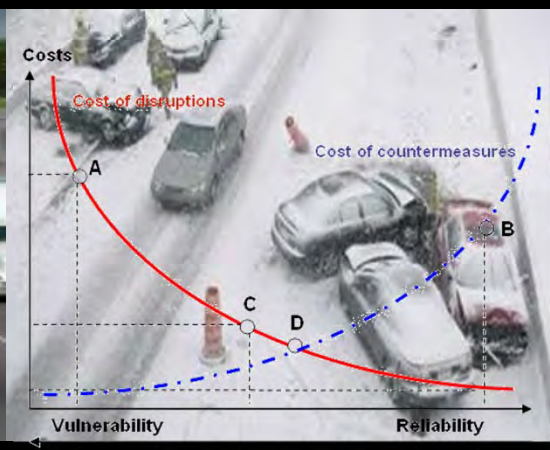
FINAL REPORT

Transportation Reliability and Trip Satisfaction

ORBP Reference Number: OR10-028

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TRANSPORTATION RELIABILITY AND TRIP SATISFACTION

MDOT ORBP Project Number: OR10-028

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16. Abstract

Travel delays and associated costs have become a major problem in Michigan over the past several decades as congestion has continued to increase, creating significant negative impacts on travel reliability on many roadways throughout the State. The Michigan Department of Transportation (MDOT) possesses the capability to distribute real-time travel time, speed, and reliability related information to the public through a variety of communication channels. If properly conveyed, such information would help facilitate necessary trip planning decisions both before and during a trip. Research was performed to develop appropriate communication techniques for distribution of travel reliability and related information to travelers through the MDOT MiDrive website based on the needs of users of the transportation network in Michigan. A number of tasks were performed to achieve this objective, including surveys of travelers, commuters, and the freight industry, in addition to the state-of-the-art and state-of-the-practice reviews. Synthesis of the information obtained from these tasks allowed for conclusions and recommendations to be drawn, including recommended techniques for reliability measurement – specifically buffer time and planning time – in addition to strategies for communication of this information through the MiDrive website.

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EXECUTIVE SUMMARY

Travel delays and associated costs have become a major problem in Michigan over the past several decades as congestion has continued to increase, creating significant negative impacts on travel reliability on many roadways throughout the State. As it is not possible to provide a perfectly reliable transportation system due to incidents, roadwork, etc., travelers and other users of the transportation network are aided by transportation reliability information disseminated through a broad variety of communication channels. The Michigan Department of Transportation (MDOT) possesses the capability to distribute real-time travel time, speed, and reliability related information to the public through a variety of communication channels. If properly conveyed, such information would help facilitate necessary trip planning decisions both before and during a trip. Although communication of transportation reliability information has become more common throughout the United States over the past decade, questions pertaining to communication of network reliability in Michigan still remain.

The primary objective of this research was to develop appropriate communication techniques for distribution of travel reliability and traffic related information to the traveling public and freight industry personnel. Of particular emphasis was determination of appropriate methods for displaying route reliability information through the MDOT MiDrive website. A number of tasks were performed to achieve this objective, including surveys of travelers, commuters, and freight industry logistics professionals, in addition to the state-of-the-art and state-of-the-practice reviews. Synthesis of the information obtained from these tasks allowed for conclusions and recommendations to be drawn, which are summarized as follows.

Information Needs of Travelers

The information needs of travelers and freight industry personnel are largely dependent on when such information is sought with respect to the trip departure. In general, travel information may be sought at three different points occurring either before or during the trip:

- En Route: Travelers that are already en route have the least amount of trip flexibility and changes are typically limited to selection of an alternate route, assuming a reasonable alternative exists. The information needs of travelers en route are best

satisfied by the display of current travel time, incident location, road work, or other congestion information on changeable message signs.

- Preparing for Near-Term Departure: Travelers preparing for a near-term departure, such as regular commuters, have some flexibility with respect to departure time, route choice, and mode choice. Advance awareness of unfavorable travel conditions allow these travelers to adjust departure time, select an alternative route, and/or select an alternative mode. The information needs of travelers preparing for a near-term departure are best satisfied by the display of current travel speed, travel time, incident location and status, road work, or transit departure times on a travel information website, such as MiDrive or television broadcast.
- Planning for Future Departure: Trip planning well in advance of departure affords the greatest level of flexibility with respect to departure time, route choice, and mode choice. Route reliability information is of particular value to travelers in this category as it allows for informed decisions to be made pertaining to route choice, departure time, and/or mode choice. The information needs of travelers planning for future departure, including freight industry personnel, are best satisfied by the display of travel time reliability or variability information on a travel information website, in addition to information pertaining to current and future road work.

State-of-the-Practice for Communicating Online Travel Reliability Information

A review of current nationwide practice found that all states have some level of traffic related information available online to assist travelers with determining suitable routes and/or departure times. At the basic level, nearly all states provide information related to construction, incidents, weather, and/or general roadway condition information, typically on some sort of interactive state or regional map. Several states, including Michigan, provide a color-coded map displaying either current travel speeds or traffic flow conditions. In most cases, the information is hosted on an official state website, although some states provide a link to related information provided by a third-party. Many states also provide a mobile version of the travel website. However, and perhaps most relevant to this particular study, it was determined that relatively few states provide online information related to travel reliability. Furthermore, the states that provide

reliability-related information typically give only basic information, such as a side-by-side comparison of current versus average segment travel times.

The lack of available online reliability information is perhaps due in part to an overall lack of consensus within the literature on the quantitative measures that best reflect travel time reliability. However, it was evident that traffic information should be quantified in a manner that provides the greatest level of flexibility in order to meet the needs of a broad range of network users. Furthermore, the data should be communicated to users in a variety of formats, including both tabular and graphical displays, using a variety of communication channels.

Recommended Methods for Quantifying Travel Reliability Data

Although many options are available for quantifying travel reliability, the measures that are most effectively utilized by the general public are those that utilize common terminology to describe quality of service of the particular facility. In a general sense, the most broadly applicable reliability measures are those that, for a specific period, compare days with high delay to days with average delay. Consequently, the recommended practices for quantifying travel reliability information for dissemination to the public through the MiDrive website include: Buffer Time/Index and Planning Time/Index. These measures were selected due to the inherent understandability by a broad range of transportation system users as they account for unexpected delays beyond that which are typical for a specific time of day.

Buffer time refers to the *amount of extra time* needed beyond the average (or median) travel time to ensure an on-time arrival for most travelers with a high level of confidence, typically 95 percent. Travelers concerned with an on-time arrival may use this data to advance their departure time by the amount of buffer time recommended for the segment. The buffer time index is simply the buffer time expressed as a percentage of the average travel time, thereby broadening the applicability by providing a time and distance neutral version of the buffer time.

Planning time relates to the *total travel time* that should be budgeted to ensure an on-time arrival for most travelers with a high level of confidence. The planning time is typically computed as the 95th percentile travel time for the particular segment during the particular time of day, while the index simply divides this value by the travel time observed during free-flow conditions. Planning time is very user-friendly as it provides an indication of the amount of time to be scheduled for the particular segment to be confident in an on-time arrival.

Recommended Methods for Communicating Travel Reliability Information via MiDrive

A common theme found throughout the review of the state-of-the-art and practice was that traffic information should be provided to road users in a variety of formats, including both tabular and graphical displays, thereby providing adequate flexibility to satisfy a broad range of users. Thus, it is recommended that MiDrive be modified to include segment travel time and reliability-related data for each roadway segment for which speed and travel time information are available. Such information should be displayed in both tabular and graphical formats, thereby providing information in a manner that is useful to a broad audience. The following data should be provided within MiDrive for each applicable roadway segment:

- Current travel time;
- Average travel time for current time-of-day and day-of-week;
- 95^{th} percentile travel time for current time-of-day and day-of-week (Planning Time);
- Difference between current travel time and average travel time, and
- Difference between 95^{th} percentile travel time and average travel time (Buffer Time).

Displaying travel time and reliability information in this manner provides information relevant for nearly all stages of travel planning. For example, travelers preparing for a near-term departure can utilize the current travel time information to determine the departure time. If on-time arrival is critical, then the user may consider basing departure on the 95^{th} percentile of travel times to determine the additional buffer time necessary to account for unexpected delays. For those concerned with route reliability, comparison can be made between the relative magnitudes of the typical travel time ranges between reasonable routes to determine the route with the least variability in travel times for the time period of interest.

These segment reliability data should be provided to users directly from the main MiDrive traffic condition map by simply clicking on the desired road segment. It may also be helpful to provide the basic segment reliability statistics, such as current travel time, average travel time, buffer time, and/or planning time either as a map layer and/or as a table in a small pop-up window that is displayed upon hovering the cursor above the particular segment. Modification to the color coded speed scale shown on the MiDrive traffic condition map from a quantitative (e.g., speed ranges) to a qualitative (e.g., “fast”, “moderate”, “slow”) scale is also recommended. Additionally, other modifications of MiDrive, including allowing users to customize the interface, create an account, and register for traffic alerts.

CHAPTER 1:
INTRODUCTION AND BACKGROUND

Travel delays and associated costs have become a major problem in Michigan. The annual urban mobility study performed by the Texas Transportation Institute estimated that the cost of traffic congestion for commuters in metro-Detroit rose nearly 425 percent between 1982 and 2009 (1). Average annual commuter delays from 1982 to 2009 increased from 14 hours to 33 hours per commuter (136 percent increase) in metro-Detroit and from 4 hours to 18 hours per commuter (350 percent increase) in Grand Rapids (1). Such congestion increases have undoubtedly contributed to diminished reliability of the transportation network in Michigan.

Prior research has shown that travelers are not only interested in minimizing the travel time of a trip, but also in minimizing the uncertainty of travel times (2). Routes with highly variable travel times are undesirable to travelers, as the ability to accurately estimate the destination arrival time is diminished. However, the degree to which the uncertainty of travel times impacts travelers' route choice and departure time decisions depends largely on the consequences associated with late arrivals (3).

For business travelers and freight haulers, the consequences of late arrivals may result in financial loss. These travelers address travel time uncertainty by either departing earlier or using an alternative route, assuming that a reasonable alternative is available. On the other hand, leisure travelers typically do not face such financial consequences for arriving late and may either avoid travel periods that produce unreliable travel times or simply absorb any unexpected travel delays without making travel adjustments.

In the absence of up-to-date traffic information, travelers are tend to rely on past experience for route planning and scheduling decisions, which often proves unreliable. As the value of time has continued to increase along with the demand for on-time deliveries, increasing pressure has been placed on roadway agencies to convey effective real-time travel mobility information through a variety of communication channels to assist with travel planning both before and during a trip. Travelers often utilize this information to assist with route choice, departure time, or other trip planning decisions.

Transportation agencies commonly communicate real-time travel mobility information to motorists on changeable message signs and/or an online map. However, such information only

describes current roadway conditions and does not relate to the day-to-day variability of conditions along the roadway, which is critical for trip planning purposes. As a result, roadway agencies have also begun to measure and communicate information related to the reliability of the transportation network, which relates to the consistency or dependability in travel times for a particular route (4).

STATEMENT OF PROBLEM

As it is not possible to provide a perfectly reliable transportation system due to incidents, roadwork, etc., travelers and other users of the transportation network are aided by transportation reliability information disseminated through a broad variety of communication channels. Although transportation reliability research has become more common over the past decade, questions pertaining to travel time reliability in Michigan still remain. Some of the questions that are relevant to transportation agencies in Michigan include:

- What is the current level of trip satisfaction on the Michigan transportation system?
- How does trip satisfaction vary by mode, trip purpose, trip length, and other factors?
- How does trip satisfaction relate to reliability?
- Which roadways are considered most unreliable in Michigan and why?
- How do users of the Michigan transportation network value travel time and its reliability?
- How much does travel time reliability contribute to route choice in Michigan?
- How do travel time and reliability related values and decisions vary by mode, trip purpose, trip length, etc. in Michigan?
- How should reliability be quantified in Michigan?
- How can accurate reliability-related data be measured?
- How do users of the transportation network value potential tradeoffs between reliability and travel time (i.e., longer route with more reliable travel time versus shorter route with less reliable travel time)?
- How can reliability effectively be communicated to users of the transportation network by MDOT?

OBJECTIVES AND TASKS

The primary goal of the research was to develop a better understanding of the needs of users of the transportation network in Michigan in order to develop appropriate communication techniques for distribution of travel reliability information. In order to satisfy this goal and answer the aforementioned questions related to reliability and trip satisfaction, the following research objectives were developed:

- Identify problems travelers encounter on the state's transportation system that could adversely impact travel time reliability.
- Provide insight and recommendations as to how best to minimize and/or eliminate the problems.
- Determine reliability measures most important to travelers and the freight industry.
- Determine factors considered by motorists when choosing a particular mode of travel.
- Determine the best practices to measure and subsequently communicate reliability.

The following tasks were performed to satisfy the research objectives:

- Perform a comprehensive state-of-the-art and state-of-the-practice review.
- Host a stakeholder focus group to discuss reliability issues in Michigan, including representatives from MDOT, Michigan State Police, freight industry, transit agencies and others.
- Perform a survey of Michigan travelers, providing adequate representation across all regions of the State and a variety of travel modes and purposes.
- Perform a survey of freight industry personnel to investigate the needs and desires of shippers, carriers, and logistics specialists with respect to travel time reliability.
- Synthesize all information to determine the best practices for reliability measurement.
- Recommend reliability measures that may be utilized by MDOT for posting to the MiDrive website or other communication channels.

A full description of all data collected, analyses performed, and results obtained as a part of this research is provided in the chapters that follow along with conclusions, and recommendations.

CHAPTER 2:
REVIEW OF RELIABILITY MEASUREMENT STRATEGIES

A review of the relevant literature and state practice was performed to determine the current state-of-the-art and state-of-the-practice pertaining to travel reliability and related subjects. Of particular interest during the review was the experience of other states with respect to measuring and calculating travel time reliability and effectively communicating this information to the travelers in a format that is easily understood by travelers across all modes. Consequently, a nationwide review was conducted to investigate the current methods for transmitting real-time traffic data, including travel speeds, travel times, road work, incidents, and reliability information to the traveling public. In addition, a comprehensive literature review was performed through queries of the Transportation Research Board's Transportation Research Information Database (TRID), which provides access to reports, journal articles, conference proceedings and other publication types from various publication sources around the world.

For reliability data to be effective, it is necessary that the measure have both technical merit for agency reporting and tracking purposes and also be easily understood by the general public. It is important to note that no single mobility or reliability measure will satisfy the needs of all users due to the complexity of trip planning (5). As the measurement and communication of transportation reliability has continued to evolve over the past decade, several methods of quantifying transportation reliability currently exist in the literature. However, broad nationwide implementation of reliability measurement and communication does not yet exist, generally due to the inability for agencies to effectively collect, store, and distribute data related to current traffic conditions.

It is first important to note the difference between "reliability" and "variability". In practice, the two terms are often used interchangeably, as both describe the impact of non-recurring congestion on the transportation system – specifically travel time or speed along a particular route (6). Although they are similarly specified, reliability has been suggested as a more appropriate definition for communicating to the traveling public as it relates more to the quality of service provided by the facility (5). More specifically, it provides an indication of the difference between the expected travel time, such as the average or median travel time, and the actual travel time along a route (7). Variability measures relate more to statistical range

measurements, such as the mean travel time plus a multiple of the standard deviation, which may be better suited for agency reporting purposes (5). Both types of measures can be defined based on common mobility measures, such as segment travel times or speeds.

Lomax and Schrank provided a comprehensive taxonomy of existing travel reliability and variability measures in reference 5. Three general categories for measuring travel time reliability and variability were suggested, including (5):

- Statistical Range Measures – These measures represent theorized or conceptualized measures. They are typically computed utilizing measures of central tendency (mean and variance) to estimate of the range of expected travel conditions. These measures relate more to the variability of network performance rather than reliability. Although they provide an indication of system performance and are useful for agency reporting, they are not easily understood by the traveling public.
- Buffer Time Measures – These measures indicate the amount of extra ("buffer") time that must be allowed for travelers to arrive on time at the destination with a high level of confidence. The measures are generally presented as either a percentage of the average trip time (i.e., "add x-percent additional time") or a value in minutes per mile or minutes of some typical or average trip. Such measures are a typical representation of travel reliability and are easily understood by the traveling public.
- Tardy Trip Indicators – These measures use a threshold to identify an acceptable late arrival time in order to answer how often a traveler will be unacceptably late to his/her destination. The threshold time can be based either on a percentage of the trip time, an increased time in minutes above the average, or some absolute value in minutes. These measures are also a typical representation of travel reliability and are easily understood by the traveling public.

STATISTICAL RANGE MEASURES

This category includes measures of travel variability, computed on the basis of a range of historical travel times experienced during daily trips along a route (8). One of the earliest and most simplistic definitions suggested utilizing the inverse of the standard deviation of the travel time distribution along the route (9). A dimensionless travel time range measure is the travel time index, which is computed based on the ratio of the average travel time to the free-flow

travel time (10). Variability can also be described using a travel time window, which may be computed using the mean travel time and some multiple of standard deviation (typically 1σ to 2σ) to describe the range of travel times that have been experienced by travelers (5). Alternatively, the median travel time plus the difference between the upper percentile travel time and the median travel time has also been proposed. Use of the median travel time is recommended over the mean to better represent congested travel time conditions, which are typically positively skewed and follow a log-normal distribution (4,11,12). Uncongested travel times are typically normally distributed and using the mean value is appropriate (4).

The coefficient of variation is a dimensionless measure of travel time variability and allows for comparison between trips of varying lengths (7,12,13). The coefficient of variation (or percent variation), is computed using the ratio of the standard deviation to the average (or median) travel time, expressed as a percentage, as follows (7):

$$\text{Percent Variation} = \frac{\text{Standard Deviation}}{\text{Average Travel Time}} \times 100\%$$

The variability index is another variability measure, which is calculated as a ratio of the difference in the upper and lower 95 percent confidence interval travel times between the peak and off-peak periods (5). Because peak variability is typically greater than off-peak variability, the variability index values are typically greater than 1.0. The variability index is computed as follows:

$$\text{Variability Index} = \frac{\text{Peak 95th percentile Travel Time - Peak 5th percentile Travel Time}}{\text{OffPeak 95th percentile Travel Time - OffPeak 5th percentile Travel Time}}$$

BUFFER TIME MEASURES

Buffer time measures describe unreliable route conditions by quantifying the amount of extra time that travelers must allow to reach their destination with a high likelihood of being on-time. They are favorable because they relate to the way travelers make trip-related decisions, including: “how much extra time do I need to allow?” and subsequently “when do I need to leave?” In this case, the failure threshold is set at a very low level of tolerance for arriving late. Consequently, the primary task is to determine the necessary buffer time to ensure a high rate of

on-time arrivals, considering all congestion factors including weather, incidents, work zones, events, holidays, etc. Lomax and Schrank have suggested that the additional travel time allowances be provided such that late work arrivals would only occur at a rate of once per month (i.e., approximately 5% of the time) (5). Higher or lower threshold percentiles may be utilized based on the need to ensure on-time arrivals. The extra time needed to ensure that the average trip will arrive on time X-percent of the time is typically referred to as the buffer time, which can be computed assuming 95 percent arrival confidence as follows:

Buffer Time (min) = 95th percentile Travel Time for a Typical Trip – Average Travel Time for a Typical Trip

The challenge lies in defining the typical trip that is to be used as the baseline. To circumvent this issue, buffer time may be communicated to motorists as extra minutes for a nominal trip length (i.e., allow 15 extra minutes per hour of travel) or as a value of extra minutes per mile (i.e., allow 1 extra minute per mile) along a route.

The buffer time index is also a useful measurement of reliability for reporting to the public (5,10,11,12,14) and provides the advantage of being dimensionless. This measure is typically computed on the basis of the percent difference between the 95th percentile travel time (or rate) and the average (or median) travel time (or rate) for the section of interest and converted to a percent, as follows:

$$\text{Buffer Time Index} = \frac{\text{95 percentile Travel Time - Average Travel Time}}{\text{Average Travel Time}} X 100\%$$

The index would be communicated to the traveler by suggesting an extra BTI percentage of total trip time (i.e., “allow 25% extra travel time”) due to unexpected congestion to allow for an on-time arrival 95 percent of the time. As previously stated, the use of the median travel times or rates are recommended over the averages to better represent congested travel time conditions (4,11,12).

It is also important to consider the source of the congestion, such roadwork, incidents or heavy traffic and the impacts on the particular reliability measure. Research has shown that roadwork more likely deteriorates buffer index than incidents, meaning disseminating accurate roadwork information is more important than incident information in order to reduce the

additional travel time that is necessary for on-time arrival. (15). Further, Mehran developed a methodology to estimate the buffer time index by modeling travel time variations as a function of demand, capacity, weather conditions, and crashes, thereby eliminating the need for empirical data (16).

The planning time index is recommended by the FHWA as a suitable reliability measure for use by the public for trip planning purposes (10). The planning time index relates to the total travel time that should be budgeted to ensure an on-time arrival for most travelers with a high level of confidence. The planning time index differs from the buffer time index in that free flow conditions are utilized as a baseline rather than average conditions for a particular time of day. The planning time index is typically computed utilizing the 95th percentile travel time (or rate) for the route during the particular time of day divided by the free-flow travel time (or rate). It is reported as a proportion rather than a percent and is computed as follows:

$$\text{Planning Time Index} = \frac{\text{95 percentile Travel Time - Free Flow Travel Time}}{\text{Free Flow Travel Time}}$$

As reliability measures are often difficult for the public to comprehend, graphical representations of travel time variability data may be utilized to simplify such data into a readily understandable format. Figure 1; recreated from data provided by the FHWA shows the interaction between the indices for buffer time, planning time, and average travel time (10).

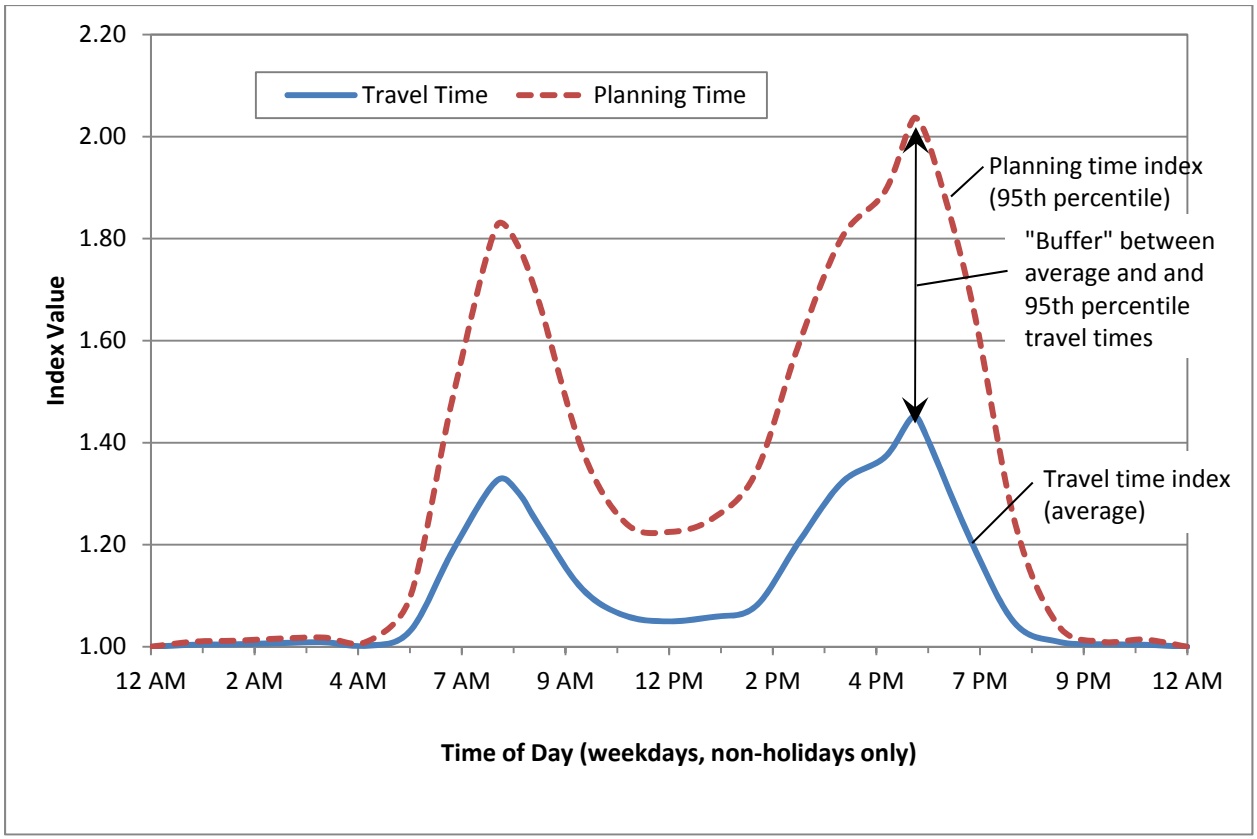


Figure 1. Relationship between Buffer Time, Planning Time, and Average Travel Time (10)

This figure charts both the travel time index and planning time index across all times of the day for a typical weekday. The lines depicting the travel time index and planning time index track similar trends, but are based on the mean and 95th percentile travel times, respectively. The difference between the planning time index and the travel time index represents the buffer time, which can be converted to the buffer time index (percentage) by dividing this value by the average travel time for the particular time of the day.

