **>** ONLY OPTIONS SELECTED DURING Q12

Q14   For what purposes did you utilize project information? (check all that apply)

1   Learn about road closures and traffic detours

2   Learn about live traffic conditions

3   Learn about the overall project schedule

4   Learn about the construction technology

97   Other (specify)

Q15   How satisfied are you with the information you received about the project?

1   Very satisfied

2   Somewhat satisfied

3   Neither satisfied nor dissatisfied

4   Somewhat dissatisfied

5   Very dissatisfied

Q16   How helpful was the project information in preparing you for construction, local road closures, detours, or traffic conditions?

1   Very helpful

2   Somewhat helpful

3   Did not need information about the project

4   Could have been more helpful

5   Not helpful at all

Q17	IF Q15>3: What could have been improved about communications to make it more useful for you?
	1 VERBATIM

Q18	Please provide a few pieces of basic information for the survey.
	AGE Age: PULLDOWN
	GENDER Gender: RADIO
	HZIP Your home Zip Code VERBATIM

THANK	Thank you for your time in taking this survey—your input is valuable and will guide our efforts in the future. If you'd like to participate in future outreach efforts, please provide your name and email below:
EMAIL	Email VERBATIM
RESPF	First Name VERBATIM
RESPL	Last Name VERBATIM
SUBMIT SURVEY	**>** Redirect to http://93fast14.dot.state.ma.us/

BUSINESS REPLY MAIL
FIRST-CLASS MAIL   PERMIT NO. 5478   AUSTIN TX

POSTAGE WILL BE PAID BY ADDRESSEE

PTV NUSTATS
206 WILD BASIN RD STE A300
AUSTIN TX 78746-9907

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

3. Why do you prefer Conventional Construction?

→ Go to Q5

4. Why do you prefer Accelerated Bridge Construction?

→ Go to Q7

5. How often do you use the portion of I-93 that goes through Medford, MA?

- ○ Almost every day
- ○ Several times a week
- ○ Once a week or less
- ○ Once a month or less
- ○ I never use this section of I-93 → Go to Q7

6. Why do you use the portion of I-93 that goes through Medford, MA?

- ○ I use it primarily for local travel within Medford and the surrounding communities
- ○ I use it regularly for travel through Medford to somewhere else as part of my daily life (such as commuting, going to school, etc.)
- ○ I use it regularly for travel through Medford to somewhere else (recreational travel, visiting family, vacation travel, etc.)
- ○ I use it as part of my job or for my business. I am a commercial driver or local business owner.
- ○ I rode a bus that travels on I-93 in Medford
- ○ I don't use I-93, but I live near or run close by
- ○ I don't use I-93 or live in Medford

7. How often do you drive on local roads (not I-93) in Medford, excluding construction related detours?

- ○ Almost every day
- ○ Several times a week
- ○ Once a week or less
- ○ Once a month or less
- ○ I never drive local Medford roads → Go to Q9

8. How do you use local roads (not I-93) in Medford, excluding construction related detours?

- ○ I use them primarily for local travel through Medford to somewhere else as part of my daily life (such as commuting, going to school, etc.)
- ○ I use them regularly for travel through Medford to somewhere else (recreational travel, visiting family, vacation travel, etc.)
- ○ I use them as part of my job or for my business. I am a commercial driver or local business owner.
- ○ I ride a bus that travels on local roads in Medford.
- ○ I don't use local roads much, but I do live in Medford
- ○ I don't use local roads or live in Medford

9. How would you rate the impact of the 93 Fast 14 project on your life? Was it...

- ○ Very positive ⎫
- ○ Somewhat positive ⎬ → Go to Q10
- ○ Neither positive nor negative → Go to Q12
- ○ Somewhat negative ⎫
- ○ Very negative ⎬ → Go to Q11

10. What was the largest positive impact?

[text box]

→ Go to Q12

11. What was the largest negative impact?

[text box]

12. MassDOT used several methods to inform residents, business owners, and road users about closings and detours. Which of the following sources of project information did you: A. Encounter and B. Use to keep updated / informed about the construction activity? (Mark all that apply)

	A. Encounter	B. Use for updates
a. The 93 Fast 14 website	○	○
b. Reporter on local TV news program	○	○
c. Story in local newspaper	○	○
d. Project signage on the road	○	○
e. Electronic signage along the roadway	○	○
f. Traditional signage along the roadway	○	○
g. Flyer	○	○
h. Information on public access television	○	○
i. "Reverse 911" phone calls	○	○
j. Public hearing / Public information session	○	○
k. Other community meeting / Stakeholder briefing	○	○
l. Email from agency/state/municipal source	○	○
m. Internet	○	○
n. Last Lane reminder email	○	○
o. Emails or newsletters from any organization	○	○
p. 93 Fast Streets	○	○
q. Sign on bus or on bus rep.	○	○
r. Through a place of worship	○	○
s. Poster at Fast Lane office or rest area	○	○
t. Handout at rest room	○	○
u. Twitter	○	○
v. YouTube	○	○
w. Flickr	○	○
x. MassDOT blog	○	○
y. Other, specify _____	○	○

13. How did you use the source of project information in Question 12? To learn about _____ (Mark all that apply)

- ○ Road closures and traffic detours
- ○ Live traffic conditions
- ○ Overall project schedule
- ○ Construction technology
- ○ Other, specify _____

Continue on the back →

→ Appendix C: Resources and Recommended Publications

Developing Successful Marketing Strategies, David Parmerlee, 1992, Lincolnwood, Illinois, NTC Business Books.

Do-It-Yourself Marketing Research, George Breen and Albert B. Blankenship, New York, NY, 1989, McGraw Hill, Inc.

State of the Art Marketing Research, A.B. Blankenship and George Edward Breen, New York, NY, 1995, American Marketing Association, NTC Business Books.

The Clustering of America, Michael J. Weiss, New York, 1988, NY, Harper & Row, Publishers.

World Wide Web Marketing: Integrating the Web into Your Marketing Strategy, Jim Sterne, 1999, New York, NY, John Wiley & Sons, Inc.

Seven Keys to Building a Robust Research Program, NCHRP Synthesis 280, Thomas B. Deen and Barbara T. Harder, 1999, Transportation, Richard R. Mudge, and Robert Hurd, Apogee Research, Inc., Bethesda, MD, 1990, Transportation Research Board, Washington, DC.

Using Market Research to Improve Management of Transportation Systems, NCHRP Report 329, Washington, DC, August 1990.

Technology Transfer in Selected Highway Agencies, NCHRP Synthesis 150, Transportation Research Board, Washington, DC December, 1989.

A Handbook: Using Market Segmentation to Increase Transit Ridership, TCRP Report 36, Transit Cooperative Research Program, Transportation Research Board, Washington, DC 1998.

A Handbook: Integrating Market Research into Transit Management, TCRP Report 37, Transit Cooperative Research Program, Transportation Research Board, Washington, DC 1998.

A Handbook of Proven Marketing Strategies for Public Transit, TCRP Report 50, Transit Cooperative Research Program, Transportation Research Board, Washington, DC 1999.

Recommended publications for how to conduct focus groups, including online focus groups:

Evaluation: A Systematic Approach, Dr. Peter H. Rossi, Mark W. Lipsey (2004)

The ABCs of Evaluation: Timeless Techniques for Program and Project Managers, Second Edition by John Boulmetis and Phyllis Dutwin, 2005, Jossey Bass, San Francisco, CA.

Real World Evaluation Working Under Budget, Time, Data, and Political Constraints, Michael J. Bamberger, Jim Rugh, 2006, Sage Publications, Thousand Oaks, CA.

Public Opinion Polling: A Handbook for Public Interest and Citizen Advocacy Groups, Celinda C. Lake with Pat Callback Harper, 1987, Island Press, Washington, DC.

Interviewing Principles and Practices, Charles J. Stewart and William B. Cash, Jr., 1988, Wm. C. Brown Publishers, Dubuque, IA.