TARDY TRIP INDICATORS

Tardy trip indicators are reliability measures that describe how often a traveler will be unacceptably late and are formulated on the basis of defining a threshold to identify an acceptable late arrival time. These reliability measures are most commonly utilized in public transportation, including the bus, rail, and airline industries (17). Whereas buffer time measurements relate to the extra time needed for a traveler to arrive on-time with a high degree of likelihood, tardy trip indicators relate to the likelihood of being unacceptably late, or

conversely, on-time. Thus, it is important to define the maximum level of tardiness that is generally deemed acceptable.

One common tardy trip indicator is that utilized in the Florida Reliability Model (18). This measure uses the median off-peak travel time plus an additional acceptable amount of travel time to estimate the upper limit of reliable travel times as follows (19):

Acceptable Travel Time = Median Off-Peak Travel Time + Acceptable Additional Time

Acceptable additional travel time is defined on the basis of a certain threshold percentage of the median travel time, typically between 5% and 20%. Travel times longer than the Acceptable Travel Time are considered unreliable and the percent of unreliable trips can be computed and communicated to motorists based on the percent of total corridor trips that exceed the Acceptable Travel Time, such as "5% of trips downtown will exceed 1 hour". The Florida model may also be modified to utilize travel rate rather than travel time, which provides reliability estimates that are independent of trip length. This information may be communicated as, for example "5% of trips require 50% additional travel time".

A similar alternative to the Florida Reliability Model is to express the information as the percent of "on-time" arrivals, which is a common reliability measure used by the commercial airline and transit industries. This reliability measurement is computed based on the percent of trips that reach a destination over a designated facility within a given travel time (or equivalently, at a given travel speed or higher) (8,19,20). The on-time arrival percentage is a universal dimensionless measurement that is easily comprehended by many travelers, which provides comparability between different periods, and across different facilities and different modes (8). This concept uses an acceptable "lateness" threshold, which varies based on trip purpose and cost to arriving late. For example, where leisurely trips may have a higher travel time threshold, trips to work or freight hauling trips may have a lower threshold. Schrank and Lomax have suggested a threshold as 10 percent, meaning that the percent of on time arrivals would be defined as trips that do not exceed 110% of the average travel time for that period (5).

Misery indices are computed based on the average number of minutes that the "worst" x-percent of trips exceed the average (5). This index is more useful for agency reporting purposes rather than for communication to the public. For example, the misery index may be computed

based on the 20 percent of trips with the longest travel times compared to the average trip duration, as follows:

$$\text{Misery Index} = \frac{\text{Avg Travel Rate for Longest 20\% of Trips (min/mile)}}{\text{Avg Travel Rate for All Trips (min/mile)}}$$

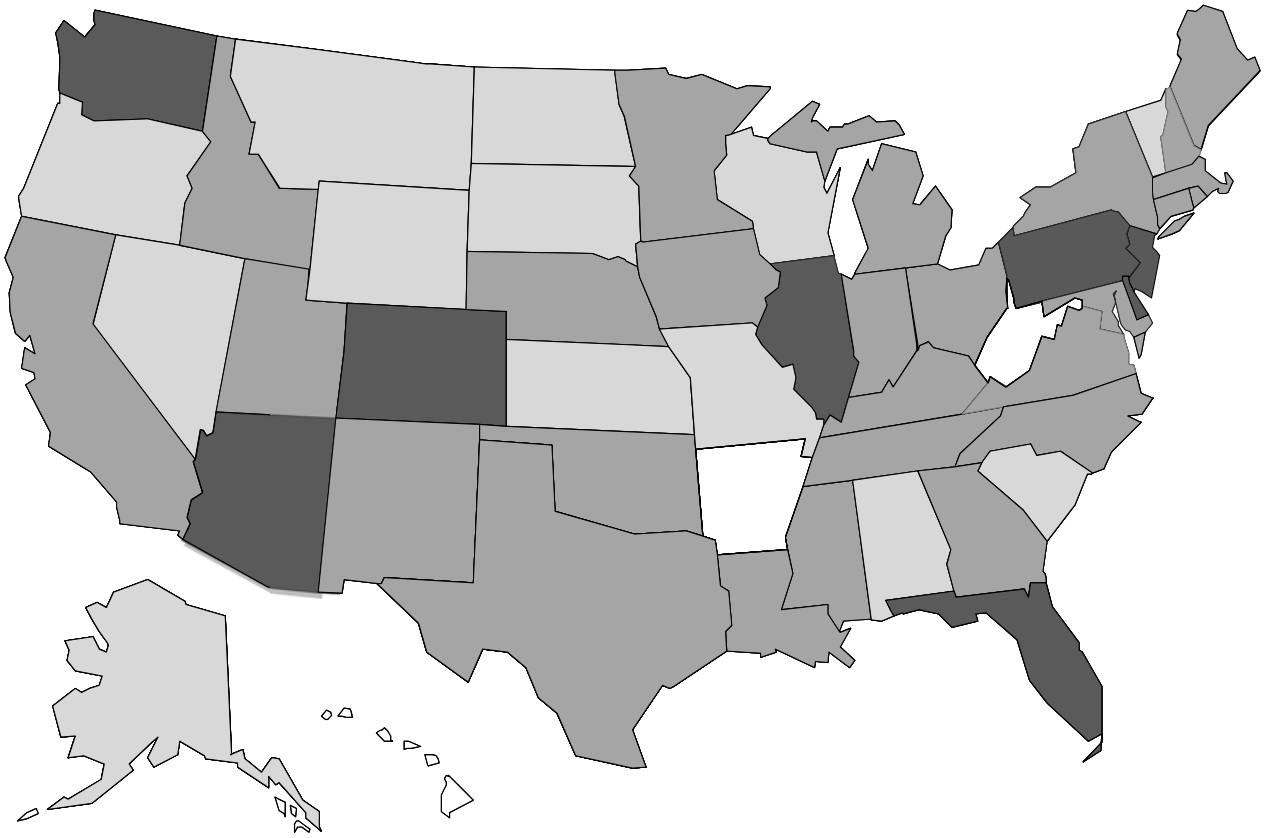
CURRENT PRACTICE FOR ONLINE COMMUNICATION OF TRAFFIC CONDITION INFORMATION

To counter the increasing congestion levels, many transportation agencies across the United States, including the Michigan Department of Transportation (MDOT), communicate real-time segment travel times and other necessary roadway condition data, such as travel speed, congestion, incident locations, alternative routes, reliability, work zone locations, and/or weather to travelers. Such information is distributed to travelers through a broad array of communication methods, most notably via changeable message signs, the internet, in-vehicle GPS, media traffic reports, highway advisory radio, 511 services, and other sources. These communication methods help travelers make informed decisions both pre-trip and en route pertaining to route choice, mode choice, and departure time, and also help them form realistic travel expectations. Although agencies often collect and communicate real-time roadway condition data using modern vehicular detection systems, numerous private sector companies also collect and/or communicate such data.

A nationwide state-of-the-practice review was conducted, specifically focusing on the procedures utilized by State DOTs with respect to the types of information and methods for providing travel planning and traffic related information in an online format. A particularly useful resource was the FHWA's National Traffic and Road Closure Information website: http://www.fhwa.dot.gov/trafficinfo/. This website provides a comprehensive collection of available traffic information websites nationwide, including both DOT websites and commercial websites. Table 1 and Figure 2 summarize the information found during this review. The list of available traffic information websites for each of the 50 states and select major cities is provided in Appendix A. A detailed list of specific information provided within the traffic information website for each state is also provided in Appendix A.

Table 1. Types of Travel Planning/Traffic Related Info Available on State Traffic Websites

Type of Information	Frequency	Percent
Interactive Map	47	94
Construction Info	48	96
Incidents	42	84
Road Conditions	43	86
Color Coded Speed or Flow	35	70
Weather Conditions	41	82
Travel Time/Reliability	9	18
Mobile Version Available	30	60



Legend:

- No traffic condition map or related travel planning information
- Traffic condition map
- Traffic condition map with current segment speed or traffic flow indications
- Traffic condition map with current and average segment travel times and/or other reliability information

Figure 2. Online Traffic Condition Map and Associated Information, by State

The state-of-the-practice review found that all states have some level of traffic related information available online to assist travelers with determining suitable routes and/or departure times. At the basic level, 47 of the 50 states provide information related to construction, incidents, weather, and/or general roadway condition information, typically on some sort of interactive state or regional map. In most cases, the information is hosted on an official state website, and many states also provided a mobile version of the website. In several cases, similar traffic related information is also available either for the entire state or major metropolitan areas through one or more third-party websites. Some states provide links to available third-party website(s) in lieu of displaying the actual traffic information. Although several states provide a color-coded map displaying either current travel speeds or traffic flow conditions, it was determined that relatively few states provide information related to travel reliability. Furthermore, those that do provide such information typically give only basic reliability information, such as a side-by-side comparison of current vs. average segment travel times.

Arizona DOT provided the best example of a state-maintained website displaying a color coded map that includes route reliability information, as shown in Figure 3. Washington DOT also provided a good example for displaying current versus average travel times, although this information was somewhat difficult to access and was not directly available from the traffic condition map. Current travel times that exceeded the average were shown as red text, while travel times that were below the average were shown as green text, as shown in Figure 4.

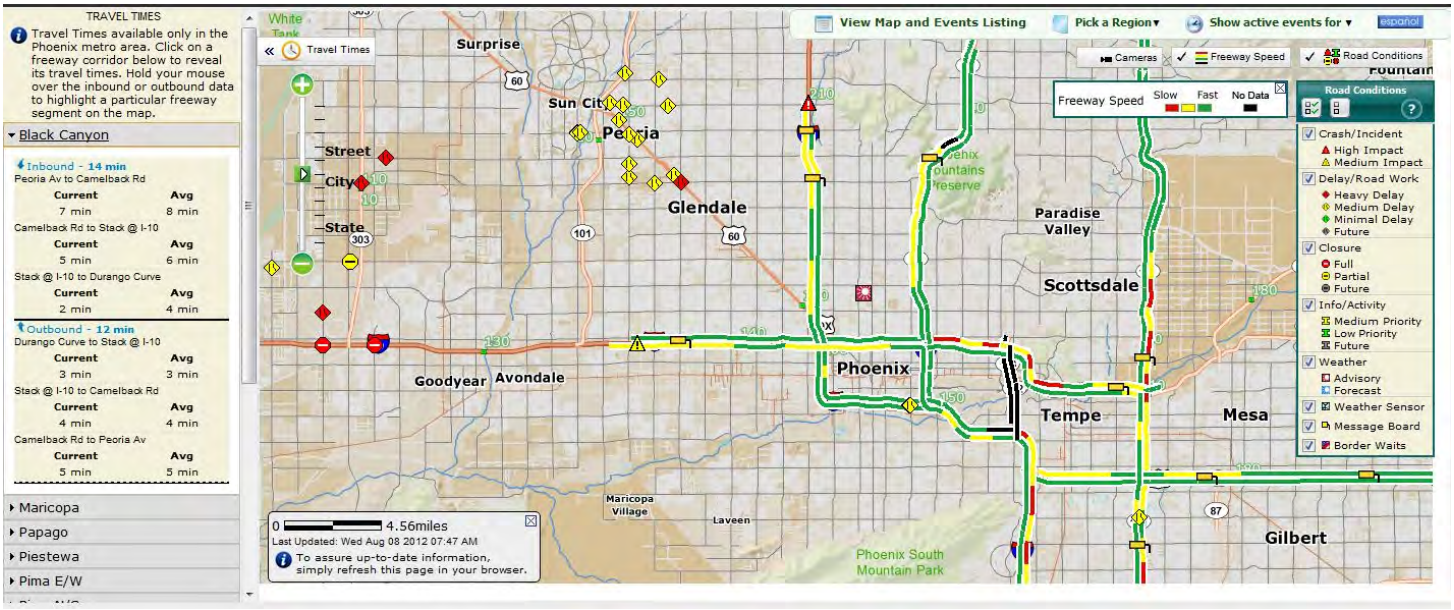


Figure 3. Arizona DOT Online Traffic Condition Map with Phoenix-Area Travel Times

State Route/ Interstate	Route Description	Distance (miles)	Average Travel Time (minutes)	Current Travel Time (minutes)	Via HOV (min.)
167	Auburn to Renton	9.8	11	12	10
405	Bellevue to Bothell	9.7	14	19	12
405 5	Bellevue to Everett	26.1	41	38	29
405 5	Bellevue to Federal Way	24.6	42	39	26
405 90	Bellevue to Issaquah	9.6	12	17	12
405	Bellevue to Lynnwood	15.6	20	24	17
405 520	Bellevue to Redmond	6.7	8	7	7
405	Bellevue to Renton	11.2	24	23	14
405 90 5	Bellevue to Seattle	10.6	16	15	14
	Via Westbound Express Lanes	N/A	N/A	N/A	N/A
405 520 5	Bellevue to Seattle	9.8	14	12	12

Figure 4. Washington DOT Online Travel Time Information for Seattle-Area

SUMMARY OF FINDINGS

There remains an overall lack of consensus on the quantitative measures that best reflect travel time reliability. Reliability measures that best serve as agency performance measures may not be easily utilized by the traveling public. What is evident is that traffic information should be quantified in a manner that provides the greatest level of flexibility in order to meet the needs of a broad range of users. The data should be communicated to users in a variety of formats, including both tabular and graphical displays, using a variety of communication channels. Lomax and Schrank suggest that selection of mobility-related measures, such as those related to travel times, speeds, or reliability should (5):

- Relate to goals and objectives of the agency;
- Clearly communicate results in an understandable and usable format;

- Be consistent and accurate;
- Illustrate effect of improvements over time;
- Consider available travel modes in urban areas;
- Apply to existing and future conditions;
- Apply broadly across all regions, and
- Use cost-effective methods to collect and/or estimate data.

The following table provides a summary of several available measures for travel time reliability and variability along with citations from the research literature.

Table 2. Common Measures of Travel Reliability or Variability Reported in the Literature

Category	Measure	Prior Research
Statistical Range	Variability Index	Lomax (5)
	Coefficient of Variation	Lomax (5), Pu (12), Rakha (4), Chien and Kolluri (21)
	Travel Time Window	Lomax (5)
	Travel Time Index	Lyman and Bertini (22), FHWA (10)
Buffer Time	Buffer Time Index	Lomax (5), Pu (12), Chien and Kolluri (21) , Lyman and Bertini (22), Chu (14), Elefteriadou (20), Pu and Meese (15), FHWA (10)
	Planning Time Index	Lyman and Bertini (22), Chu (14), Pu and Meese (15), FHWA (10)
Tardy Trip	Misery Index	Lomax (5)
	Florida Reliability Model	Florida DOT (18)
	On-Time Arrival Rate	Elefteriadou (20), Watkins and Rutherford (23)

CHAPTER 3:
SURVEY OF EN ROUTE TRAVELERS

Although transportation reliability and trip satisfaction research has become more common over the past decade, several questions pertaining to travel reliability and satisfaction in Michigan remain. In an effort to better understand Michigan travelers' satisfaction and preferences, a comprehensive interview-style questionnaire survey was conducted at a sample of public rest areas across the State of Michigan. The primary objectives of this survey were to:

- Determine traveler satisfaction with the MDOT transportation system;
- Determine route selection preferences of travelers, and
- Determine communication preferences for travel reliability information.

The survey sought to determine the opinions and preferences of travelers on MDOT highways pertaining to the following subjects:

- Level of satisfaction associated with specific routes and Michigan travel in general;
- Factors that influence trip satisfaction;
- Reason for selecting a particular route;
- Definition of an unacceptably late arrival to the destination;
- Buffer time added to account for unexpected delays en route;
- Relative value of travel time versus reliability;
- Desired types of traffic condition information, and
- Familiarity and frequency of use of MiDrive and other sources of traffic information.

The survey also solicited demographic related data from the respondents, including zip code, age, job status, trip purpose, trip duration, and familiarity with the particular roadway. This information allowed for analysis of the differences in response due to such factors. In particular, three distinct types of travelers were targeted:

- Drivers of commercial trucks,
- Work-related travelers, and
- Leisure travelers (recreational travelers, vacationers, personal business, etc.).

SURVEY METHODS

The survey locations were selected to include each MDOT region and each major freeway in Michigan, with bi-directional representation along the primary interstate routes of I-94, I-75, I-96, and I-69. Selecting sites in this manner ensured statewide representation and allowed for comparison to be made between traveler responses between regions and routes. The overall target number of survey responses was determined based on the following equation using a 1.5 percent margin of error (Δ) at a 95 percent level of confidence ($Z_{\alpha/2} = 1.96$):

$$n \cong \frac{(Z_{\alpha/2})^2 0.5^2}{\Delta^2}$$

The preceding equation yielded a minimum sample size of approximately 4,270 surveys. The target number of surveys per region was based on the regional vehicle miles traveled (VMT) as a proportion of the statewide total. The target number of surveys per region is shown in Table 3 along with the actual number of surveys obtained.

Table 3. Target and Actual Survey Sample Size by Region

Region	VMT (2009)	% of Total VMT	Target No. of Surveys	Actual No. of Surveys	% of Total Surveys
Bay	12,535,263	13.1	558	987	21.4
Grand	12,170,912	12.7	542	437	9.5
Detroit Metro	35,774,655	37.3	1592	1437	31.2
North	6,407,424	6.7	285	402	8.7
Southwest	10,293,556	10.7	458	537	11.7
Superior	3,196,858	3.3	142	208	4.5
University	15,562,057	16.2	693	599	13.0
TOTAL	95,910,725	100	4,270	4607	100

In order to collect an adequate representation of statewide travelers, the surveys were administered at 30 MDOT public rest areas and welcome centers located throughout the State of Michigan. The rest area locations were selected to include at least one rest area within each MDOT region and along each limited access freeway. Multiple rest areas in each direction were selected for each of the major truck-haul routes in Michigan, which included I-75, I-94, and I-69. Table 4 displays the number of surveys obtained by roadway and the location of survey sites is identified in Figure 5.

Table 4. Survey Sample Size by Roadway

Roadway	Surveys Obtained
I-94	1293
I-96	789
I-69	160
I-75	1305
I-275	74
US-127	325
US-23	274
US-31	63
US-131	59
US-2	208
I-196	57
TOTAL	**4607**

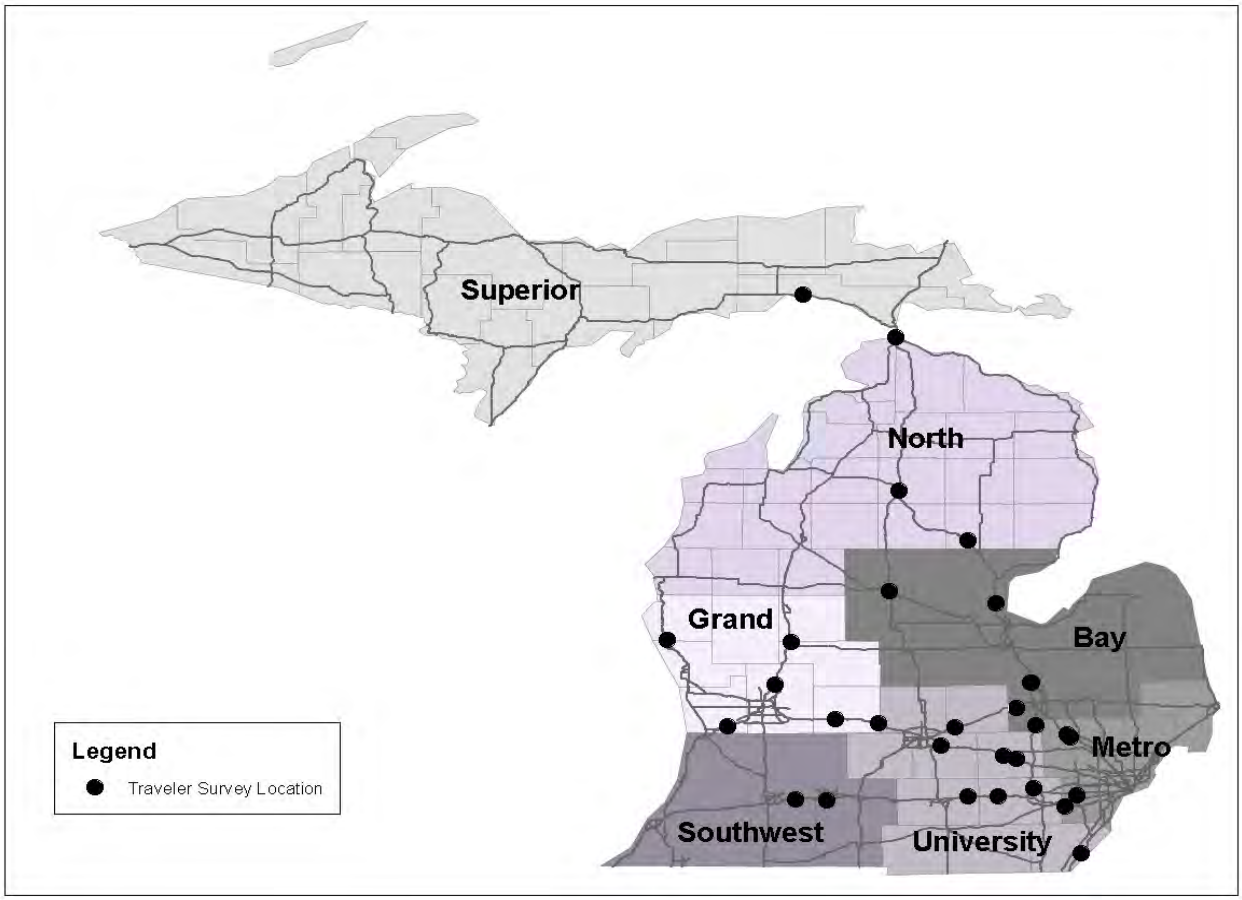


Figure 5. Michigan Rest Area Site Locations for Traveler Survey

The surveys were conducted at the selected rest areas from May to July 2012. In most cases, all surveys were obtained for an individual site within a single day, although surveys were performed on multiple days at selected locations. The surveys were performed on weekdays and weekends and were typically performed between the hours of 8:30 AM and 4:00 PM. The surveys were not administered at night for safety reasons. Surveys were typically performed on weekdays at rest areas located along primary trucking routes, including all freeways in southern Michigan. Weekend surveys were typically reserved for locations along recreational routes, particularly those located in northern Michigan and the Upper Peninsula.

The surveys were conducted by a team of two to three individuals. At least one surveyor was stationed at each entry point to the building with a portable canopy, folding table, and sign, as shown in Figure 6. Patrons approaching the facility were asked to participate in the survey and were given the option to take the survey either before or after entering the building. Whenever possible, the surveyors would also walk through the parking areas to interview persons that did not enter the building. However, it was not possible to engage all persons that did not approach the rest area building.

The survey instrument consisted of a one-page questionnaire targeted at drivers and passengers of passenger vehicles, recreational vehicles, and commercial vehicles. The questionnaire included a total of 19 questions and was designed to be as concise as possible to encourage a high level of response. The survey questionnaire included the following topics (full questionnaire form is provided in Appendix B):

- Traveler information, including: zip code, age, and type of job held by respondent;
- Trip information, including: trip purpose (truck haul, recreation, work, etc.), trip duration, time sensitivity for late arrival, and extra buffer time added to account for delays;
- Factors causing highest travel dissatisfaction (arriving late, encountering unexpected delay, stop-and-go traffic, and traveling below desired speed);
- Level of satisfaction with travel on the specific roadway and Michigan travel in general;
- Familiarity/frequency of use of MiDrive website for trip planning;
- Preferred communication method for reliability information (online, television traffic reports, radio traffic reports, and in-vehicle devices),

- Importance of items presented on traffic information websites (travel speeds, travel times, work zone, incidents, route reliability, etc.).

Figure 6. Examples of On-Site Rest Area User Survey Administration

Table 5 provides a summary of locations and corresponding dates that the surveys were conducted along with the total number of surveys obtained per location. A total of 4,607 surveys were obtained, representing an average of 153 surveys per each of the 30 locations. The survey data were analyzed using ordinal regression techniques to determine the factors that affect the preferences and behaviors of survey respondents. Given the inherent ordered structure and multiple categories for each dependent variable, ordered logit models allow for the best analysis of the data.

Table 5. En Route Traveler Survey Locations, Dates, and Number of Responses Obtained

Region*	Facility Name	Roadway and Direction	Dates Surveys Conducted (2012)	No. of Surveys
Bay	Clare	US-127 NB/SB	6/21	325
Bay	Clio	I-75 SB	5/24	53
Bay	Dodge Rd	I-75 NB	5/24	299
Bay	Fenton	US-23 NB	5/22	58
Bay	Linwood	I-75 NB	5/25	194
Bay	Swartz Creek	I-69 EB	5/23	58
Grand	Morley	US-131 NB	6/14	27
Grand	Portland	I-96 WB	6/5	115
Grand	Rockford	US-131 SB	6/14	32
Grand	Rothbury	US-31 NB	6/15	63
Grand	Saranac	I-96 EB	6/7, 6/20	143
Grand	Zeeland	I-196 EB	6/13	57
Metro Detroit*	Belleville	I-94 WB	5/23, 6/6	211
Metro Detroit*	Chelsea	I-94 EB	5/17, 6/5	340
Metro Detroit*	Clarkston	I-75 SB	5/17, 6/6	106
Metro Detroit*	Davisburg	I-75 NB	5/18, 6/6	97
Metro Detroit*	Howell	I-96 EB	5/16, 6/1	275
Metro Detroit*	Lake Chemung	I-96 WB	5/18	180
Metro Detroit*	Monroe	I-75 NB	5/25	154
Metro Detroit*	Westland	I-275 NB	5/22	74
North	Grayling	I-75 NB	6/21	107
North	Mackinac	I-75 NB	7/6	84
North	West Branch	I-75 NB	6/21	211
Southwest	Battle Creek	I-94 EB	6/7	219
Southwest	Galesburg	I-94 WB	6/8	318
Superior	Naubinway	US-2 EB/WB	7/7	208
University	Grass Lake	I-94 WB	5/31	205
University	Northfield Church	US-23 SB	5/30	216
University	Okemos	I-96 EB	5/30	76
University	Woodbury	I-69 WB	5/31	102
TOTAL				**4,607**

*Metro Detroit included facilities within 25 miles of the MDOT Metro Region and along a primary Interstate freeway leading directly into the Metro Region.

RESULTS

Demographic Characteristics

A summary of the survey respondent demographics including home region, age, and job status is provided in Table 6. Approximately 73 percent of all survey respondents resided in Michigan, while 19 percent were from other portions of the United States, and 2.5 percent resided in Canada. The most widely represented MDOT region of residence was the Metro Region with approximately one third of all respondents, while all other regions of Michigan combined were represented by a total of 40 percent of the total survey respondents. Nearly 24 percent of respondents were between the ages of 16 and 44, another 20.3 percent were ages 45 to 54, and just over half of the survey participants were 55 years or older. In terms of job status, 63 percent of travelers were employed, while 37 percent reported either being retired, not employed, or a student.

Table 6. En Route Traveler Survey Participant Demographics

Category	Sub-Category	Number of Respondents	Percent of Respondents
Region of Residence (MDOT Region, where applicable)	Superior	40	0.9
	North	258	5.6
	Grand	405	8.8
	Bay	443	9.6
	Southwest	269	5.8
	University	396	8.6
	Metro	1559	33.8
	Out of State	881	19.2
	Canada	116	2.5
	No Response	240	5.2
Age Group	16-29	351	7.6
	30-44	737	16.0
	45-54	934	20.3
	55-64	1291	28.0
	65+	1058	23.0
	No Response	236	5.1
Job Status	Full Time: Salary	1390	30.2
	Part Time	304	6.6
	Student	124	2.7
	Full Time: Hourly	837	18.2
	Not Employed	177	3.8
	Retired	1386	30.1
	Self Employed	341	7.4
	No Response	48	1.0

Trip Characteristics

A summary of the trip characteristics of the survey respondents including trip purpose, duration, and annual frequency on the particular route is provided in Table 7. The majority of survey respondents (70 percent) were on leisure trips that were not related to work. This included trips specified as recreation, vacation, or personal business. Approximately 10 percent of travelers were commercial vehicle operators driving a truck haul route and the remaining travelers were on a work trip (21 percent). Over half of travelers were on a trip with duration of 2 to 6 hours, while nearly a quarter of respondents indicated a trip of 8 or more hours. Truck drivers tended to be on longer trips, as the median truck driver trip duration was approximately 8 hours. The vast majority (approximately 84 percent) of the survey respondents had previously traveled along the particular section of roadway within the prior 12 months. Only 16 percent were first-time travelers along the roadway. Truck drivers tended to travel more frequently on the particular route as weekly travel was the approximate median route frequency for truck drivers. It is also important to note that the home residence of the surveyed truck drivers was split approximately evenly between Michigan and all other states. Further, approximately 20 percent of the truck drivers resided in the Metro Region.

Table 7. En Route Traveler Survey Trip Characteristics

Category	Sub-Category	Number of Respondents	Percent of Respondents
Trip Purpose	Truck Haul	475	10.3
	Work Trip	957	20.8
	Leisure Trip	3126	67.9
	No Response	49	1.1
Trip Duration	Less than 1 hour	114	2.5
	1 to 2 hours	446	9.7
	2 to 4 hours	1204	26.1
	4 to 6 hours	1056	22.9
	6 to 8 hours	709	15.4
	8 + hours	1048	22.7
	No Response	30	0.7
Annual Frequency On Route	First time	762	16.5
	2-5 times	1596	34.6
	6-20 times	1109	24.1
	20-50 times	540	11.7
	51+ times	585	12.7
	No Response	15	0.3

MiDrive Familiarity and Use

Overall, 22.5 percent of respondents reported that they were familiar with MDOT's MiDrive website. Approximately 27 percent of travelers had obtained traffic information prior to departing on the particular trip, although only 1.9 percent indicated MiDrive as the source. The responses were found to vary based on several demographic or trip related characteristics, as reflected in Table 8. The overall results are also displayed in Figure 7.

Table 8. MiDrive Familiarity and Use Based on Demographic and Trip Characteristics

			Percent of Respondents		
Category	**Subcategory**	**Sample Size**	**Familiar with MiDrive**	**Obtained Traffic Info Today**	**Used MiDrive Today**
Trip Purpose	Truck Haul	473	27.4	35.3	4.3
	Work Trip	951	25.6	26.6	1.2
	Leisure Trip	3096	21.0	25.1	1.8
Age Group	16-29	349	16.1	26.4	2.6
	30-44	733	22.9	27.8	1.5
	45-54	927	25.7	31.0	2.4
	55-64	1283	25.4	25.9	2.1
	65+	1045	17.8	22.0	0.9
Employment Status	Employed	2979	23.7	27.4	2.3
	Not Employed	1544	20.1	24.3	1.2
Home Region	Superior	39	17.9	15.4	0.0
	North	258	20.6	20.5	1.2
	Grand	403	22.9	24.8	1.0
	Bay	441	25.6	24.7	1.9
	Southwest	267	22.6	25.1	2.3
	University	394	27.9	19.3	1.3
	Metro	1541	27.4	28.2	2.7
Home State	Michigan	3365	25.7	25.3	2.0
	Border State	628	13.2	31.8	2.1
	Other State	567	14.3	27.9	1.3
Trip Duration	< 2 hours	556		21.8	1.8
	2 to 4 hrs	1196		24.1	1.4
	4 to 6 hrs	1047		27.3	2.2
	6 to 8 hrs	705		28.4	1.7
	8 + hrs	1036		29.5	2.3
Number of Times on Roadway	First Time	752		33.5	0.7
	2-5 Times	1582		26.8	2.5
	6-20 Times	1102		24.0	2.1
	21-50 Times	539		21.9	1.9
	51+ Times	580		25.7	1.7
	TOTAL	**4560**	**22.5**	**26.5**	**1.9**

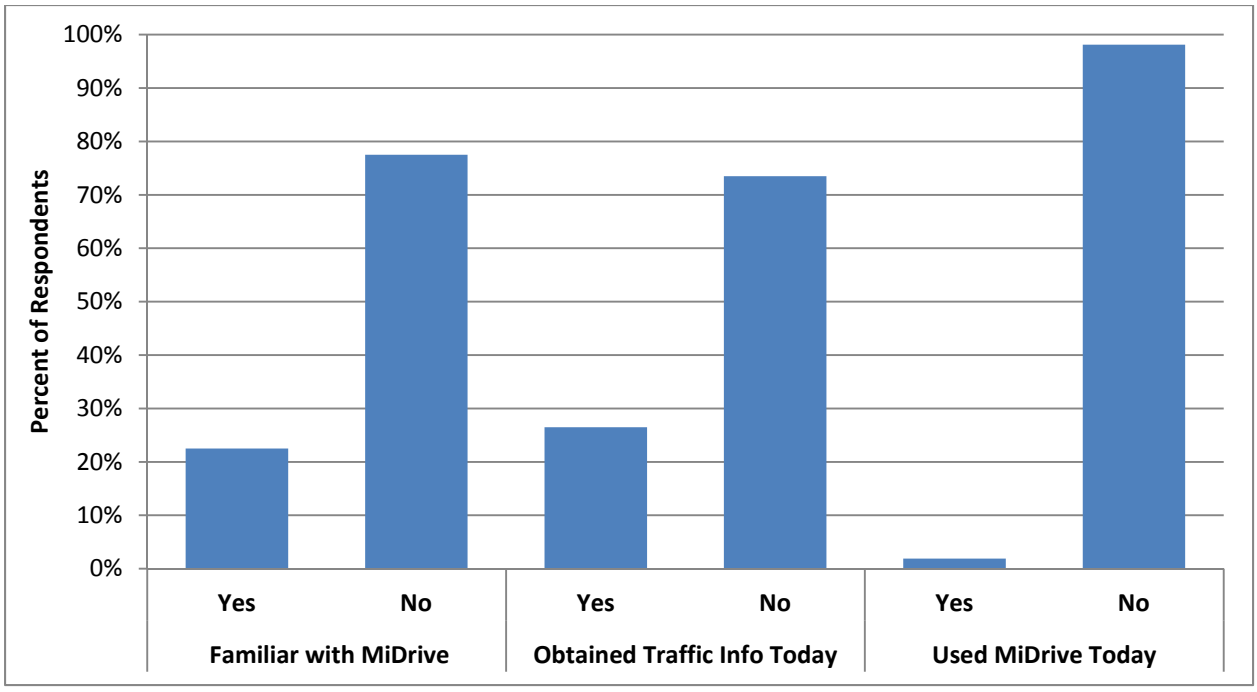
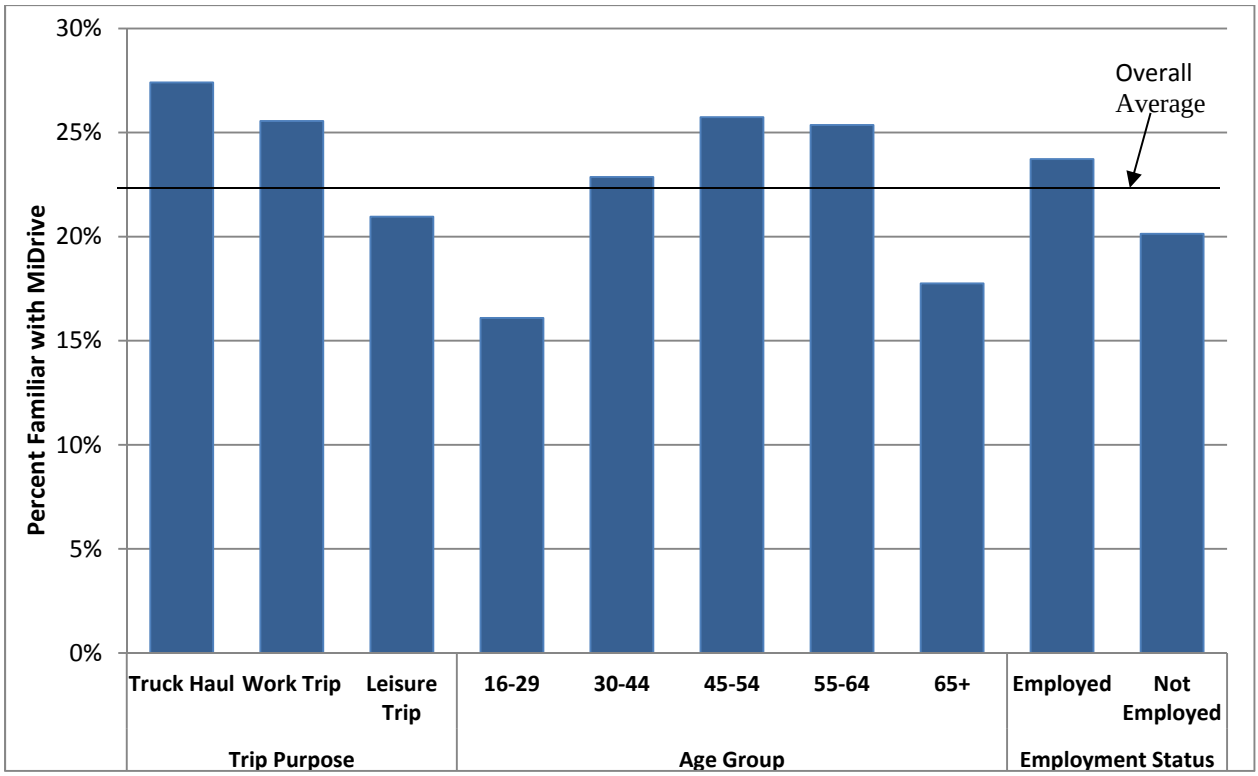
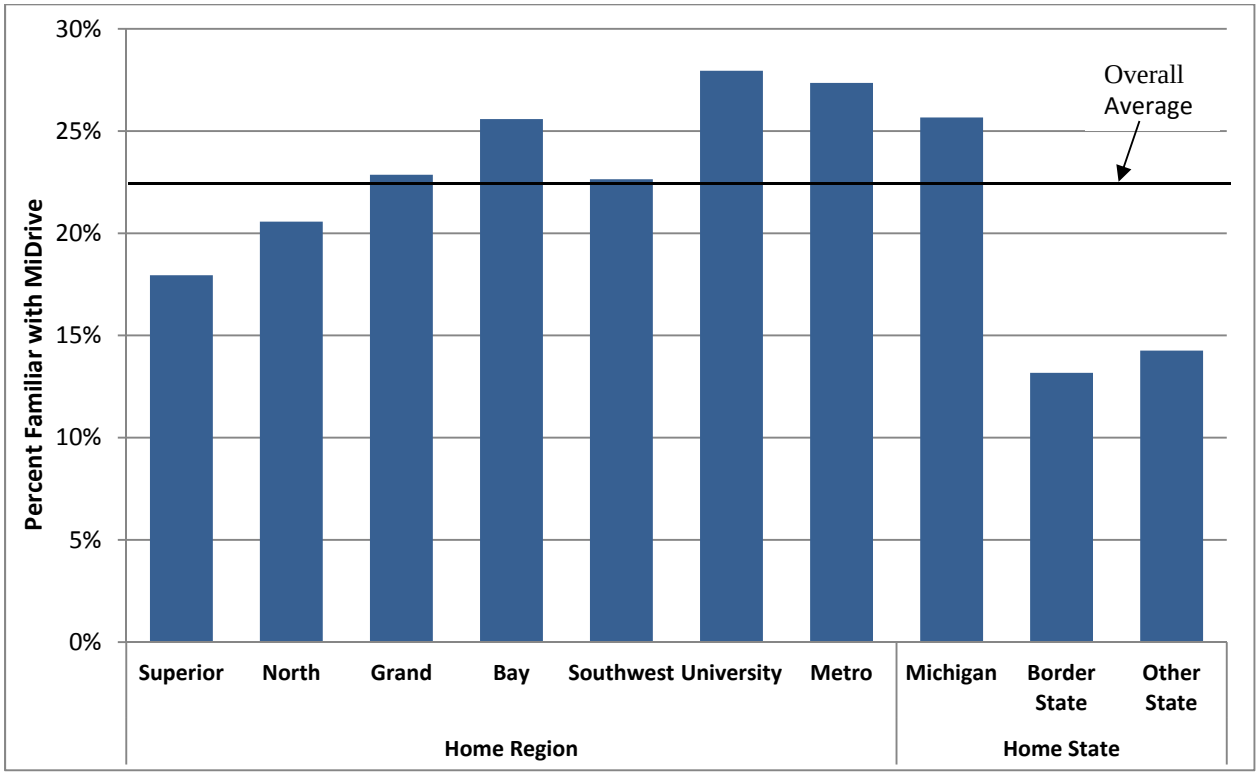


Figure 7. Overall Response for MiDrive Familiarity and Use.

Truck drivers showed the highest level of familiarity with MiDrive across all traveler groups at 27.4 percent. Truckers also most frequently obtained traffic information prior to departure for the particular trip (35.3 percent) and most frequently utilized MiDrive for the particular trip (4.3 percent). Higher levels of familiarity were observed for travelers between the ages of 45 and 64, while lower familiarity was observed for the youngest (16 – 29) and oldest (65+) age groups. The 65 and older age group was also far less likely to have utilized MiDrive for the particular trip. Travelers that were employed were more likely to be familiar with MiDrive than travelers that were not employed and were almost twice as likely to have utilized MiDrive for the particular trip. Travelers residing within Michigan were nearly twice as likely to be familiar with MiDrive as travelers from out-of-state. However, travelers from outside of Michigan were more likely to seek traffic information prior to the particular trip. In terms of MDOT Regions, travelers residing in the Metro and University Regions showed higher levels of familiarity with MiDrive, while travelers residing in the North and Superior Regions showed lower levels. Travelers on longer trips, and on the particular roadway for the first time, were more likely to have sought traffic information prior to departure. The results related to MiDrive familiarity with respect to traveler demographic and trip characteristics are reflected in Figures 8a and 8b.



a. by Trip Purpose, Age Group, and Employment Status



b. by Home Region and Home State

Figure 8. Traveler Familiarity with MiDrive Based on Demographic and Trip Characteristics

Sources of Traffic Information and MiDrive Use

Travelers were also asked about the utilization frequency of various traffic information sources either before or during travel. The sources included MiDrive, other websites, television, radio, and GPS. The results are reflected in Table 9.

Table 9. Utilization Frequency of Various Traffic Information Sources

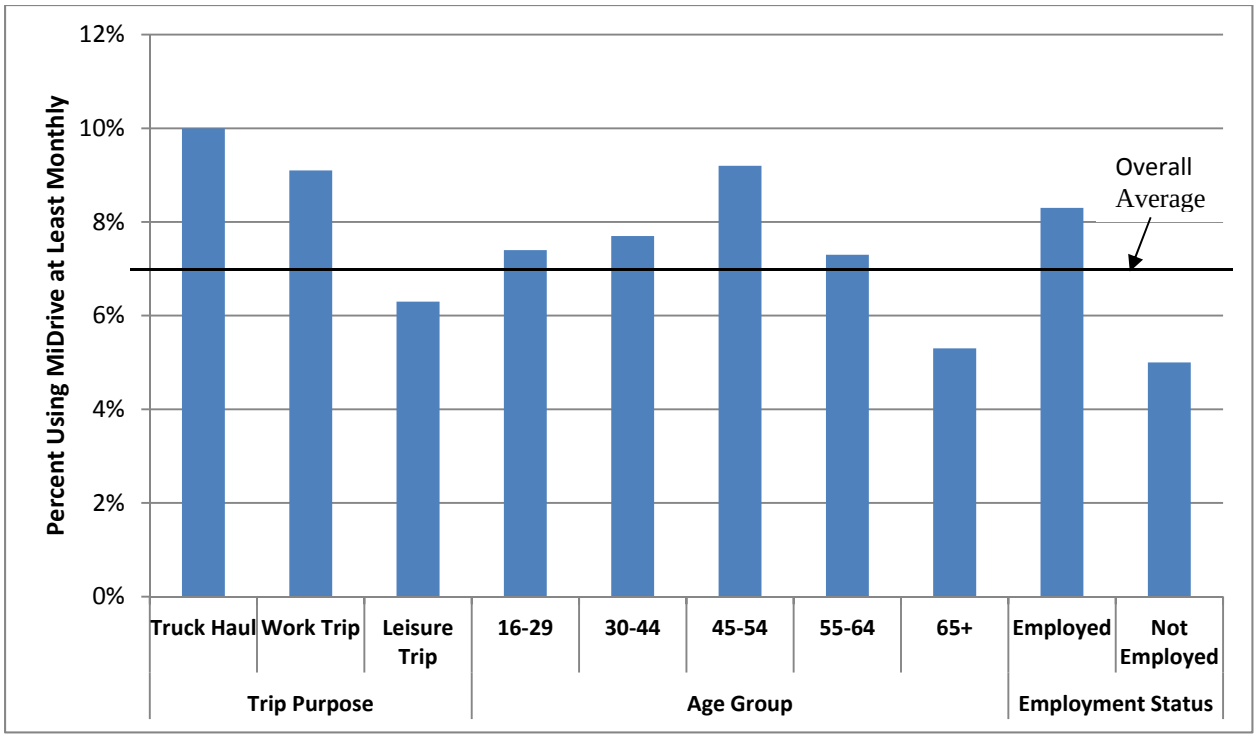
	Percent of Respondents				
Information Source	**Never**	**Yearly**	**Monthly**	**Weekly**	**Daily**
MiDrive	87.7	5.1	4.4	2.0	0.8
Other Website	68.6	7.9	12.2	8.1	3.2
Television	64.5	4.7	7.8	11.1	11.9
Radio	52.4	4.3	7.5	12.0	23.8
GPS	47.7	5.5	13.5	11.8	21.5

The most commonly utilized sources of traffic information were the radio and GPS devices with 35 percent and 33 percent of travelers, respectively, using these sources to obtain traffic information at least weekly. Only about 14 percent of travelers indicated using traffic websites on a weekly or daily basis, and fewer than 3 percent utilize MiDrive at least weekly. Approximately 7 percent of travelers utilize MiDrive at least monthly, while only 12.3 percent of travelers had ever utilized MiDrive.