Identifying the Right Markets, David Parmerlee, 1992, Lincolnwood, Illinois, NTC Business Books.

Focus Groups: A Practical Guide for Applied Research, Richard A. Krueger, 1994, Sage Publications, Thousand Oaks, CA.

Systems Approach to Evaluating Innovations for Integration into Highway Practice, NCHRP Report 442, Transportation Research Board, Washington, DC, 2000.

Putting Customer Research into Practice: Guidelines for Conducting, Reporting, and Using Customer Surveys Related to Highway Maintenance Operations, NCHRP Project 20-07/Task 260, 2009, NuStats, Inc., Austin, Texas, Transportation Research Board, Washington, DC.

World Wide Web Marketing: Integrating the Web into Your Marketing Strategy, Jim Sterne, 1999, New York, NY, John Wiley & Sons, Inc.

How Do You Use Data From Likert Scales?, Tyson Gingery, December 2009.

Washington, D.C. "A Primer on Consumer Marketing Research: Procedures, Methods and Tools," 1994, Jane E. Lappin, EG&G Dynatrend, Paula Figoni, Simmons College Graduate School of Management, Suzanne M. Sloan, EG&G Dynatrend, prepared for Office of Policy Development, Federal Highway Administration, Washington, DC.

Case Studies of Market Research for Three Transportation Communication Products, 1994, Thomas R. Parish, Arthur D. Little, Inc., Cambridge, Mass., prepared for Office of Policy Development, Federal Highway Administration, Washington, DC.

Conference Proceedings 14: Information Needs to Support State and Local Transportation Decision Making into the 21st Century, Proceedings of a Conference in Irvine, California, March 2-5, 1997, Transportation Research Board, Washington, DC 1997.

Managing Customer Value – Creating Quality and Service That Customers Can See, Bradley T. Gale with Robert Chapman Wood, 1994, New York, NY, The Free Press.

Marketing, Richard L. Sandhusen, 1987, New York, NY, Barron's Educational Series, Inc.

Promotional Strategy – Managing the Marketing Communications Process, James F. Engel, Martin R. Warshaw, and Thomas C. Kinnear, 1987, Homewood, Illinois, Irwin Publishing.

Services Marketing: Principles and Practice, Adrian Palmer and Catherine Cole, 1995, Englewood Cliffs, NJ, Prentice-Hall.

Social Marketing: Strategies for Changing Public Behavior, Philip Kotler and Eduardo L. Roberto, New York, NY, 1989, The Free Press.

Digital Differences, http://www.pewinternet.org/Reports/2012/Digital-differences/Overview.aspx, The Pew Foundation Internet and American Life Project, Zickuhr, Kathryn and Aaron Smith, April 13, 2012.

SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
LENGTH				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
AREA				
in²	square inches	645.2	square millimeters	mm²
ft²	square feet	0.093	square meters	m²
yd²	square yard	0.836	square meters	m²
ac	acres	0.405	hectares	ha
mi²	square miles	2.59	square kilometers	km²
VOLUME				
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft³	cubic feet	0.028	cubic meters	m³
yd³	cubic yards	0.765	cubic meters	m³
NOTE: volumes greater than 1000 L shall be shown in m³				
MASS				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
TEMPERATURE (exact degrees)				
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
ILLUMINATION				
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m2	cd/m²
FORCE and PRESSURE or STRESS				
lbf	poundforce	4.45	newtons	N
lbf/in²	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
LENGTH				
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
AREA				
mm²	square millimeters	0.0016	square inches	in²
m²	square meters	10.764	square feet	ft²
m²	square meters	1.195	square yards	yd²
ha	hectares	2.47	acres	ac
km²	square kilometers	0.386	square miles	mi²
VOLUME				
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m³	cubic meters	35.314	cubic feet	ft³
m³	cubic meters	1.307	cubic yards	yd³
MASS				
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
TEMPERATURE (exact degrees)				
°C	Celsius	1.8C+32	Fahrenheit	°F
ILLUMINATION				
lx	lux	0.0929	foot-candles	fc
cd/m²	candela/m2	0.2919	foot-Lamberts	fl
FORCE and PRESSURE or STRESS				
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in²