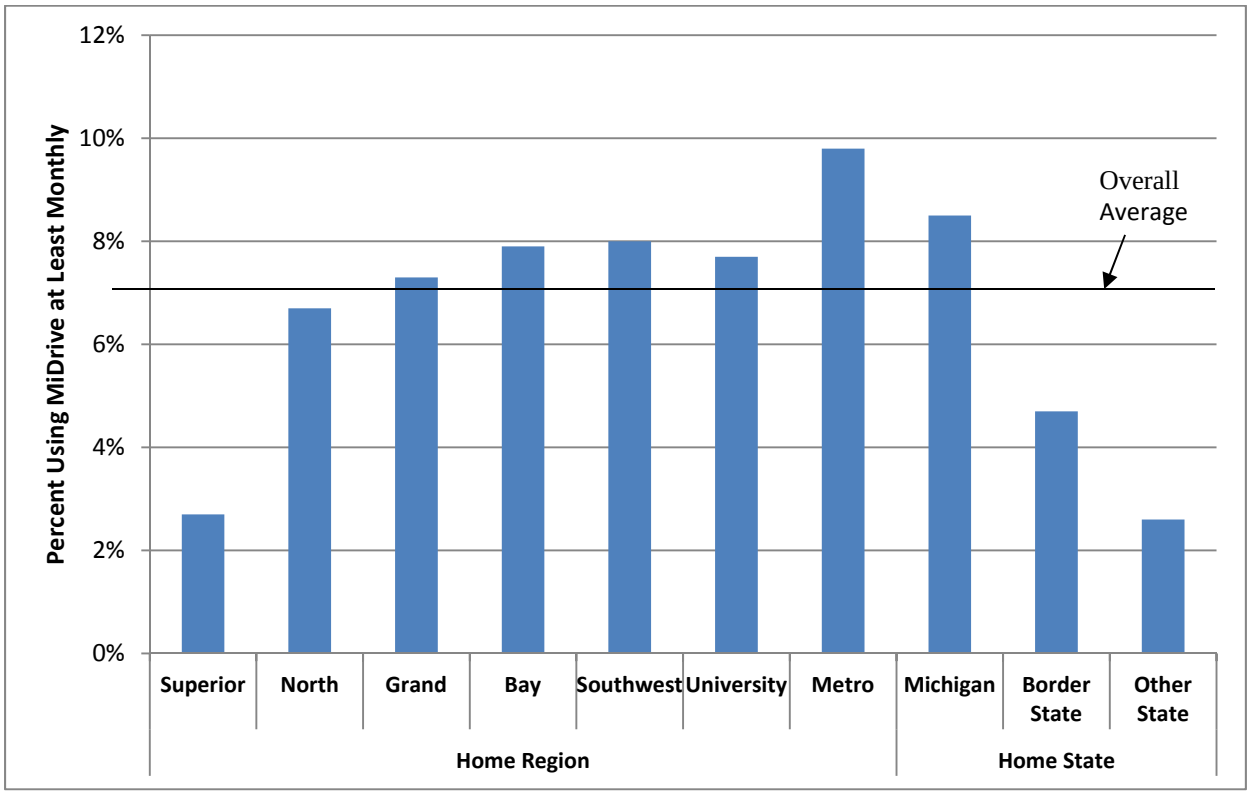
Additional analyses of the utilization of MiDrive on at least a monthly basis were also performed across demographics and trip characteristics. These results are displayed in Table 10 and Figure 9. Ten percent of truckers utilized MiDrive at least monthly, which was approximately 50 percent higher utilization rate than all other travelers. Persons over the age of 65 were approximately 50 percent less likely to utilize MiDrive at least monthly. Employed persons were approximately 66 percent more likely to utilize MiDrive at least monthly than non-employed persons. Persons residing in Metro Region showed more frequent utilization of MiDrive, while persons residing in the Superior Region showed the least frequent utilization. Michigan residents were more than twice as likely to utilize MiDrive at least monthly compared to persons residing outside of Michigan.

Table 10. Frequency of MiDrive Use Based on Demographic and Trip Characteristics

		Percent of Respondents				
Category	**Subcategory**	**Never**	**Yearly**	**Monthly**	**Weekly**	**Daily**
Trip Purpose	Truck Haul	87.7	2.3	2.9	3.4	3.7
	Work Trip	87.0	3.9	5.3	3.2	0.6
	Leisure Trip	88.0	5.7	4.4	1.5	0.4
Age Group	16-29	88.5	4.1	3.4	3.0	1.0
	30-44	87.2	5.1	4.5	2.1	1.1
	45-54	85.4	5.4	5.6	2.5	1.1
	55-64	86.5	6.3	4.5	2.2	0.6
	65+	91.4	3.3	3.9	1.0	0.4
Employment Status	Employed	86.6	5.1	4.9	2.4	1.0
	Not Employed	89.9	5.0	3.5	1.2	0.3
Home Region	Superior	89.2	8.1	2.7	0.0	0.0
	North	90.5	2.9	4.8	1.4	0.5
	Grand	85.4	7.3	4.9	1.7	0.7
	Bay	88.3	3.8	5.0	2.0	0.9
	Southwest	86.0	6.0	4.0	2.5	1.5
	University	84.2	8.0	4.5	3.2	0.0
	Metro	84.0	6.2	6.3	2.7	0.8
Home State	Michigan	85.6	5.9	5.4	2.4	0.7
	Border State	93.2	2.1	2.1	1.5	1.1
	Other State	94.0	3.5	1.4	0.5	0.7



a. by Trip Purpose, Age Group, and Employment Status



b. by Home Region and Home State

Figure 9. Percent of Travelers Using MiDrive at Least Monthly

Desired Online Traffic Information

Respondents were also asked to assess the relative importance of various types of traffic related information that are typically displayed on a traffic information website. The types of information included travel speeds, travel times, reliability, accident locations, road work information, wet/icy conditions, and freeway camera views. Table 11 reflects the overall results. The most highly valued types of information for display on a traffic information website included construction information, wet/icy road conditions, accidents, and route reliability information. Travel times, speeds, and freeway camera views were considered less important.

Table 11. Traffic Website Information Most Valued by Survey Respondents

	Percent of Respondents				
Type of Information	**Not Important**	**Somewhat Important**	**Important**	**Very Important**	**Essential**
Road Work	11.8	3.0	11.7	25.1	48.4
Wet/Icy Conditions	12.3	5.0	14.2	25.2	43.3
Accident Locations	12.4	4.5	14.9	25.6	42.5
Reliability Info	13.3	3.8	15.7	29.9	37.3
Travel Times	14.6	5.3	20.3	31.4	28.4
Travel Speeds	15.3	6.4	22.3	30.0	26.0
Freeway Cameras	32.1	16.1	25.0	13.3	13.5

Figure 10 displays the corresponding percentage of respondents who indicated “Very Important” or “Essential” for a given item, separated by trip purpose. Truck drivers and business travelers were more likely to desire nearly all types of information compared to leisure travelers. Business travelers valued nearly all types of information slightly higher than truck drivers. However, truck drivers were more likely to desire road weather information and freeway camera views, which were often noted as being useful for verifying road weather conditions downstream along a route.

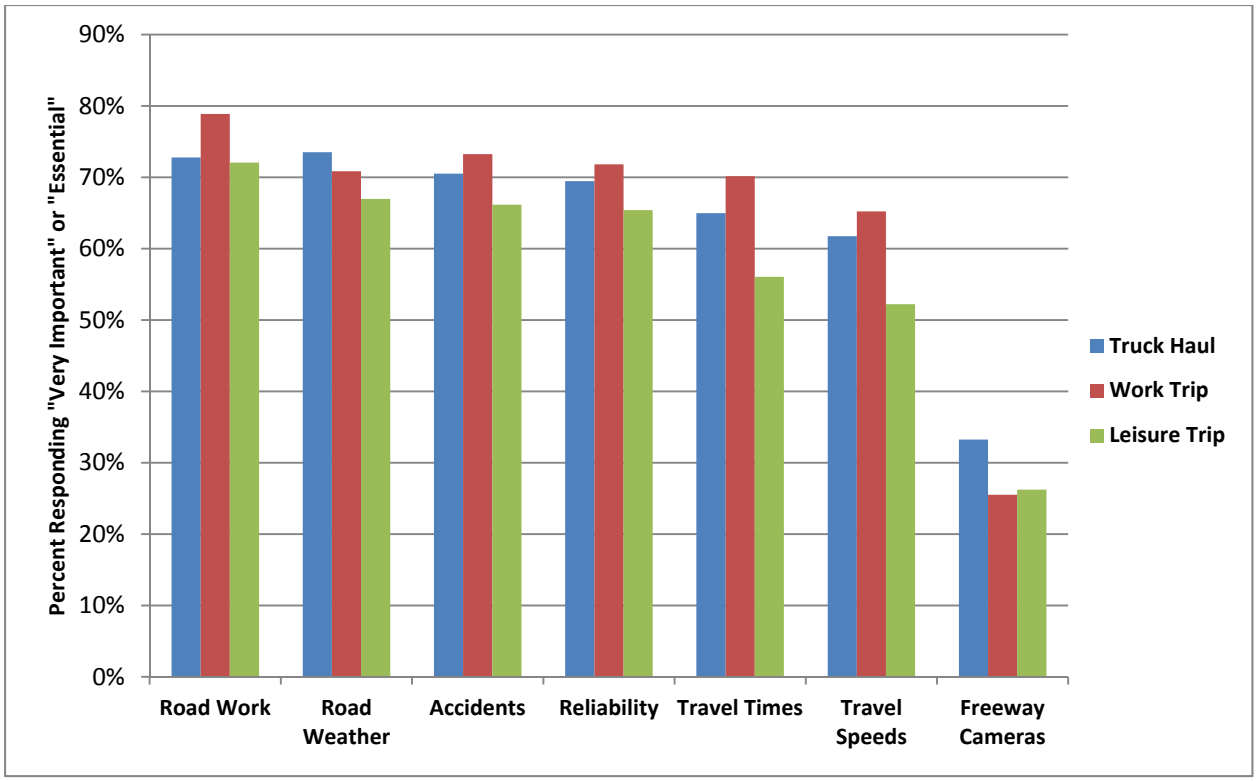


Figure 10. Relative Importance of Online Traffic Information, by Trip Purpose

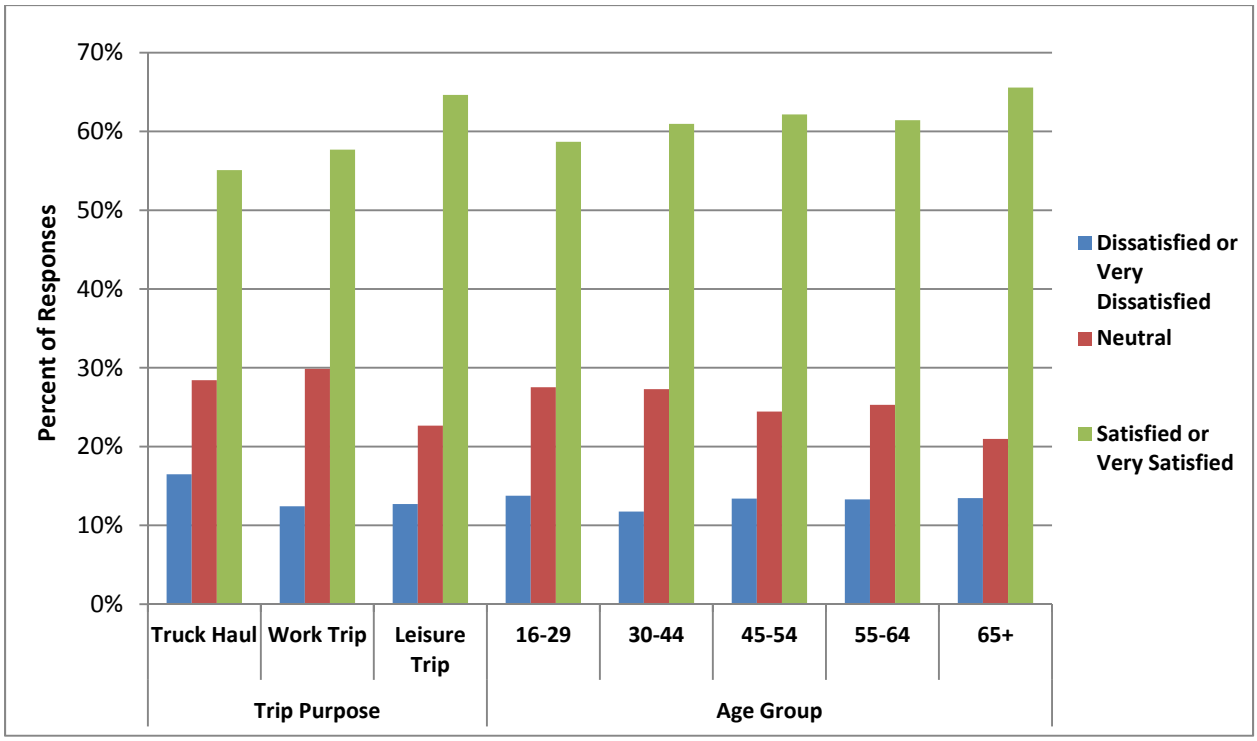
Satisfaction with Michigan Travel

Travelers were asked to rate the level of satisfaction associated with Michigan travel on a 1 (very dissatisfied) to 5 (very satisfied) scale. Considering all travelers surveyed, travel in Michigan had a mean satisfaction score of 3.70, with 62.6 percent providing a rating of 4 or 5 (satisfied or very satisfied). Approximately 13 percent of travelers were dissatisfied or very dissatisfied with Michigan travel. The level of satisfaction with Michigan travel was also investigated across the demographic and trip related categories. These results are presented in Table 12.

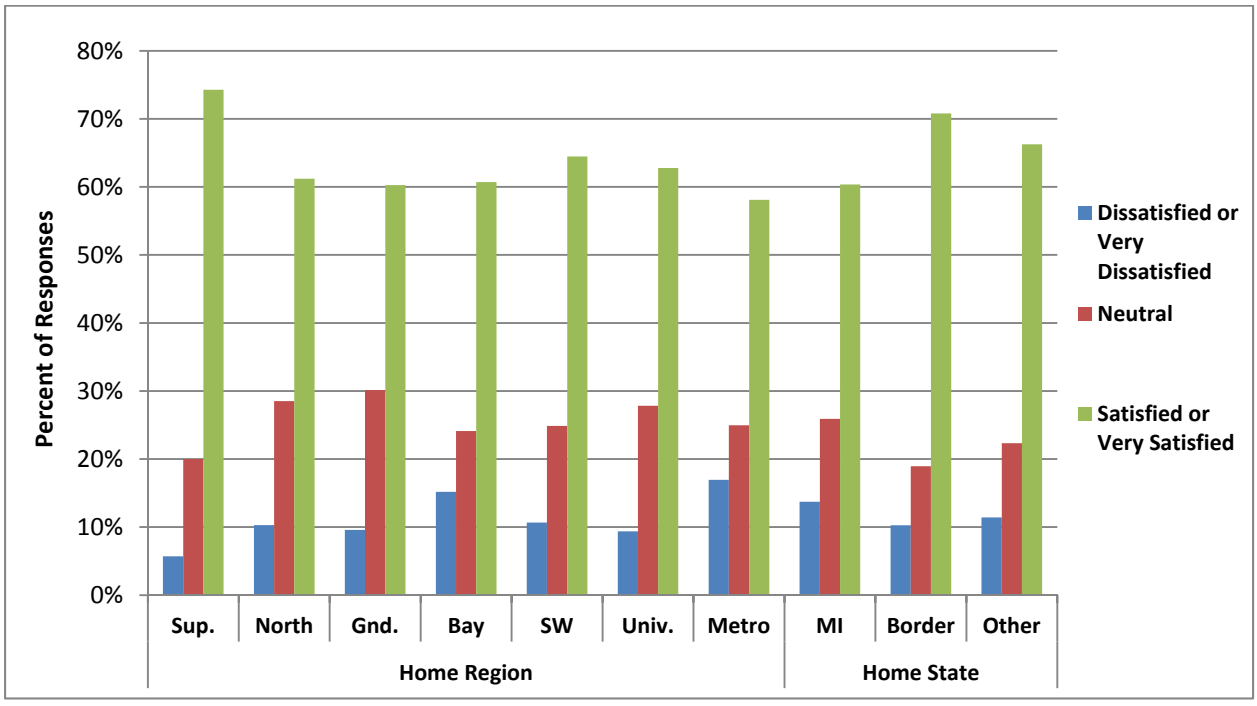
Table 12. Satisfaction with Michigan Travel by Demographic and Trip Characteristics

		Percent of Respondents		
Category	**Subcategory**	**Dissatisfied or Very Dissatisfied**	**Neutral**	**Satisfied or Very Satisfied**
Trip Purpose	Truck Haul	16.5	28.4	55.1
	Work Trip	12.4	29.9	57.7
	Leisure Trip	12.7	22.7	64.6
Age Group	16-29	13.8	27.5	58.7
	30-44	11.7	27.3	61.0
	45-54	13.4	24.4	62.2
	55-64	13.3	25.3	61.4
	65+	13.5	21.0	65.6
Employment Status	Employed	12.4	25.6	62.0
	Not Employed	13.8	22.5	63.6
Home Region	Superior	5.7	20.0	74.3
	North	10.3	28.5	61.2
	Grand	9.6	30.1	60.3
	Bay	15.2	24.1	60.7
	Southwest	10.7	24.9	64.5
	University	9.4	27.8	62.8
	Metro	17.0	25.0	58.1
Home State	Michigan	13.7	25.9	60.4
	Border State	10.3	18.9	70.8
	Other State	11.4	22.3	66.3
OVERALL		**13.0**	**24.5**	**62.6**

With the exception of employment status, there were distinct differences with the traveler satisfaction ratings across the various demographic and trip related categories. Truck drivers and travelers from the Metro Region tended to be the least satisfied with Michigan travel compared to all other travelers, as approximately 17 percent of travelers in these categories were dissatisfied or very dissatisfied with Michigan travel. Travelers from the Superior Region, travelers from outside of Michigan, leisure travelers and travelers over the age of 65 showed the highest levels of satisfaction associated with travel in Michigan. Interestingly, travelers from border states, including Wisconsin, Illinois, Indiana, Ohio, and Ontario were substantially more satisfied with Michigan travel than travelers from Michigan. The results are displayed in Figure 11. Additionally, the Michigan travel satisfaction scores are displayed by region in Figure 12.



a. by Trip Purpose and Age Group



b. by Home Region and Home State

Figure 11. Satisfaction with Michigan Travel

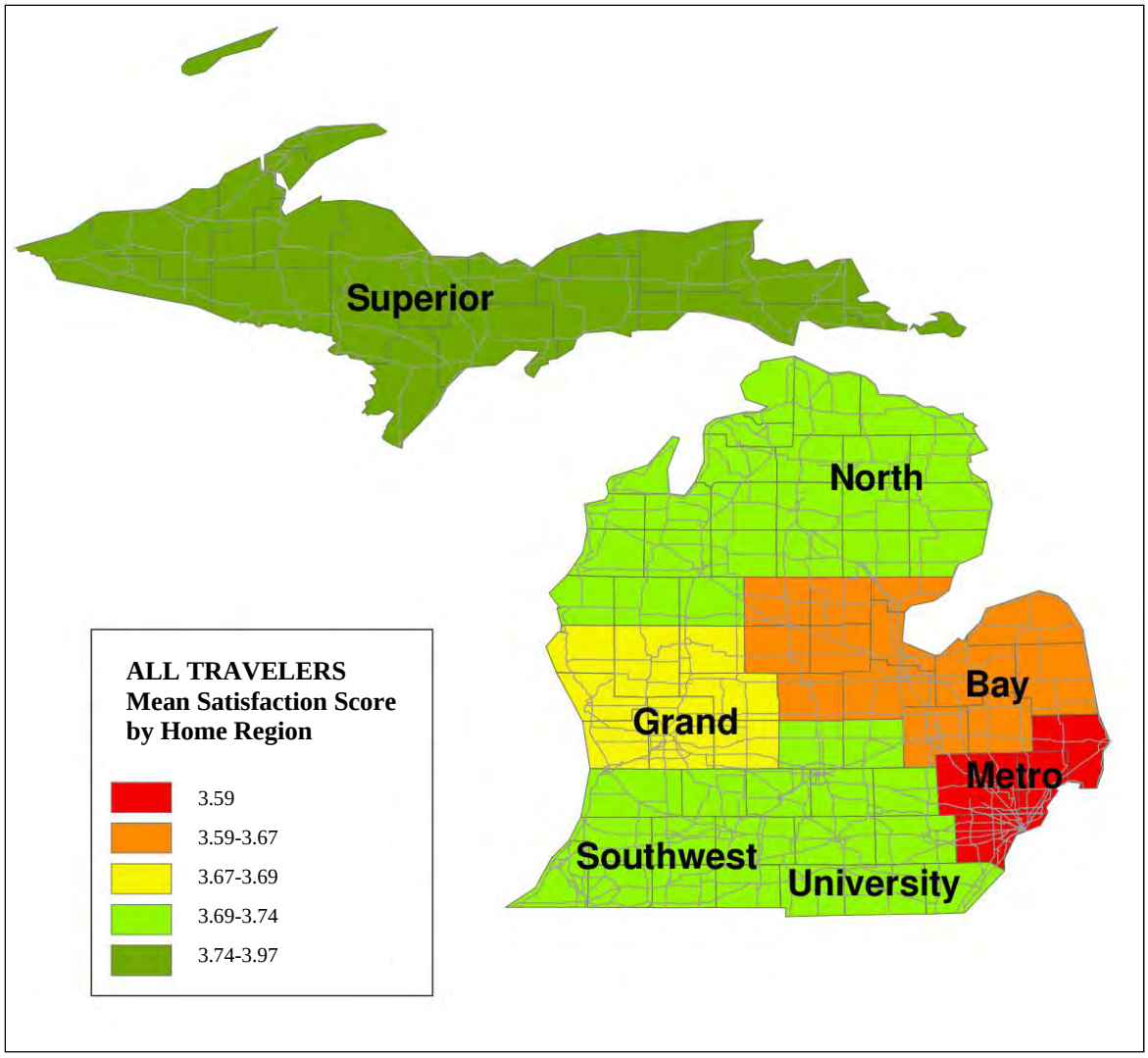


Figure 12. Satisfaction with Michigan Travel, by Home Region

Route Satisfaction

Satisfaction with the particular route was also investigated as part of the survey, both overall and for truck drivers. The routes with the highest satisfaction rating for all travelers were I-69 , I-96, and I-94 in the University Region, I-75 in the Bay and North Regions, US-31, I-96, and US-131 in the Grand Region and US-2 in the Superior Region. The lowest rated roadways overall were I-75 between the Ohio border and Genesee County, I-94 in the Metro Region, US-23 in the University Region, and I-196 in the Grand Region.

The routes with the highest satisfaction rating by truck drivers were I-69 and I-96 in the University Region and I-75 in the Bay Region. The route rated lowest by truck drivers was I-75

between the Ohio border and Genesee County, followed by I-94 in the Metro Region, and US-23 in the University Region. These results are reflected in Table 13 and Figures 13 and 14.

Table 13. Route Satisfaction – All Travelers vs. Truck Drivers

		Percent Satisfied or Very Satisfied with Travel on the Route	
Region	**Route**	**All Travelers**	**Truck Drivers Only**
Bay	I-75	78.9	77.8
Bay	US-127	87.1	Insufficient Sample Size
Metro Detroit	I-94	74.3	68.6
Metro Detroit	I-96	79.2	77.8
Metro Detroit	I-75	66.7	44.1
Grand	I-96	81.2	79.3
Grand	I-196	74.1	Insufficient Sample Size
Grand	US-31	80.6	Insufficient Sample Size
Grand	US-131	84.2	Insufficient Sample Size
North	I-75	79.3	Insufficient Sample Size
Southwest	I-94	75.7	69.4
Superior	US-2	80.3	Insufficient Sample Size
University	I-94	75.8	68.2
University	I-96	79.7	Insufficient Sample Size
University	US-23	71.6	63.6
University	I-69	86.7	90.0

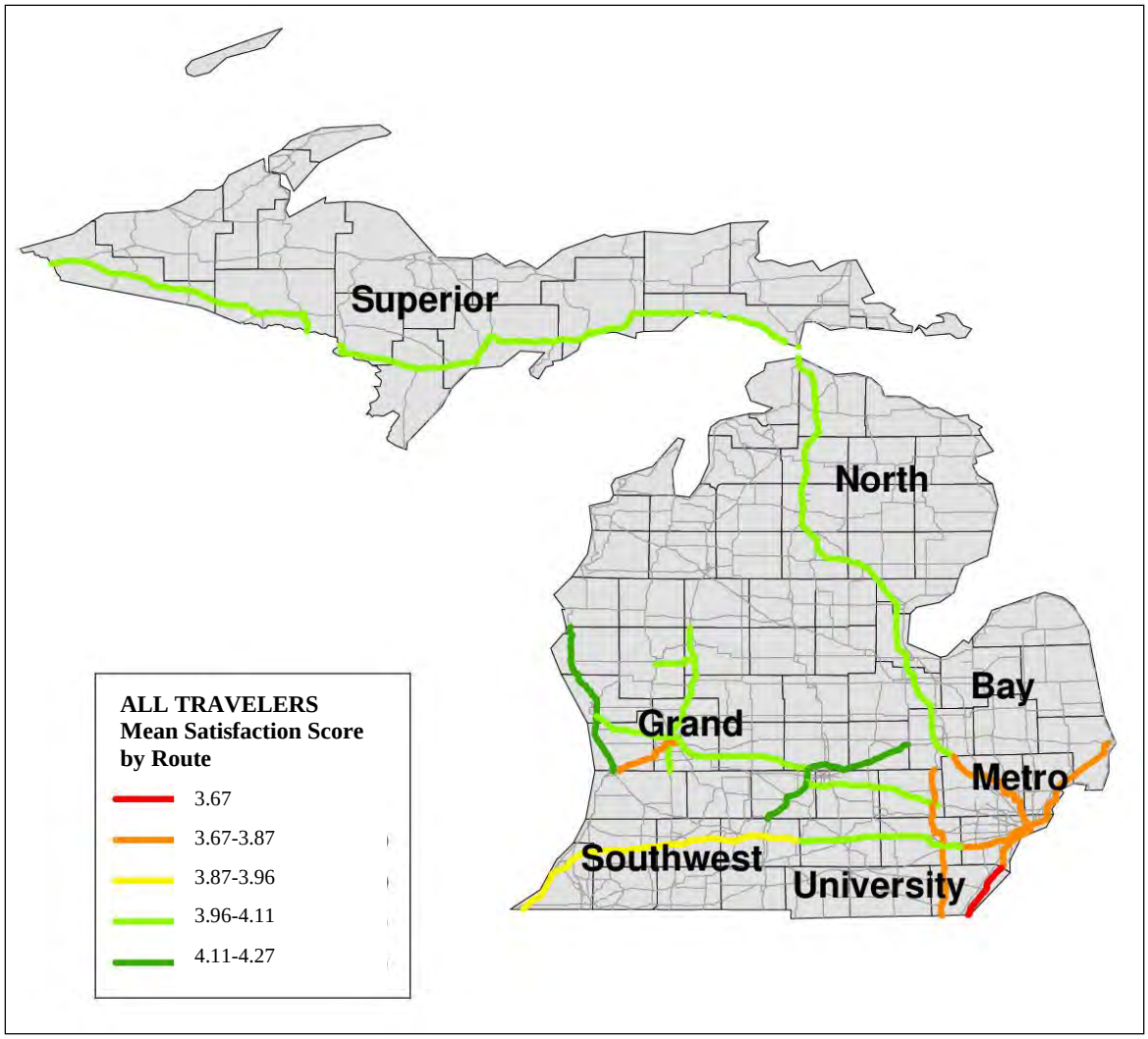


Figure 13. Mean Satisfaction Score by Route and Region – All Travelers.

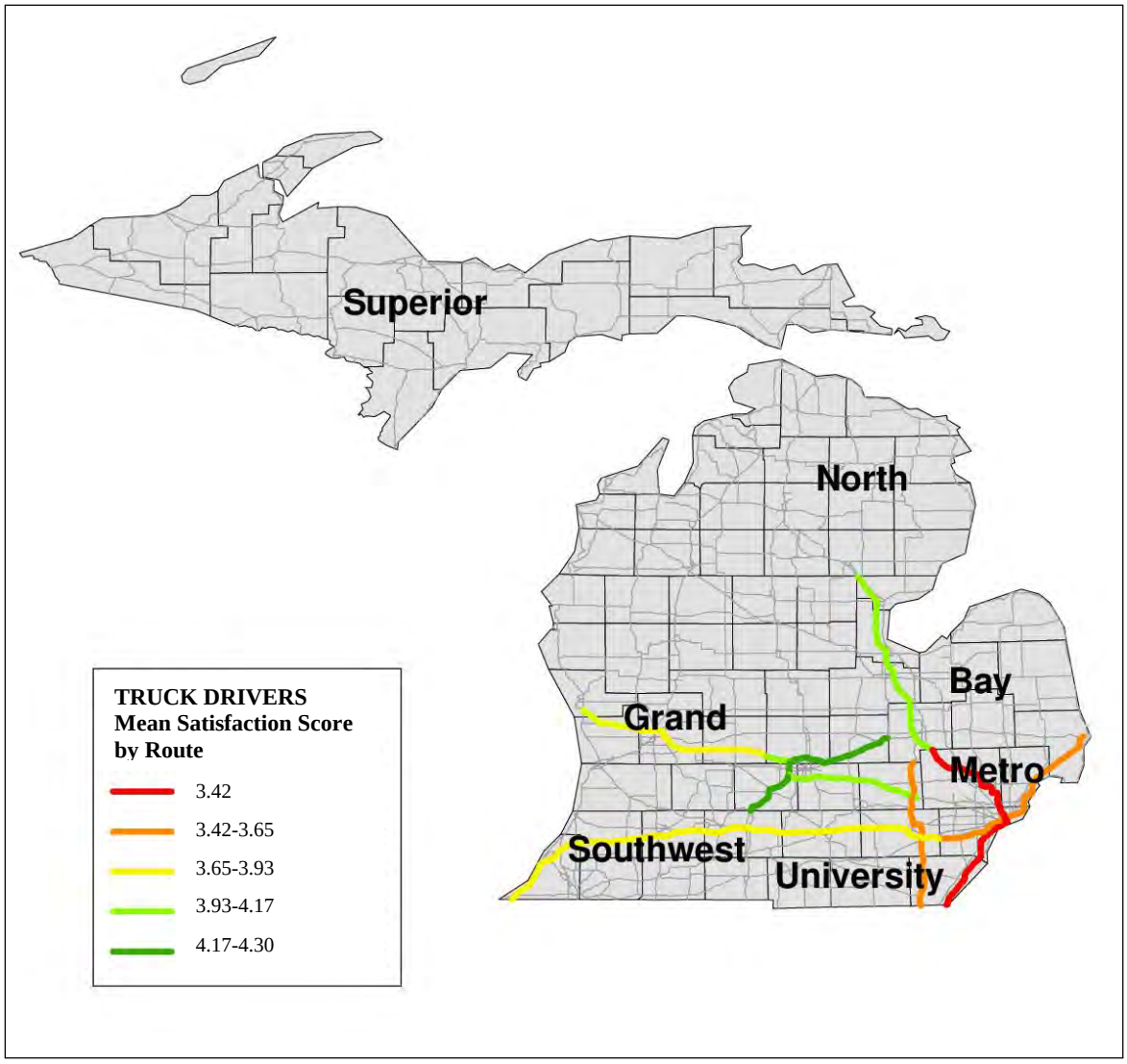


Figure 14. Mean Satisfaction Score by Route and Region – Truck Drivers.

Definition of Late Arrival

Survey respondents provided information on what they considered to be an unacceptable late arrival to their destination for that particular trip. The results are displayed by trip purpose in Table 14 and Figure 15.

Table 14. Unacceptably Late Arrival Time, by Trip Purpose

	Percent of Respondents Indicating Unacceptable Late Arrival to Destination					
Trip Purpose	**0-1 min**	**1-5 min**	**6-15 min**	**15-30 min**	**30+ min**	**Not a concern**
Truck Haul	10.4	9.7	16.1	20.1	19.9	23.9
Work Trip	8.9	13.2	26.2	17.3	12.9	21.4
Leisure Trip	3.1	4.7	10.0	14.6	19.1	48.4

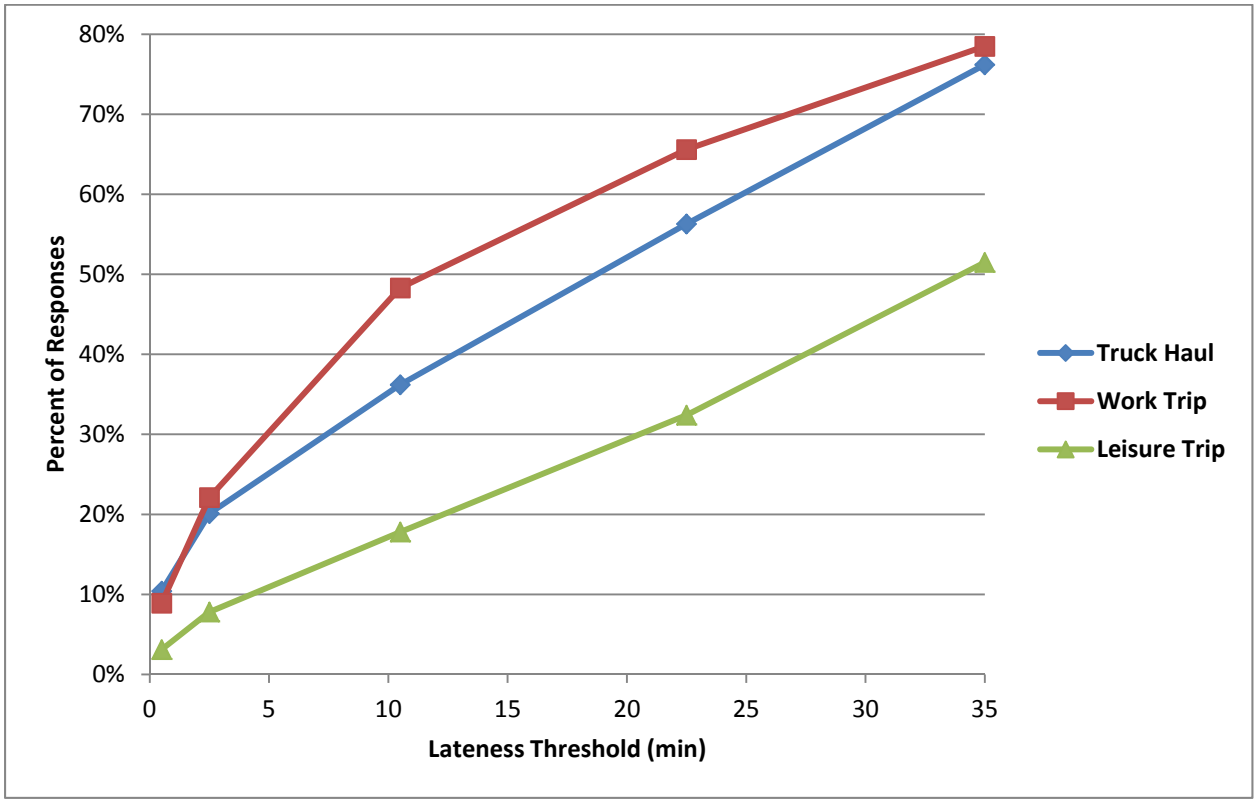


Figure 15. Distribution of Unacceptably Late Arrival Times, by Trip Purpose

Travelers on a work trip or truck route were more likely to require an on-time arrival to their destination compared to those travelers on a leisure trip. Approximately 10 percent of truck drivers and 9 percent of work travelers required an on-time arrival. Approximately 56 percent of truck drivers and 66 percent of work travelers required an arrival that was no more than 30 minutes late. The median "lateness threshold" for truck drivers was approximately 18 minutes and for work travelers was approximately 11 minutes. Almost one-half of all leisure travelers were not concerned with a late arrival. These results reinforce the expectation that those traveling on business purposes have a larger requirement to meet a defined schedule in contrast to those recreational travelers who do not necessarily need to arrive at a prescribed time.

Additional Time Budgeted

Travelers were also asked to provide the amount of additional time budgeted into their trip to account for unexpected delays. The results are provided in Table 15, separated by trip purpose. Over half of those on leisure trips indicated they did not budget any extra time on their current trip. On the other hand, nearly one-half of all truck drivers and work travelers budgeted at least 10 minutes extra into their trip to account for unexpected delays. Commercial truck drivers were the most likely group to budget 30 or more minutes for their trip, likely due to the typically greater trip distances compared to other travelers.

Table 15. Additional Time Budgeted to Account for Delay, by Trip Purpose

	Percent of Respondents						
	Additional Time Budgeted (minutes)						
Trip Purpose	**0**	**1-10**	**11-20**	**21-30**	**31-60**	**61-120**	**121+**
Truck Haul	42.9	5.8	13.6	16.0	16.8	3.1	1.8
Work Trip	35.8	12.3	21.8	20.0	8.0	1.2	0.5
Leisure Trip	53.1	4.7	8.5	17.0	13.2	2.5	1.1

As trip duration also influences the amount of buffer time added to a trip, the average additional time budgeted was plotted as a function of trip duration for both truck drivers and other travelers. These results are displayed in Figure 16. Not surprisingly, truck drivers budgeted more time than other travelers across each trip duration category. Truck drivers on shorter trips tended to report greater amounts of buffer time as a percent of the overall trip while those on longer trips tended to report proportionally lower amounts of buffer time. Generally speaking, the amount of time budgeted by truck drivers for trips greater than 2 hours ranged between approximately 5 percent and 10 percent of the overall trip duration, or 3 minutes to 6 minutes per hour of travel.

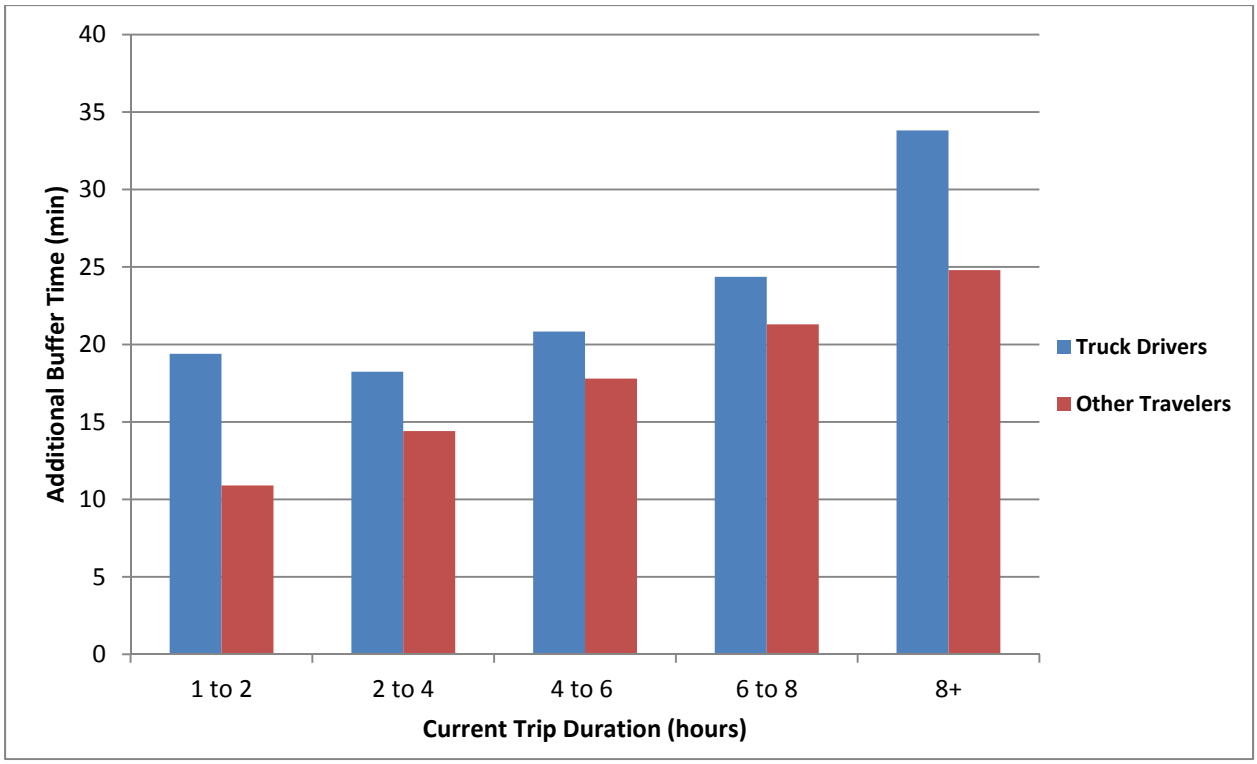


Figure 16. Extra Time Budgeted – Truck Drivers vs. Other Travelers

Factors Influencing Trip Satisfaction

Respondents to the survey were asked to rate factors that influence trip satisfaction, including arriving on time, encountering no delays, traveling at high speeds, and avoiding stop-and-go traffic. Figure 17 displays the results across all trip categories. Commercial truck drivers and work travelers were most concerned with arriving on time, encountering no delays, and avoiding stop-and-go traffic. Each of these factors was rated as "very important" or "essential" factor related to trip satisfaction by 70 to 80 percent of all truck drivers and work travelers. Leisure travelers were most concerned with avoiding stop-and-go traffic. Traveling at high speeds was of less importance across all traveler categories.

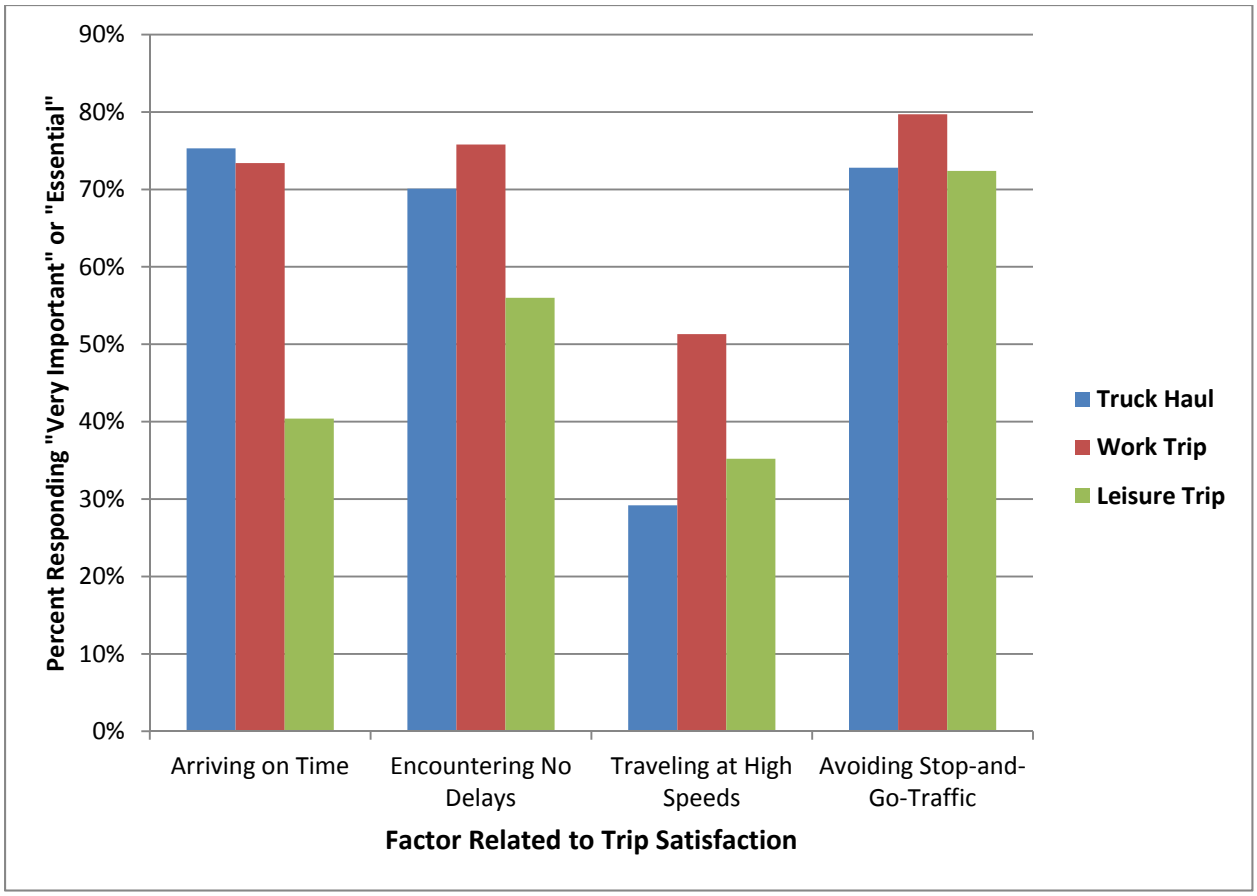


Figure 17. Relative Importance of Factors that Influence Trip Satisfaction, by Trip Purpose

CHAPTER 4:
SURVEY OF MICHIGAN COMMUTERS

An online survey was distributed via email to various employers throughout Michigan during June and July of 2012. The survey questions and format were similar to those utilized in the en route traveler survey, although the overall theme of the survey was specifically directed towards commuter travel. The survey questionnaire form is displayed in the Appendix C. The questions targeted the following topics related to various aspects of the daily commute for respondents along with other travel related questions, including:

- Basic demographic information: home zip code, employer name, employer address, full time or part time employment status;
- Basic commute information: primary routes traveled (no more than 2), typical daily commute time, frequency of various commute modes, mode and route choice factors;
- Threshold for late arrival to work and typical buffer time added to commute to account for unexpected delays;
- Relative importance of route reliability versus overall travel time;
- Trip satisfaction information: factors that influence trip satisfaction, satisfaction with daily commute, regional and statewide travel satisfaction, and
- Travel planning: use of travel information resources, MiDrive familiarity and use, utilization of smartphone for traffic information, usefulness of various types of information found on a traffic information website, frequency that travel plans are modified based on traffic info received.

BASIC RESPONDENT DEMOGRAPHICS

A total of 744 responses were received and nearly 200 employers were represented. Multiple responses were received from 48 employers, which accounted for greater than 75 percent of all survey responses. The top 48 employers are displayed in Table 16 along with the total number of surveys received from each.

Table 16. List of Employers Submitting Two or More Survey Responses

Employer	Freq.	Pct.	Cum. Pct.	Employer	Freq.	Pct.	Cum. Pct.
University of Michigan	76	10.2	10.2	City of Wixom	4	0.5	69.0
Road Comm. for Oakland County	49	6.6	16.8	MDOT	4	0.5	69.5
Univ. of Michigan Health System	45	6.0	22.8	State of Michigan	4	0.5	70.0
Wayne State University	45	6.0	28.9	Eastern Michigan University	3	0.4	70.4
Wade Trim	44	5.9	34.8	Eaton Co. Road Commission	3	0.4	70.8
Ford Motor Company	42	5.6	40.5	Jefferson East Business Asso.	3	0.4	71.2
Blue Cross Blue Shield Michigan	34	4.6	45.0	Providence Park Hospital	3	0.4	71.6
Hubbell Roth & Clark	23	3.1	48.1	AARP Foundation	2	0.3	71.9
City of Ann Arbor	21	2.8	50.9	Ann Arbor Township	2	0.3	72.2
Genesee Co. Road Commission	20	2.7	53.6	Aquatest Laboratories Inc.	2	0.3	72.4
City of Detroit	16	2.2	55.8	Autodesk	2	0.3	72.7
Ann Arbor Transp. Authority	13	1.7	57.5	Carrier & Gable	2	0.3	73.0
Soil and Materials Engineers	12	1.6	59.1	Consumers Energy	2	0.3	73.3
CBRE	10	1.3	60.5	DTE Energy	2	0.3	73.5
City of Grand Rapids	7	0.9	61.4	Focus: HOPE	2	0.3	73.8
Self Employed	7	0.9	62.4	General Electric	2	0.3	74.1
University of Detroit Mercy	7	0.9	63.3	General Motors	2	0.3	74.3
Washtenaw County	7	0.9	64.2	KMG	2	0.3	74.6
Priority Health	6	0.8	65.1	Michigan Fitness Foundation	2	0.3	74.9
SE MI Council of Governments	6	0.8	65.9	Michigan Tech University	2	0.3	75.1
Henry Ford Health System	5	0.7	66.5	Parsons	2	0.3	75.4
Midtown Detroit Inc.	5	0.7	67.2	Transportation Riders United	2	0.3	75.7
Stryker	5	0.7	67.9	Vanguard CDC	2	0.3	75.9
City of Monroe	4	0.5	68.4	Washtenaw Area Transp. Study	2	0.3	76.2

The majority of survey participants worked within Southeast Michigan. In total, 591 of the 744 responses (79.4 percent) were received from persons who worked with in Wayne, Oakland, or Washtenaw Counties. Nearly 66 percent of all survey respondents indicated that they were salaried employees, while 31 percent were hourly employees. Table 17 details the full breakdown of the respondents by work region and job status.

Table 17. Work Region and Employment Status of Respondents

Category	Subcategory	Reponses	Percent of Total
Work Region of Michigan	Metro Detroit/Southeast	625	84.0
	- Wayne	263	35.3
	- Oakland	121	16.3
	- Washtenaw	207	27.8
	- Other Southeast	34	4.6
	West/Southwest	39	5.2
	Lansing/Jackson	25	3.4
	Bay	41	5.5
	Other	14	1.9
Employment Status	Full Time - Salaried	488	65.6
	Full Time - Hourly	177	23.8
	Part Time	55	7.4
	Other	24	3.2
	TOTAL	744	100

COMMUTE MODE AND MODE CHOICE FACTORS

The survey respondents were asked to indicate the frequency of use of various commute modes, in addition to providing an indication of the importance of various factors with respect to selection of commute travel mode. As expected, the vast majority of survey respondents (80.8 percent) use their personal vehicle to travel to and from work on a daily basis. Of the remaining commuters, approximately 6 percent use a bus at least weekly and approximately 16 percent commute via bus at least once per year. Table 18 indicates the frequency of common commute modes.