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380. (Revised March 2003)

About the Center for Accelerating Innovation

FHWA established the Center for Accelerating Innovation (CAI) to support and expand its Every Day Counts initiative. Every Day Counts is the Federal Highway Administration's initiative to advance a culture of innovation in the highway community. Through this collaborative, State-based effort, FHWA encourages rapid deployment of proven, market-ready technologies to shorten the project delivery process, enhance roadway safety, and improve environmental sustainability. It uses an innovation deployment approach that tailors strategies to the needs, preferences, and regulations of each participating State and develops a nationwide network of innovation proponents.

Regional summits are an integral component of the EDC initiative, bringing together the front-line professionals responsible for delivering the highway projects that keep America moving. The eight EDC summits held in fall 2012 gave transportation professionals the opportunity to learn about the second 2-year round of EDC innovations, exchange ideas with their agency and industry counterparts in neighboring States, and provide feedback to FHWA on the support they need to adopt innovations in their own States. Since the first round of EDC innovations was launched in October 2010, EDC has focused on moving proven but underused technologies and practices into widespread use to benefit road users and taxpayers.

The Center for Accelerating Innovation's role is to coordinate outreach and communication efforts, develop training and educational tools, provide technical support, and work with the agency's partners throughout the highway community to deploy innovation. The CAI is a resource for all members of the highway community to help them embrace innovation use in ways that will improve service to America's drivers and value to its taxpayers.

Center for Accelerating Innovation

USDOT - Federal Highway Administration

1200 New Jersey Ave., SE

E84-430

Washington, DC 20590
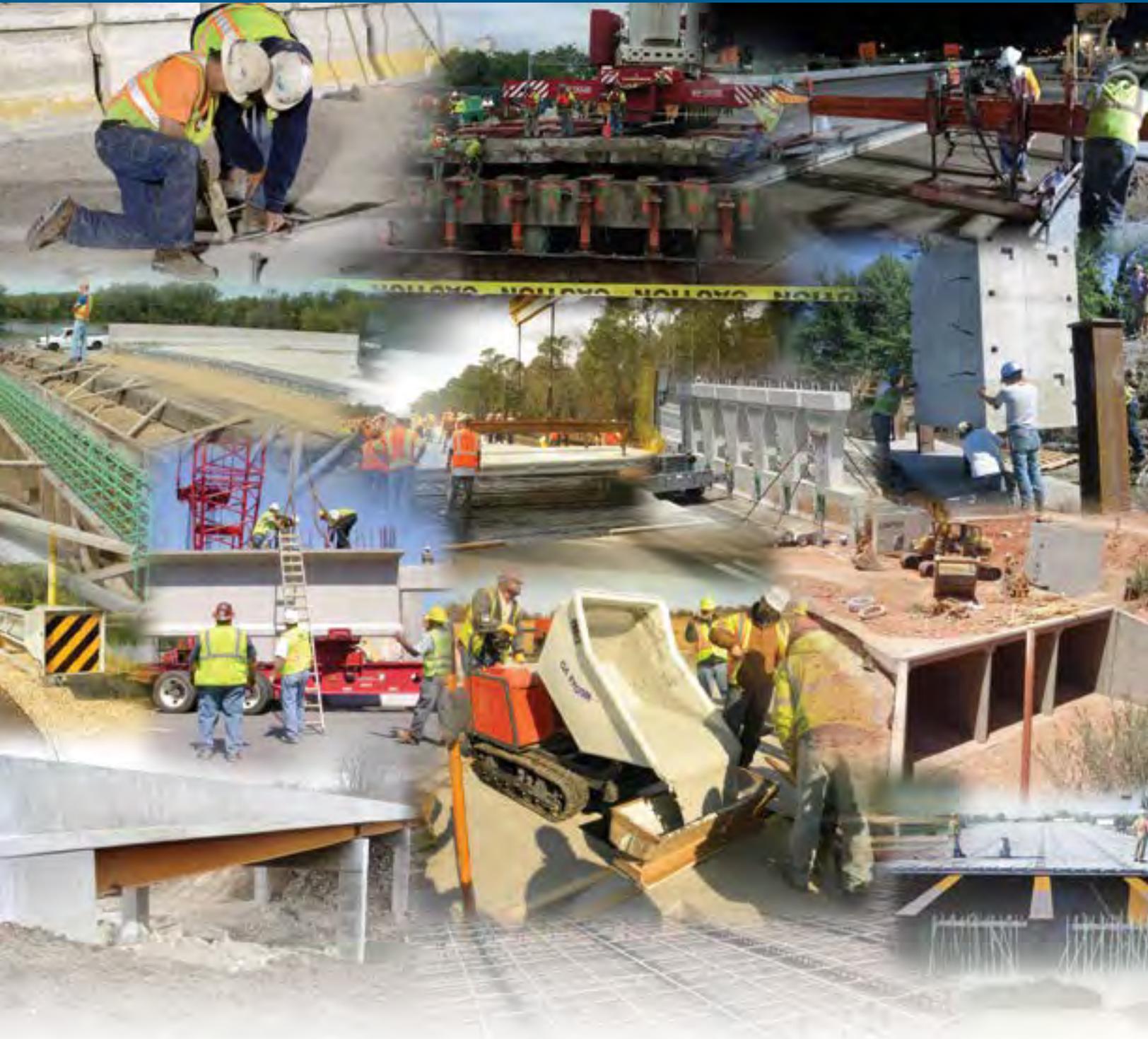
http://www.fhwa.dot.gov/everydaycounts