Table 18. Commute Mode Frequency

	Percent of Respondents				
Commute Mode	**Never**	**Yearly**	**Monthly**	**Weekly**	**Daily**
Personal Vehicle	3.5	3.0	4.0	8.7	80.8
Carpool/Rideshare	80.5	10.2	3.1	3.0	3.2
Bus	84.1	7.9	2.2	2.0	3.8
Bicycle	84.8	7.0	2.4	3.5	2.3
Walk	88.7	4.4	1.5	2.2	3.2
Telecommute	64.8	23.8	7.4	2.4	1.6

Figure 18 displays the percent responding "important" or "very important" related to various mode choice factors. The most important factors for selection of commute mode were arrival time reliability and convenience/flexibility of the particular mode. Other important factors included safety, comfort, and cost.

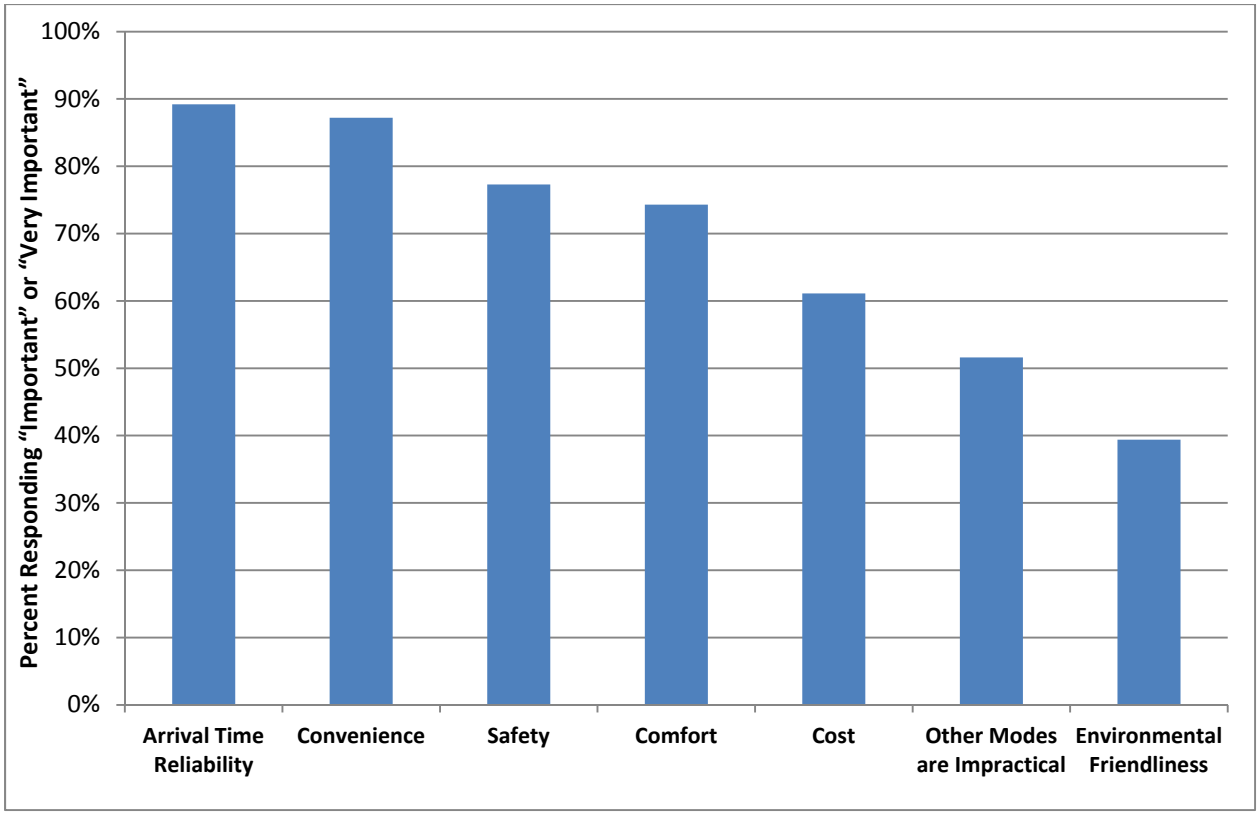


Figure 18. Importance of Various Mode Choice Factors

COMMUTE DURATION

Table 19 and Figure 19 display the aggregated distribution of commute times by respondents region of work. Commuters working in Southeast Michigan had the longest commute times compared to all other areas of Michigan. Greater than 40 percent of Southeast Michigan commutes exceeded 30 minutes with a median commute time of approximately 22 minutes. The median commute time for persons commuting in other regions of the state was approximately 14 minutes.

Table 19. Distribution of Commute Times by Work Region

	Percent of Respondents						
Work Region	**5 min or less**	**6-10 min**	**11-20 min**	**21-30 min**	**31-45 min**	**46-60 min**	**More than 1 hour**
Southeast	1.9	9.7	21.1	25.9	22.5	14.9	4.0
West/Southwest	0.0	12.8	33.3	20.5	12.8	10.3	10.3
Lansing/Jackson	12.0	8.0	44.0	8.0	12.0	16.0	0.0
Flint/Bay	12.2	9.8	34.1	19.5	19.5	4.9	0.0
Other	7.7	53.8	0.0	15.4	15.4	7.7	0.0
TOTAL	2.8	10.6	22.8	24.5	21.4	14.0	3.9

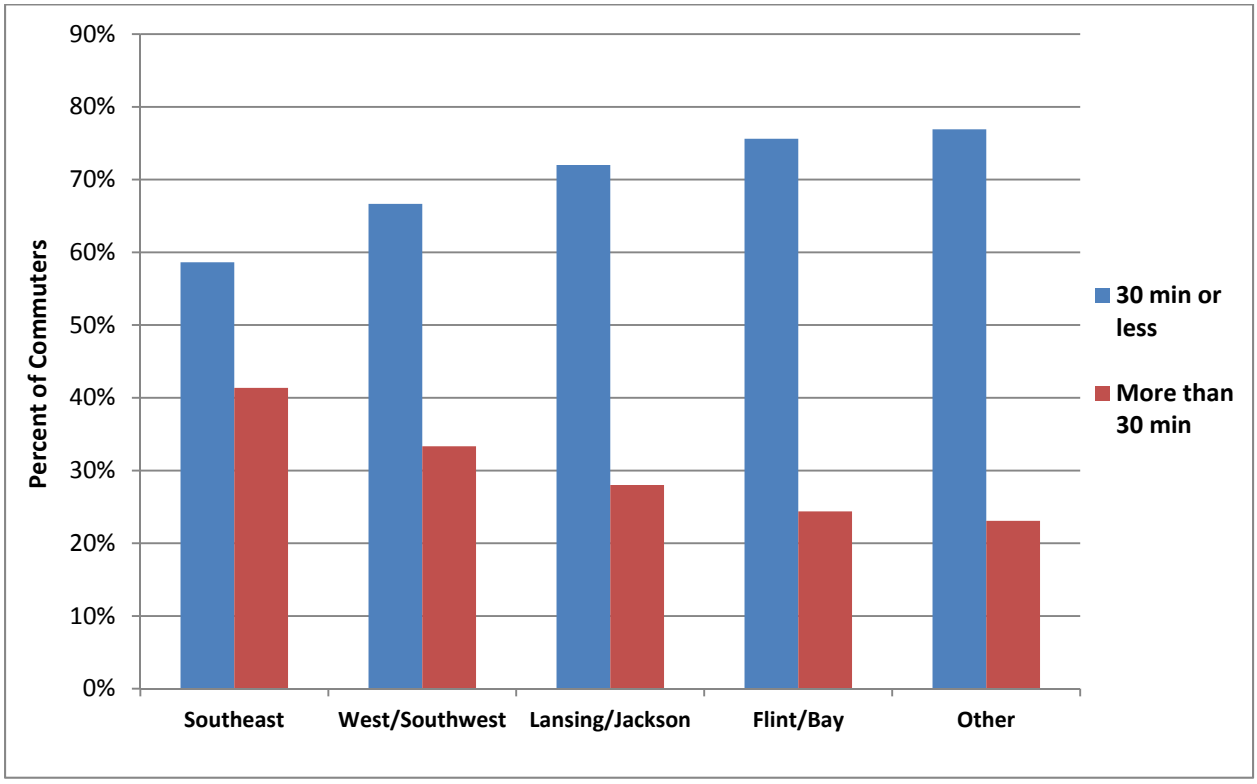


Figure 19. Percent of Commutes Above and Below 30 minutes, by Work Region

DEFINITION OF LATE ARRIVAL TO WORK

Commuters were also asked to indicate what was considered an unacceptable late arrival to their destination, with the results shown in Table 20. On-time arrival was required by 15.6 percent of commuters and another 14.8 percent responded that arriving more than 5 minutes late was unacceptable. Conversely, greater than 23 percent of commuters indicated that late arrivals to work could either exceed 30 minutes or were not a concern. The median late arrival threshold

for all commuters was approximately 9 minutes, which was similar to the median threshold for late arrival of 10 minutes reported by business travelers in the en route traveler survey.

Table 20. Unacceptably Late Arrival to Work

Maximum Late Arrival	Percent of Respondents
0 min	15.6
1-5 min	14.8
6-15 min	25.3
16-30 min	21.1
More than 30 min	9.3
Not a concern	14.0

ADDITIONAL TIME BUDGETED TO ENSURE ON-TIME ARRIVAL TO WORK

In order to account for unexpected delays arising during their drives, commuters were asked to indicate how much extra time they budget if an on-time arrival to work is necessary. Greater than 45 percent would budget an additional 10 minutes or less into their commute. Slightly less than 12 percent indicated buffering an additional 20 minutes or more. These results are displayed in Table 21.

Table 21. Additional Time Budgeted if On-Time Arrival to Work is Necessary

Buffer Time	Percent of Respondents
0 min	3.0
1-5 min	14.4
6-10 min	28.2
11-15 min	29.9
16-20 min	13.0
21-30 min	8.6
More than 30 min	3.1

The amount of additional buffer time is also sensitive to the overall commute duration. The average additional time added to the commute is shown versus commute duration in Figure 20. For commutes greater than 20 minutes in duration, the average additional time added to the commute to ensure an on-time arrival ranged from approximately 30 percent to 40 percent of the

overall commute time. In other words, a typical commuter would add between 9 and 12 minutes of additional time to ensure on-time arrival for an average commute of 30 minutes. Commuters with shorter duration commutes tend to add proportionally greater buffer time, typically adding between 70 and 130 percent of the typical trip duration if an on-time arrival is necessary.

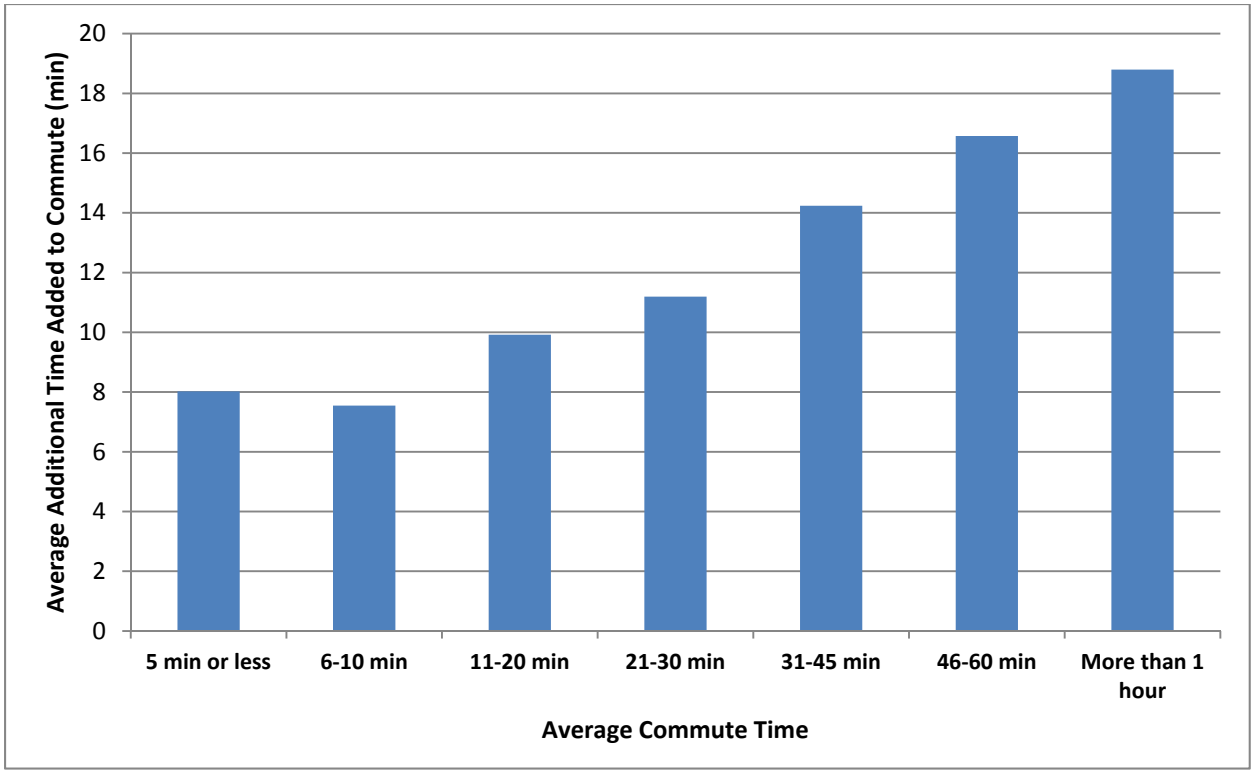


Figure 20. Additional Time to Ensure On-Time Arrival

ROUTE PREFERENCE

In order to determine the relative importance of minimizing travel time variability versus overall travel times, commuters were asked to indicate whether they preferred either:

- A slightly slower router with more reliable travel times, or
- A slightly faster route with less reliable travel times.

This question was asked separately for commute trips versus vacation/recreation trips. The results are shown in Figure 21. Commuters showed a strong preference towards route reliability for their daily commute. Vacation travel was more evenly split between reliability and minimizing travel time, although reliability was still preferred.

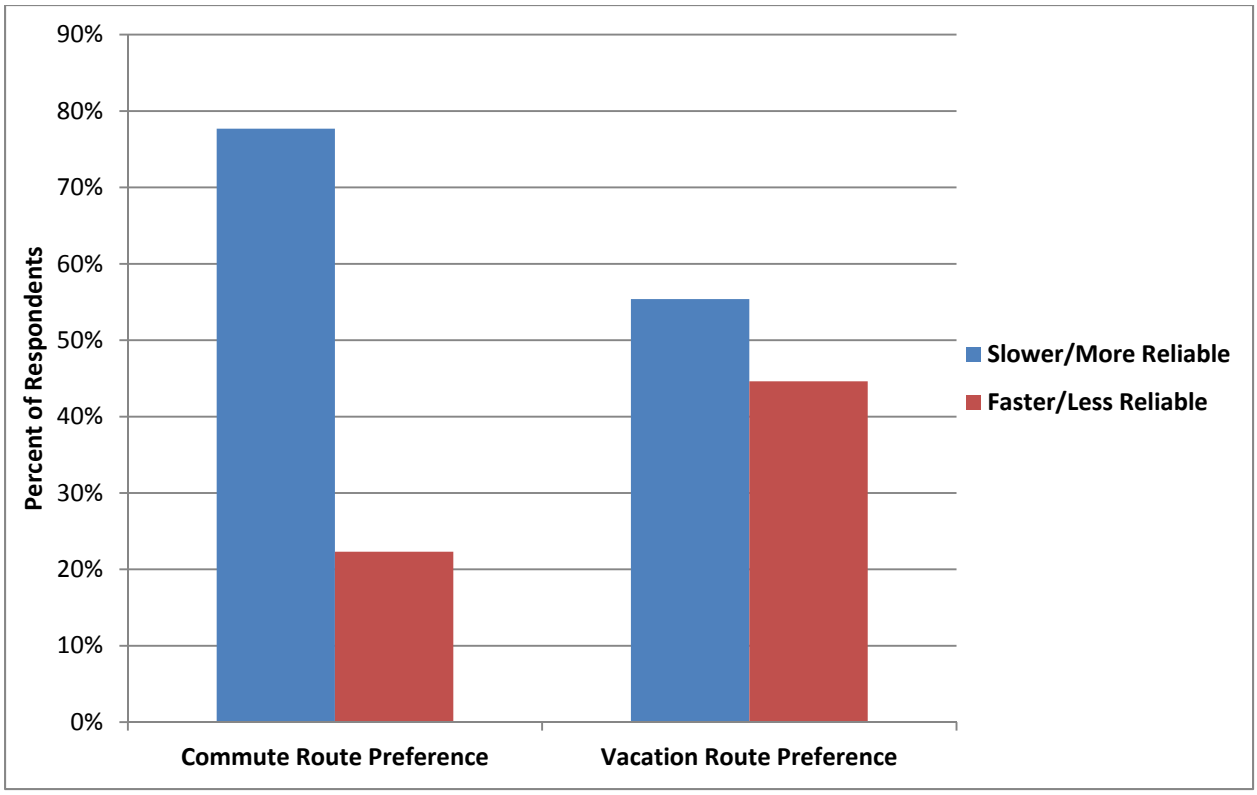


Figure 21. Commuter Preference for Reliability versus Minimum Travel Time

COMMUTE SATISFACTION

Commuters were asked to rate the level of satisfaction associated with their daily commute on a 1 (very dissatisfied) to 5 (very satisfied) scale. Considering all commuters surveyed, the average commute satisfaction score was 3.61, with 65.4 percent providing a commute satisfaction rating of 4 or 5 (satisfied or very satisfied). Approximately 18 percent of commuters were dissatisfied or very dissatisfied with their commute. The level of satisfaction with Michigan travel was also investigated across the commute duration and work region categories. These results are presented in Table 22.

Table 22. Satisfaction with Commute by Commute Duration and Work Region

		Percent of Respondents		
Category	**Subcategory**	**Dissatisfied or Very Dissatisfied**	**Neutral**	**Satisfied or Very Satisfied**
Commute Duration	20 min or less	6.7	10.7	82.6
	21 min – 45 min	17.0	19.1	63.9
	Greater than 45 min	42.9	22.6	34.6
Work Region	Southeast	19.7	17.4	62.9
	West/Southwest	5.3	21.1	73.7
	Lansing/Jackson	12.5	8.3	79.2
	Flint/Bay	2.4	17.1	80.5
OVERALL		**17.9**	**16.7**	**65.4**

There is a very strong negative correlation between commute time and commute satisfaction. As commute time increases, the commuter's satisfaction with his/her daily commute tends to decrease. Nearly 83 percent of survey respondents commuting 20 minutes or less were either satisfied or very satisfied with their commutes. However, only 34.6 percent of respondents with commute times greater than 45 minutes were satisfied or very satisfied, while nearly 43 percent were dissatisfied or very dissatisfied with their commutes. Not surprisingly, commuters in Southeast Michigan were the least satisfied with their commutes. These results are also reflected in Figures 22 and 23.

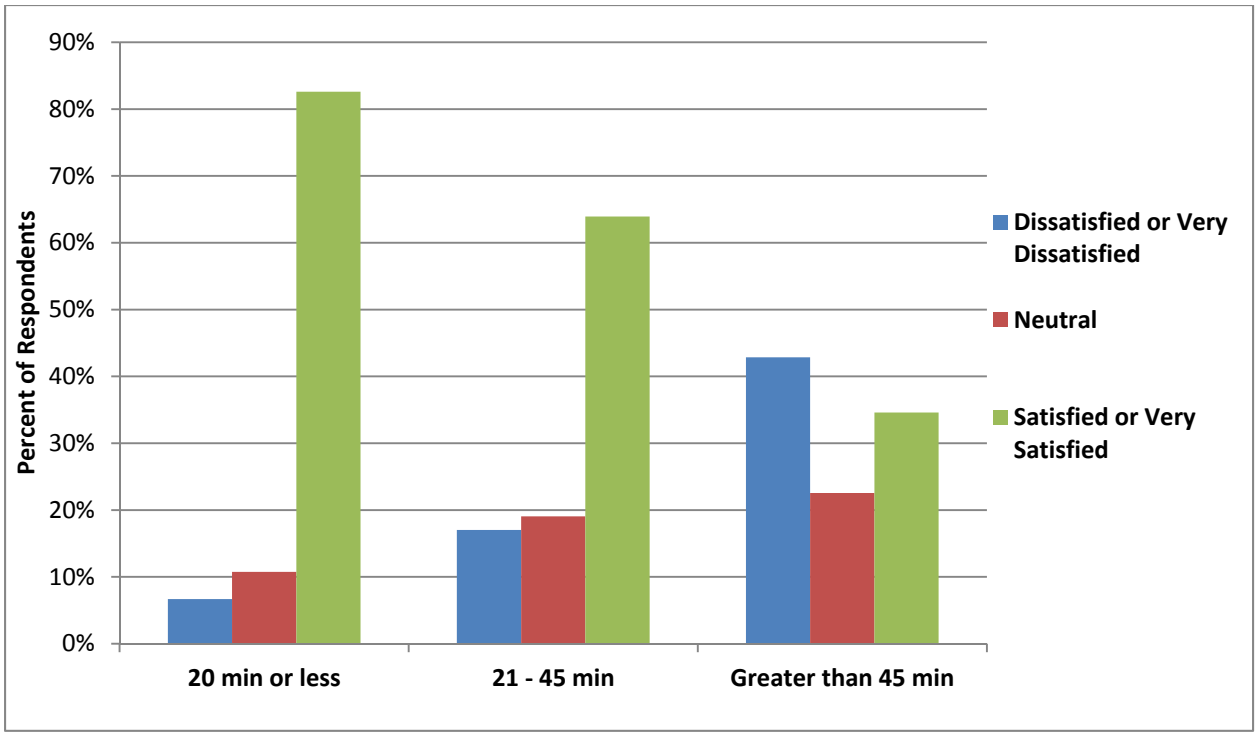


Figure 22. Satisfaction with Commute, by Commute Time

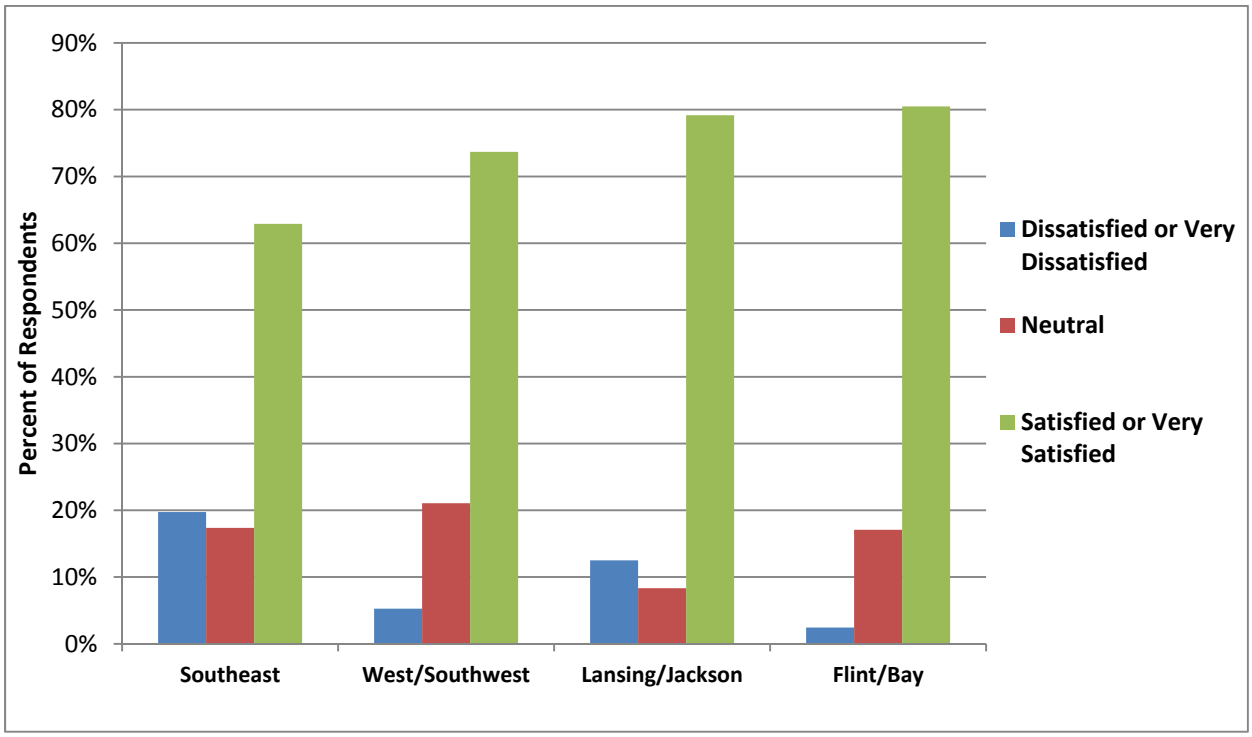


Figure 23. Satisfaction with Commute, by Work Region

The relatively large sample of commuters in Southeast Michigan allowed for additional analysis to be performed with respect to commute satisfaction by route and sub-area within the region. In particular, the satisfaction of commuters working in downtown Detroit (zip code 48226) was compared to other areas of Detroit, and Southeast Michigan, and elsewhere in Michigan. These results are displayed in Figure 24.

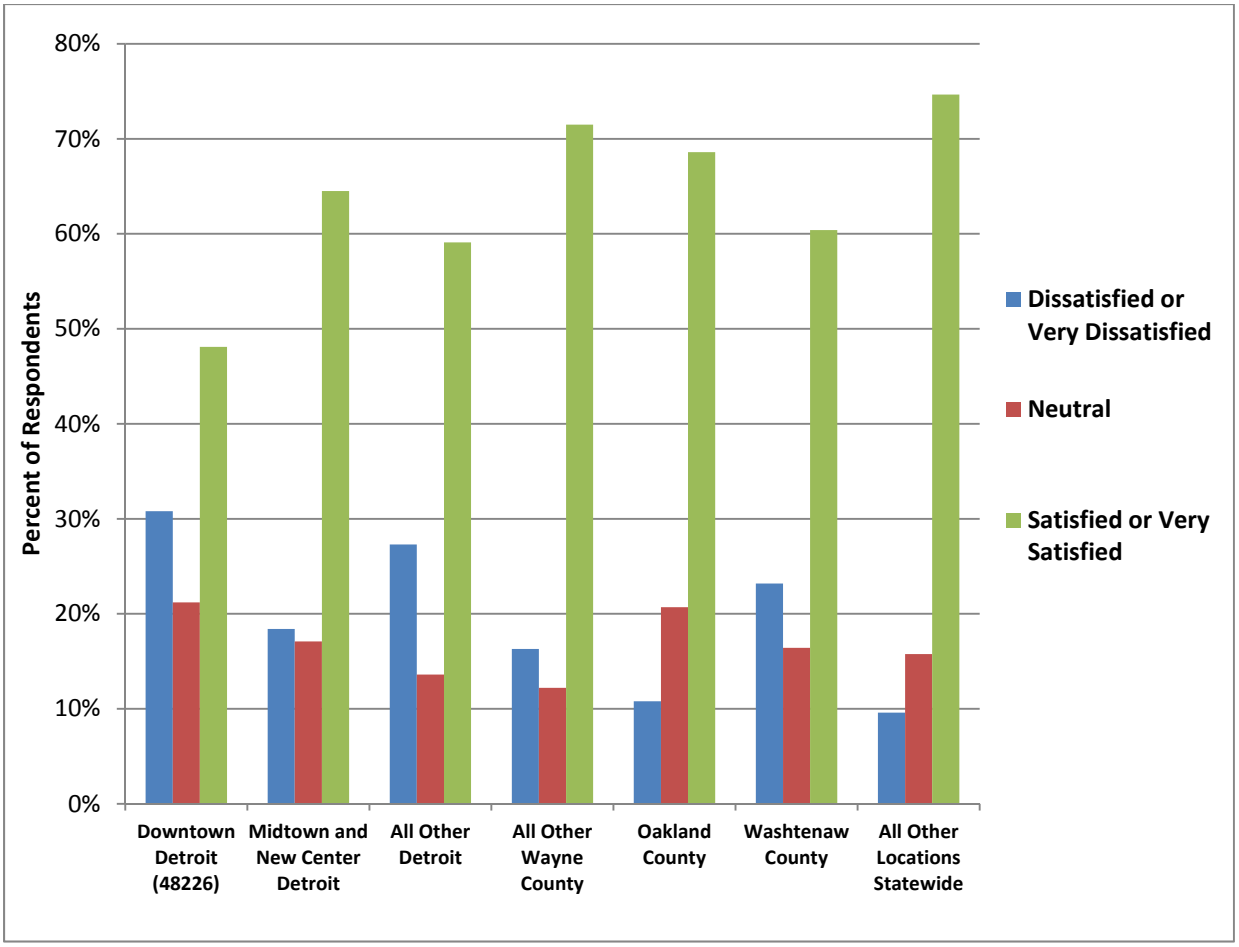


Figure 24. Commute Satisfaction within Southeast Michigan, by Sub-Region

Persons commuting to downtown Detroit were found to possess the lowest satisfaction scores within Detroit, Southeast Michigan, and Michigan in general. Fewer than one-half of all commuters working in downtown Detroit were satisfied or very satisfied with their commute. Other work locations displaying relatively low commute satisfaction scores were in other areas of Detroit and Washtenaw County. The highest levels of commute satisfaction statewide were noted by workers located outside of Southeast Michigan. Within Southeast Michigan, the highest commute satisfaction scores were associated with commuters working in portions of Wayne County outside of Detroit followed closely by commuters working in Oakland County

The commute satisfaction scores within Southeast Michigan were also investigated by route, with the results displayed in Figure 25. Fewer than half of commuters that utilize I-696 and US-23 were either satisfied or very satisfied with their commutes and were the lowest-rated commute routes statewide. Commutes that included I-75, I-275, and I-94, in Southeast Michigan were rated only slightly more favorably. In general, commutes that primarily involved local roadways were associated with the highest levels of satisfaction in Southeast Michigan. The MDOT roadways possessing the highest commute satisfaction scores included M-39, M-10, and non-freeways, including M-1, US-24, and M-59.

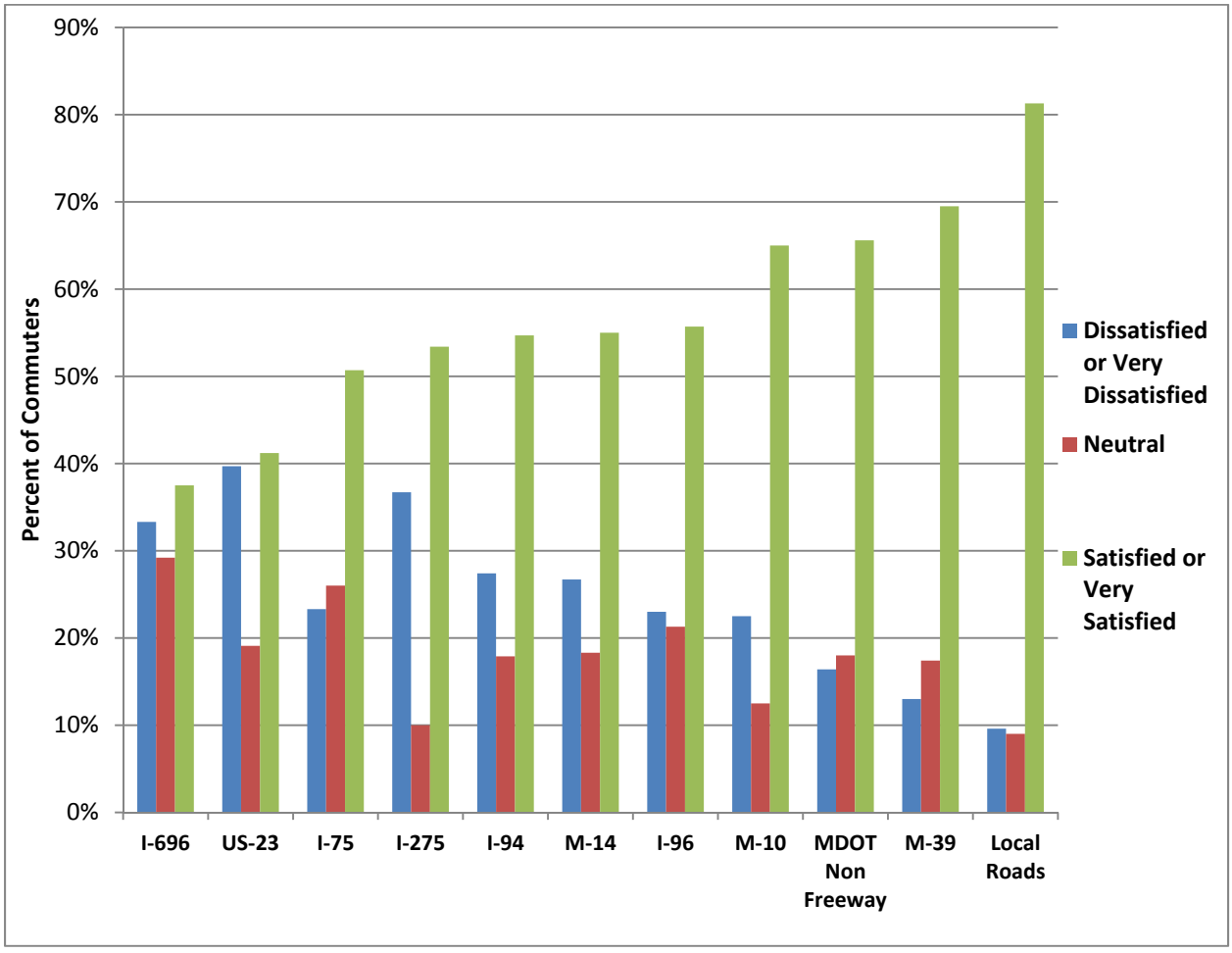


Figure 25. Commute Satisfaction within Southeast Michigan, by Route

SOURCES OF TRAFFIC INFORMATION AND MIDRIVE USE

Commuters were also asked about the utilization frequency of various traffic information. Same as the en route traveler survey, the sources included MiDrive, other websites, television, radio, and GPS. The results are reflected in Table 23 and Figure 26.

Table 23. Utilization Frequency of Various Traffic Information Sources

	Percent of Respondents				
Source	**Never**	**Yearly**	**Monthly**	**Weekly**	**Daily**
MiDrive	73.4	16.4	6.9	2.4	0.9
Other Website	52.8	24.5	13.3	6.9	2.6
GPS	48.0	18.7	18.0	9.8	5.5
Television	39.4	22.0	13.0	11.2	14.4
Radio	16.8	15.5	16.0	19.9	31.9

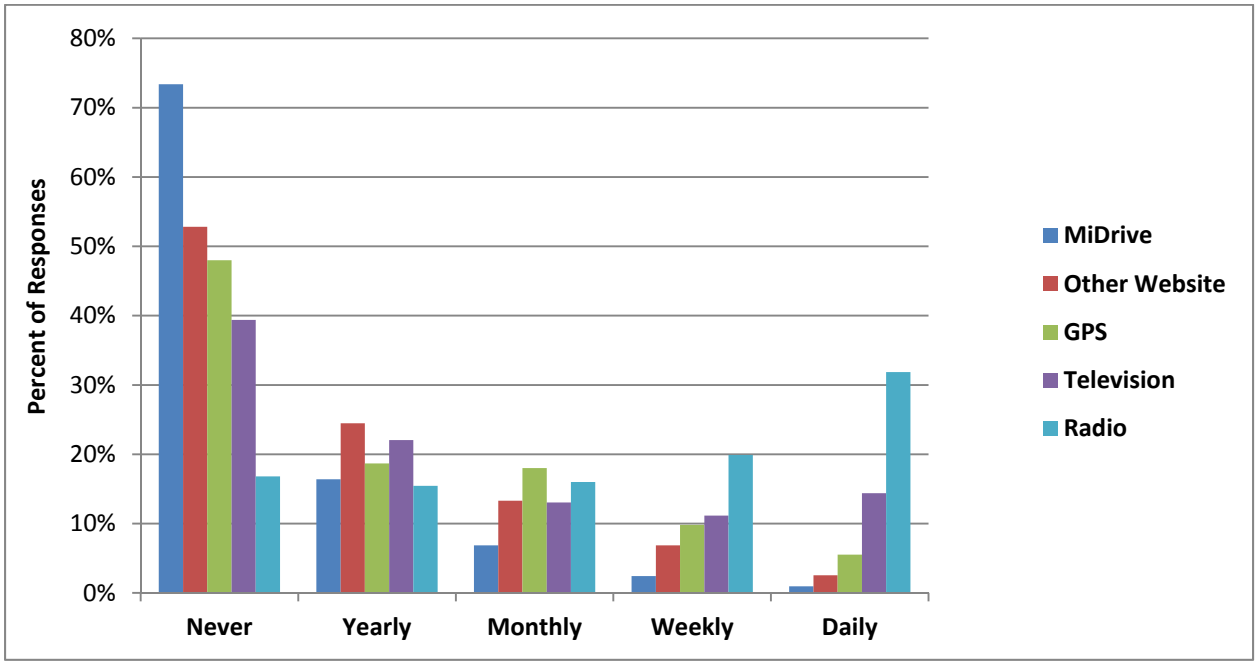


Figure 26. Utilization Frequency of Various Traffic Information Sources

The most utilized sources of traffic information was the radio with more than 50 percent utilizing radio for traffic information weekly or daily. Only about 13 percent of commuters indicated using traffic websites on a weekly or daily basis, which was consistent with the traveler survey. MiDrive use was relatively low, as only approximately 10 percent utilize MiDrive on at least a monthly basis, 3 percent on a weekly basis, and 1 percent on a daily basis. Greater than

26 percent of commuters had utilized MiDrive at least once in the past, which was more than double the MiDrive utilization found in the en route traveler survey.

Commuters were also asked to indicate the frequency of use of a web-enabled smartphone to obtain traffic information. Slightly less than 70 percent of commuters own a smartphone. However, smartphone owners were far more likely to obtain traffic information from an online source, as indicated in Figure 27. Greater than 37 percent of smartphone owners obtain traffic information via smartphone at least monthly, while greater than 18 percent and 6 percent obtain traffic information via smartphone at least weekly or daily, respectively.

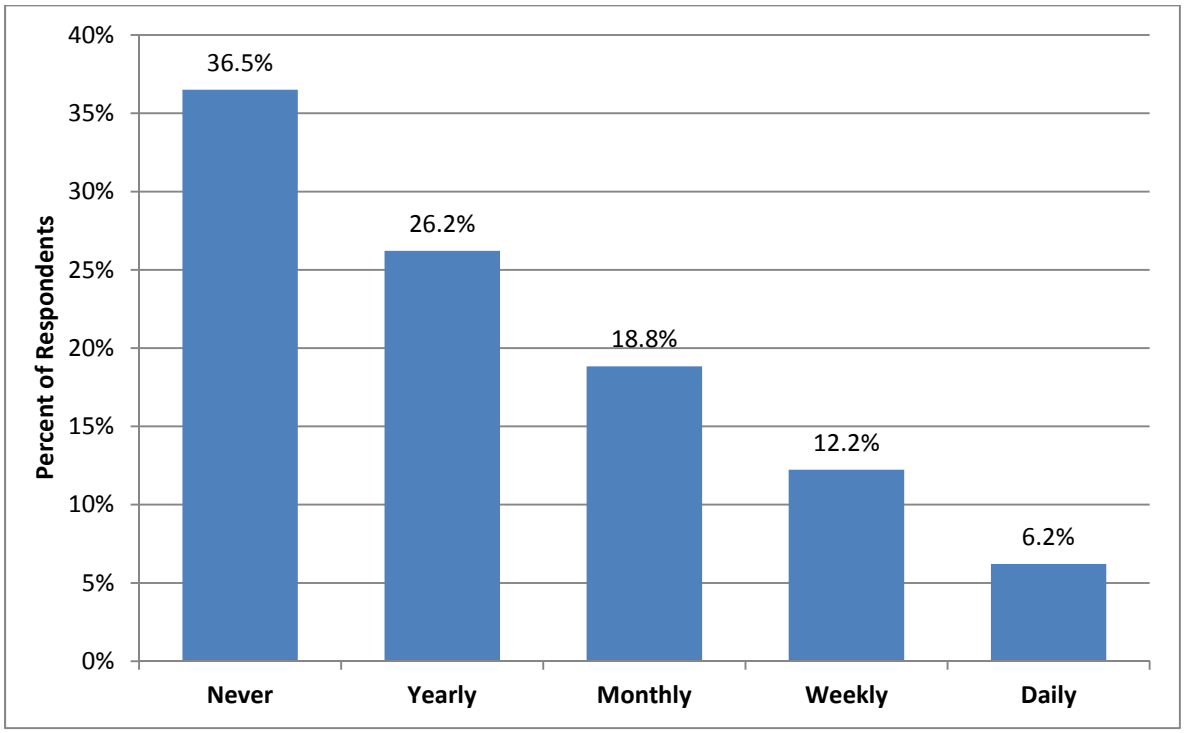


Figure 27. Use of Smartphone to Obtain Traffic Information (Smartphone Users Only)

DESIRED ONLINE TRAFFIC INFORMATION

Commuters were also asked to assess the relative importance of various types of traffic related information that are typically displayed on a traffic information website, including travel speeds, travel times, reliability, accident locations, current and future road work information, wet/icy conditions, freeway camera views, bus arrival information, and special event information. Figure 28 displays the responses for "Important or Very Important." The most highly valued types of information for display on a traffic information website included current

road work and accident locations. Travel times, weather, reliability, travel speeds, future road work, and special event information were also commonly rated as important or very important. Bus arrival times and freeway camera views were considered less important.

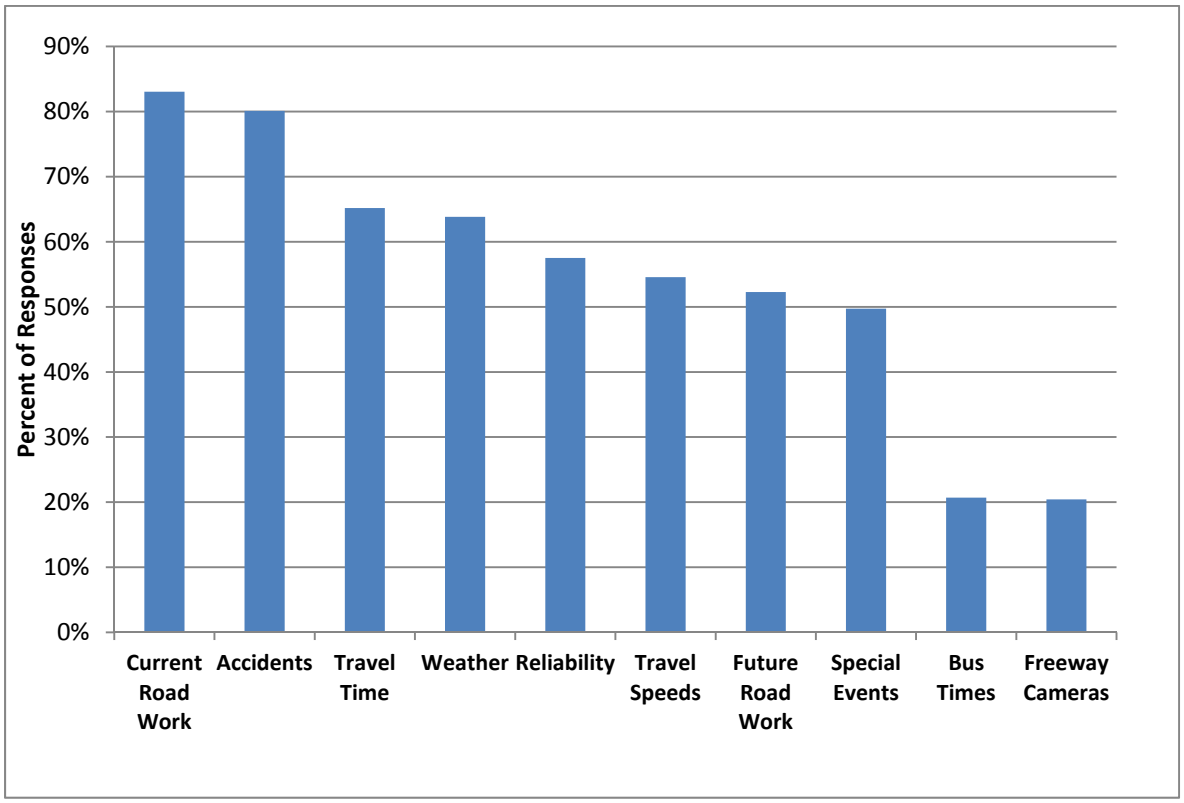


Figure 28. Traffic Website Information Most Valued by Commuters

USE OF TRAFFIC INFORMATION TO MODIFY TRAVEL PLANS

Additional analyses was performed to determine the way commuters utilize traffic information to modify travel plans, with respect to route choice, departure time, or mode choice. These results are displayed in Table 24 and Figure 29. Nearly 60 percent of commuters indicated that the information was utilized to change the travel route at least one-half of the time. Greater than 47 percent of commuters utilized the information to modify the departure time for the trip at least one-half of the time. Commuters are far less likely to use the information for mode choice modifications, as fewer than 18 percent utilized this information more than one-half of the time to change the travel mode.

Table 24. Frequency of Travel Plan Modification based on Traffic Information Received

	Percent of Respondents				
Action	**Never**	**Rarely**	**Half the Time**	**Usually**	**Always**
Change Route	7.3%	30.0%	19.9%	26.6%	13.4%
Change Departure Time	14.9%	34.0%	17.2%	22.4%	8.2%
Change Mode	55.6%	21.4%	5.2%	8.2%	4.4%

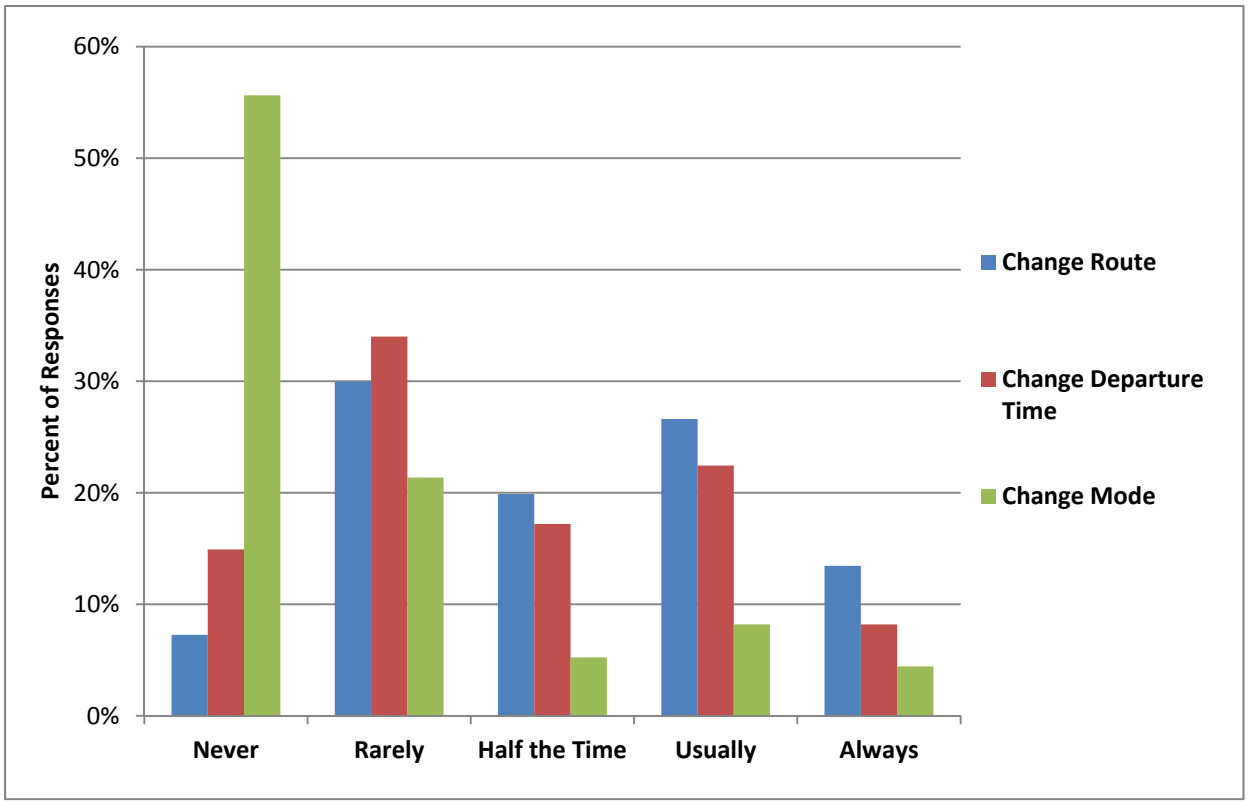


Figure 29. Frequency of Travel Plan Modification based on Traffic Information Received

CHAPTER 5:
FREIGHT INDUSTRY SURVEY

A telephone questionnaire survey was administered to schedulers and logistics specialists involved with freight industry operations in Michigan. The survey was primarily administered to shippers, carriers, logistics companies, and private contractors throughout Michigan and the Midwest in general. More than 100 companies were contacted from a list generated based on information obtained from various sources, including various traveler surveys, online resources, and recommendations from participants in the initial focus group meeting. The only major criterion for a trucking company to be included in the survey was that the company operates one or more haul routes on Michigan freeways. Three transit agencies that operate routes on Michigan freeways were also contacted and responses were included in the results, where applicable. The questionnaire was brief and a total of 10 targeted questions were included and covered the following topics:

- Most frequently utilized Michigan roadways;
- Most unreliable Michigan roadways in terms of arriving on-time;
- Ways of dealing with unreliable travel and unexpected delays;
- Maximum late arrival time to destination without penalty;
- Frequency at which late arrivals may occur;
- Typical buffer time added to schedule to account for unexpected delays;
- Relative importance of route reliability versus overall travel time;
- Route planning and scheduling resources utilized;
- Use of MiDrive for route planning or scheduling;
- Usefulness of various types of information found on a traffic information website for route planning/scheduling.