Acknowledgments
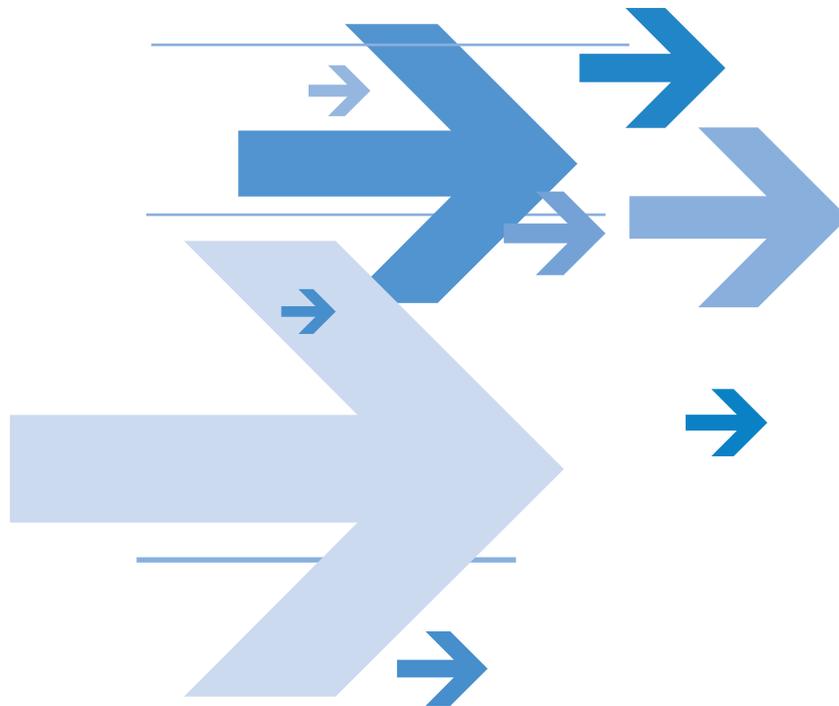
HIGHWAYS FOR LIFE

Accelerating Innovation for the American Driving Experience.

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FHWA-HIF-13-035

U.S. Department
of Transportation

**Federal Highway
Administration**