A total of 32 responses were received. The complete list of respondents is provided in Appendix D, along with the primary freeways utilized. The telephone questionnaire survey form is also provided in Appendix D.

MANAGING UNRELIABLE ROUTES

The most common freeways used by the freight survey respondents included the four primary interstates in Michigan: I-94, I-75, I-96, and I-69, each of which was utilized by 50 to 60 percent of those surveyed. The most commonly reported unreliable roadways were I-94 and I-75 with 37 percent and 28 percent, respectively, of companies using these routes reporting reliability issues. Nearly 50 percent of the survey respondents indicated that the drivers are instructed to utilize an alternate route when encountering unexpected delays.

Similar to the commuter survey response, two-thirds of the freight industry respondents preferred a more reliable route over a slightly faster route when planning haul routes. To help reduce the uncertainty of travel times along the haul routes, more than one-third of respondents scheduled hauls during off-peak hours to avoid unwanted and unpredictable delays.

MANAGING LATE ARRIVALS

Forty-three (43) percent of respondents reported adherence to a 100 percent on-time arrival goal, while an additional 47 percent reported a 95 percent on-time arrival goal. Thus, 90 percent of the freight industry respondents reported adherence to a 95 percent or better on-time arrival performance goal. Approximately 28 percent of respondents indicated that on-time deliveries were necessary in order to avoid penalties from receivers. The median threshold for late arrivals without penalty was approximately 15 minutes beyond the scheduled arrival time. The maximum acceptable late arrival time reported by any respondent was 2 hours. The distribution of maximum late arrival times is shown in Table 25.

Table. 25. Maximum Amount of Time a Shipment May Arrive Late Without Penalty

Time	Frequency	Percentage	Cumulative Frequency	Cumulative Percentage
0 min (On-Time)	8	26.7	8	26.7
5 min	4	13.3	12	40.0
10 min	1	3.3	13	43.3
15 min	2	6.7	15	50.0
30 min	4	13.3	19	63.3
60 min	5	16.7	24	80.0
90 min	1	3.3	25	83.3
120 min	5	16.7	30	100.0

In an effort to compensate for unexpected delays along freight haul routes, greater than 38 percent of all respondents indicated scheduling up to an additional 5 percent of the total expected trip duration as a buffer to account for unexpected delays while en route, while an additional 29 percent buffer 5 to 10 percent additional time into a freight trip. The distribution of buffer time responses is provided in Table 26.

Table 26. Additional Buffer Time Added as Percent of Total Trip Time

Additional Buffer Time	Frequency	Percentage	Cumulative Frequency	Cumulative Percentage
0 to 5 percent	12	38.7	12	38.7
5 to 10 percent	9	29.0	21	67.7
11 to 15 percent	4	12.9	25	80.6
16+ percent	6	19.4	31	100.0

ROUTING AND SCHEDULING RESOURCES

Proprietary software was utilized by nearly 75 percent of the freight industry respondents for routing and scheduling of haul routes. In particular, the software program "PC Miler" was utilized by greater than 56 percent of all freight industry respondents, which was the most commonly referenced software. Mapping websites were utilized by greater than 43 percent of the respondents for freight routing purposes.

MiDrive had been utilized by only 15 percent of respondents for routing and scheduling purposes. Although most respondents were completely unfamiliar with MiDrive, there was a noted interest among the survey respondents for future utilization. Figure 30 displays the responses pertaining to potential usefulness of travel planning information displayed on a website such as MiDrive. The display of current roadwork information was most frequently indicated as useful or very useful by respondents, followed by road weather condition, and accident locations.

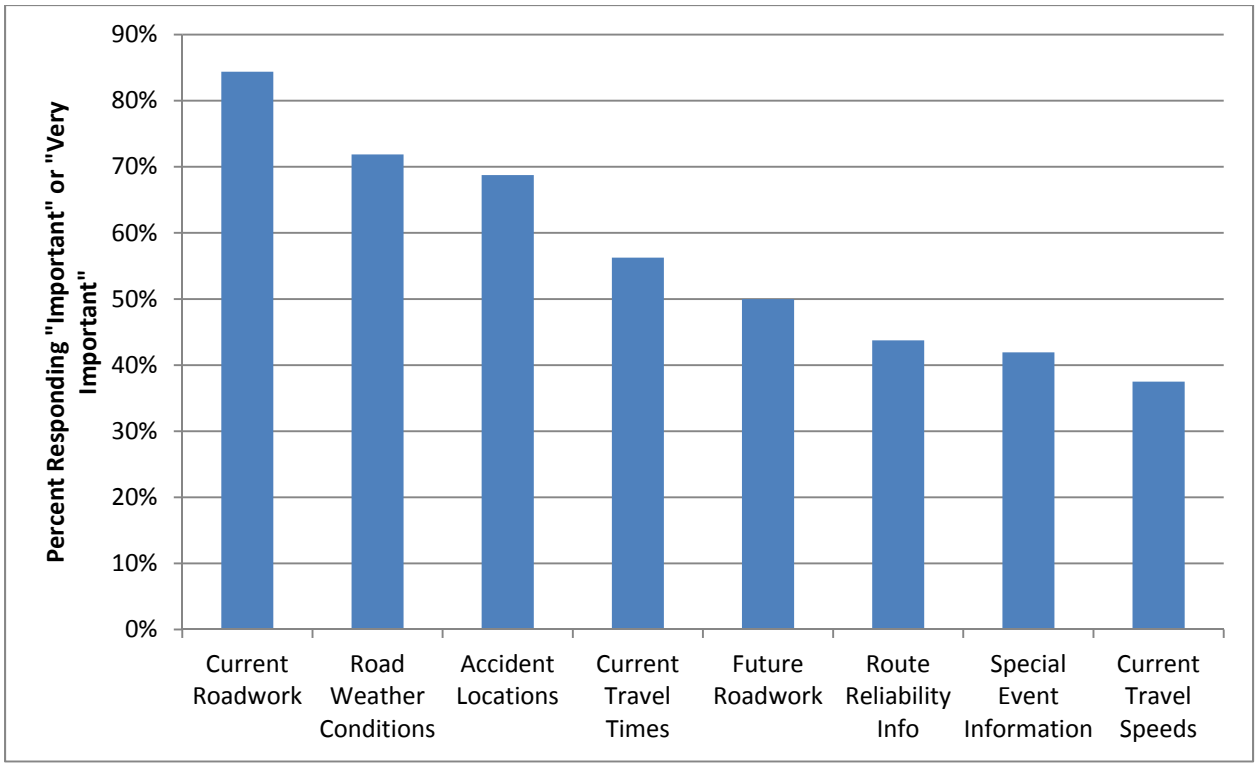


Figure 30. Usefulness of Website Information for Route Planning or Scheduling Purposes

CHAPTER 6:
CONCLUSIONS

Travel delays and associated costs have become a major problem in Michigan over the past several decades as congestion continues to increase, thus, creating significant negative impacts on travel reliability on many roadways throughout the State. MDOT is currently capable of measuring and communicating real-time travel time, speed, and reliability related information to the public through a variety of communication channels. If conveyed correctly, such information would assist in the trip planning process both before and during a trip. However, prior to this research effort, many questions remained pertaining to the measurement and communication of real-time travel information to the public in Michigan.

The research described herein sought to develop appropriate communication techniques for distribution of travel reliability and traffic related information to the public based on the needs of users of the transportation network in Michigan. A number of tasks were performed to achieve this goal, including surveys of travelers, commuters, and freight industry logistics professionals, in addition to the state-of-the-art and state-of-the-practice reviews. Synthesis of the information obtained from these tasks allowed for conclusions to be drawn, which are described in detail in the following sections.

CAUSES OF UNRELIABLE TRAVEL

Roadway congestion may be classified into either of two categories based on the regularity of occurrence: 1) recurring, which is generally consistent and predictable and 2) non-recurring, which is generally variable and unpredictable. Typical contributors to roadway congestion include the following (5):

- Recurring
    - Day-to-day fluctuations in demand,
    - Traffic control devices (poorly timed signals, railroad crossings, etc.), and
    - Inadequate roadway capacity.
- Non-recurring
    - Incidents
    - Work zones (construction and maintenance)
    - Weather

- Special events

Recurring congestion contributes relatively little to the day-to-day variability in travel times and is most effectively treated by roadway or traffic signal capacity improvements. Non-recurring congestion provides the greatest contribution to travel time variability and unreliability. While weather, road work, and special events contribute to travel time variability, such sources are also generally either scheduled or somewhat predictable. Congestion and travel variability caused by road work and special events may be minimized by scheduling their occurrence during nights or weekends. Furthermore, communicating planned road closure occurrences to travelers in advance will also aid in the trip planning process. Weather-related impacts are best handled by providing as much advance notice as possible through appropriate communication channels so that travelers can make adjustments prior to departure. Incidents are the most problematic contributors to day-to-day travel time variability and subsequent traveler uncertainty. This is due to the difficulty in predicting when and where incidents will occur and the degree and duration of subsequent traffic flow impacts. As it is not possible for agencies to provide advance travel alerts, incidents are better managed by strategies such as Michigan's Quick Clearance program.

IMPACTS OF VARIABILITY ON TRAVELER UNCERTAINTY

While travelers are generally able to account for recurring congestion, which typically occurs during the peak daily commute periods, the unpredictability of non-recurring congestion leads to traveler uncertainty in terms of selecting a route and subsequent departure time. Although delays related to non-recurring congestion may occur at any time and any location, the magnitude of such delays are largely dependent on existing levels of congestion. Consequently, the occurrence of non-recurring congestion during peak periods generally has severe consequences on travel times due to the congestion that is already present. As a result, peak-period travelers are often forced to plan their departure times substantially earlier and/or choose an alternate route if an on-time arrival is necessary. However, when non-recurring congestion does not occur, the additional buffer time and/or travel distance is wasted, resulting in an excessively early arrival or unnecessary vehicle operating costs. As off-peak period travelers or travelers in rural areas are less likely to experience recurring congestion, they also tend to be less inclined to budget substantial additional travel time due to the low frequency of non-recurring

congestion that occur in these areas. As a result, incidents, unexpected road work, major events or holiday travel may cause unexpected delays for travelers during off-peak periods.

Travel time uncertainty has the greatest impact on the freight industry, due to the often severe penalties associated with late arrivals. Ninety percent of respondents to the survey of freight industry logistics professionals indicated adherence to 95 percent or better on-time arrival performance. Additionally, more than 25 percent of the surveyed freight industry logistics professionals indicated that on-time arrivals were critically necessary for deliveries in order to avoid penalties. The median threshold for late arrivals without penalty was approximately 15 to 20 minutes beyond the scheduled arrival time, as reported by both freight logistics professionals and truck drivers en route. Business travelers were even more time sensitive, reporting a median threshold for late arrival to work of approximately 10 minutes. In an effort to compensate for unexpected delays along freight haul routes, it is common practice for schedulers/drivers to buffer between 5 and 10 percent extra time into the trip schedule. Commuters tended to add a proportionally greater amount of time to ensure an on-time arrival, likely due to the uncertainty associated with greater levels of congestion experienced during peak hour commute travel. For commutes greater than 20 minutes in duration, the average additional time added to the commute to ensure an on-time arrival ranged from approximately 30 percent to 40 percent of the overall commute time.

INFORMATION NEEDS OF TRAVELERS

The information needs of travelers and freight industry personnel are largely dependent on when such information is sought with respect to the trip departure. In general, travel information may be sought at three different points either before or during the trip, which include:

- En route,
- Preparing for near-term departure, or
- Planning for future departure.

En Route

Travelers that are already en route have the least amount of trip flexibility – particularly for short duration trips. Changes made en route are often limited to selection of an alternate route,

assuming a reasonable alternative exists, as the departure time and mode choice selections have already occurred. As such, en route travelers desire only basic information pertaining to downstream travel conditions that will assist with route choice decisions and/or allow for the traveler to be notified of delays. The information needs of travelers en route are best satisfied by the display of current travel time, incident location, road work, or other congestion information on changeable message signs. Information should also continue to be distributed to motorists via radio broadcasts (traditional, highway advisory, or subscription services) as radio still stands as the most common media for travelers seeking traffic information. Travelers en route may also be served by a traffic information website, such as MiDrive, that could be accessed via a smartphone during a stop.

Preparing for Near-Term Departure

Travelers preparing for a near-term departure have some flexibility with respect to departure time, route choice, and mode choice - particularly for short duration trips. Regular commuters tend to fall in this category, as long-range travel planning is generally not performed due to familiarity, but current travel information is often useful prior to departure. If travelers preparing for departure are aware of unfavorable travel conditions, they have the option of adjusting departure time, selecting an alternative route, and/or selecting an alternative mode. The survey of Michigan commuters indicated that 60 percent of commuters will utilize traffic information to modify their route at least half of the time, while nearly 50 percent will modify their departure time. The information needs of travelers preparing for a near-term departure are best satisfied by the display of current travel speed, travel time, incident location and status, road work, or transit departure times on a travel information website or television broadcast.

Planning for Future Departure

Trip planning well in advance of departure affords the greatest level of flexibility with respect to departure time, route choice, and mode choice. Long distance travelers – particularly those traveling on unfamiliar routes and freight haulers – generally fall within this category due to the level of complexity associated with scheduling, particularly if there are multiple route options. As travel planning occurs well in advance of the trip, current travel conditions are generally of little value. However, reliability information is of particular importance as it allows

for informed decisions to be made pertaining to route choice, departure time, and/or mode choice. Additional information pertaining to the location of current and/or future road work is also of value to travelers in this category. The information needs of travelers planning for future departure, including freight industry personnel, are best satisfied by the display of travel time reliability or variability information on a travel information website, in addition to information pertaining to current and future road work. The freight industry did note substantial utilization of specialized truck routing software, most notably PC Miler, although many noted a desire for a comprehensive travel planning website to assist with scheduling or routing.

UTILIZATION OF ONLINE TRAFFIC INFORMATION AND MIDRIVE

The use of websites for traffic information by Michigan travelers remains relatively low, as evidenced by the responses obtained during the surveys. Only about 14 percent of travelers and commuters indicated using traffic websites on a weekly or daily basis, although smartphone users were far more likely to seek online traffic information. MiDrive recognition is also relatively low as only 22.5 percent of travelers were familiar with MiDrive. Furthermore, only 12.3 percent of travelers had ever utilized MiDrive, approximately 7 percent utilize MiDrive at least monthly, while fewer than 3 percent utilize MiDrive at least weekly.

The relatively low utilization of MiDrive may be at least partially attributed to the saturation of websites that display current traffic information for all or part of Michigan, which is often redundant with the information found on MiDrive. Including MiDrive, at the time of this report, no fewer than six different online sources provide a real-time traffic information map for Michigan that include, as a minimum, a color-coded map depicting current travel speeds/flow conditions, along with incident and road work locations. These include popular mapping and trip routing websites, such as Google, Bing, and MapQuest, in addition to beathtetraffic.com, traffic.com operated by Navteq, which currently serves as the traffic data provider for MDOT and many other agencies nationwide. Numerous other online sources, particularly news media websites, provide regional traffic information. Further, mobile versions and/or smartphone applications are also provided for many of these websites and stand-alone traffic applications are also available. In particular, Google and beatthetraffic.com each provide highly functional mobile sites.

SATISFACTION WITH TRAVEL IN MICHIGAN

The results of the traveler, commuter, and freight industry surveys provided several conclusions related to the satisfaction of travelers in Michigan. Overall, greater than 60 percent of survey respondents indicated being satisfied or very satisfied with travel in Michigan. Analysis of the results by home region found that travelers residing in the Metro Region had the lowest levels of travel satisfaction. These results are not unexpected due to the elevated levels of congestion found in Southeast Michigan compared to other areas of the state. Travelers residing in the Superior Region had the highest percentage of satisfied travelers, which is also not unexpected due to relatively low levels of congestion.

The survey of Michigan commuters also showed varied response based largely on region and route. Respondents from the Southeast Michigan were the least satisfied with their daily commute, whereas respondents commuting in the Grand and Southwest regions reported the highest level of satisfaction. A more detailed analysis of commuters in Southeast Michigan indicated that the highest levels of dissatisfaction were associated with commutes that included one or more of the following commonly congestion roadways: I-696, US-23, or I-275. Southeast Michigan commuters were most satisfied if their commute included M-39, M-10, an MDOT non-freeway such as M-1, US-24, M-59, or local a roadway. Commuters who worked within the City of Detroit were generally less satisfied with their commute compared to those who commuted to other areas of Southeast Michigan. Further analysis revealed that commuters who work in Downtown Detroit (zip code 48226) were the least satisfied of all commuters in Michigan, likely due to elevated congestion levels experienced during peak-periods on freeways approaching Downtown Detroit.

Commercial motor vehicle (CMV) operators tended to be less satisfied with travel on Michigan highways compared to all other travelers. CMV operators were most commonly dissatisfied with travel on freeways in Southeast Michigan, specifically on US-23, I-75, and I-94. I-94 and I-75 were similarly noted by freight industry logistics professionals as the most unreliable routes with respect to on time arrivals. Of the major trucking corridors in the state, I-96 and I-69 tended to receive the highest satisfaction ratings by both CMV operators and freight industry professionals.

RELIABILITY MEASUREMENT

Travel time reliability is defined as the consistency or dependability in travel times as measured from day-to-day or across different times of a day. Reliability may be quantified based on the impact of non-recurring congestion on the transportation system, particularly the impacts on travel time or speed along a particular route. The goal for an effective reliability measurement strategy is to provide information that is both easily understood by a broad range of transportation users and useful as an agency performance measure.

There are numerous methods for estimating reliability to help travelers to plan their trip, which are split into three general categories, which include: statistical range measures, buffer time measures, and tardy trip measures. Although several reliability measures have been suggested in the literature and, to a lesser extent, used in practice, it is clear that no such universally effective measure of reliability currently exists. The most common methods for determining travel time reliability are categorized as follows:

- Statistical Range Measures
    - Standard Deviation of Travel Time
    - Coefficient of Variation - Computed as standard deviation of travel time divided by mean travel time.
    - Travel Time Window – Computed as the average or median travel time plus or minus 1 or 2 standard deviations.
    - Travel Time Index - Computed as the average or median travel time divided by assumed free-flow travel time.
    - Variability Index – Computed as the difference between the peak period 95th percentile and 5th percentile travel times divided by the difference between the off-peak 95th percentile and 5th percentile travel times.
- Buffer Time Measures
    - Buffer Time - Computed as difference between 95th percentile travel time and average or median travel time.
    - Buffer Time Index - Computed as difference between 95th percentile travel time and average or median travel time, divided by average or median travel time.
    - Planning Time – 95^{th} percentile travel time.

    - Planning Time Index - Computed as 95th percentile travel time divided by assumed free-flow travel time.
- Tardy Trip Indicators
    - Florida Reliability Model – Computed as the percent of trips that exceed the median off-peak travel time plus additional acceptable travel time (typically 5 to 20 percent of the median).
    - On-time Arrival Rate – Computed as the percent of trips that reach a destination within a given travel time.
    - Misery Index - Computed as the average or median travel time for worst 20% of trips divided by the average or median travel time for all trips.

A review of current state practice for communication of current travel condition information found that nearly all states include some form of travel planning information online. Furthermore, a majority of states provide current traffic speeds or flow conditions on a color-coded online map. However, very few states include information related to route reliability. Those that do display reliability-related information typically do so in a simple format, such as a side-by-side comparison of current travel times versus average or ideal travel times.

CHAPTER 7:
RECOMMENDATIONS

The findings from the state-of-the-art and state-of-the-practice review were synthesized along with the survey responses to generate several recommendations pertaining to the best practices for quantification and communication of travel reliability information for use by the public through MiDrive and other sources. The recommendations included:

- Strategies for quantifying travel reliability information
- Communication of reliability information through MiDrive
- Communication of current traffic conditions
- Modifications to the MiDrive user interface
- Provision of alert notifications through MiDrive

STRATEGIES FOR QUANTIFYING TRAVEL RELIABILITY INFORMATION

Reliability measures that are most effectively utilized by the general public are those that utilize common terminology to describe quality of service of the particular facility. For example, the concepts of buffer time, planning time, and on-time arrival percentage are all inherently simple descriptions that may be effectively utilized by the public. Statistical range measurements, such as the standard deviation of travel time and coefficient of variation, are typically suitable for use as agency performance measures, but are not readily understood by the general public. In a general sense, the most broadly applicable reliability measures for both public communication and agency purposes are those that, for a specific period, compare days with high delay to days with average delay (10). The recommended practices for quantifying travel reliability information for public use include the following performance measures:

- Buffer Time and Index
- Planning Time and Index

Buffer Time and Index

Buffer time and buffer time index represent the most widely recommended measures of travel reliability found in the literature. These measures were selected due to the inherent understandability by a broad range of transportation system users as they account for unexpected

delays beyond that which are typical for a specific time of day. Buffer time refers to the *amount of extra time* needed beyond the average (or median) travel time to ensure an on-time arrival for most travelers with a high level of confidence. The buffer time index is simply the buffer time expressed as a percentage of the average travel time, thereby broadening the applicability by providing a time and distance neutral version of the buffer time.

The amount of buffer time is typically determined based on the 95th percentile travel time for the route during the particular time of day, which represents a lateness frequency of approximately one weekday per month, which was found to be a generally acceptable threshold both in the literature and in the survey of freight logistics personnel. However, other travel time percentiles, such as the 90th or 99th percentile, could be used depending on the level of need for an on-time arrival. For example, critical on-time deliveries may require higher level of reliability, whereas leisure trips may warrant a lower level. As such, trip planners would likely benefit from an online interface that included a user-selectable percentile for computing the buffer time.

Buffer time is inherently a more user-friendly measure for travelers interested only in the specific segment to which the buffer time applies. Travelers planning a trip along the segment can simply add the displayed amount of buffer time to the expected trip travel time for that particular time of day. Travelers concerned with an on-time arrival may simply advance their departure time by the amount of buffer time recommended for the segment. The buffer time index may be utilized in a similar fashion by multiplying the buffer index (percentage) by the expected segment travel time and advancing the departure time by the calculated amount. For example, a buffer index of 50 percent translates to adding an extra 15 minutes of travel time for a 30 minute average commute to be confident in an on-time arrival.

Planning Time and Index

The planning time and corresponding index are other popular measures of travel time reliability. Planning time relates to the *total travel time* that should be budgeted to ensure an on-time arrival for most travelers with a high level of confidence. The planning time is simply the 95th percentile travel time for the route during the particular time of day, while the index simply divides this value by the free-flow travel time.

Planning time differs from the buffer time in that free flow conditions are utilized as a baseline rather than average conditions for a particular time of day. Thus, whereas the buffer time (and index) only accounts for delays beyond expected (i.e., average) for the particular period, the planning time index includes any delays beyond free flow conditions. Similar to the buffer time, a larger planning time value relates to lower reliability and other travel time percentiles, such as the 90th or 99th percentile, could be used depending on the level of need for an on-time arrival.

Planning time is very user-friendly as it provides an indication of the amount of time to be scheduled for the particular segment to be confident in an on-time arrival. Similarly, the planning time index may be multiplied by the travel time at the speed limit or under very light traffic conditions to determine the overall amount of time to allow. Again, the departure time may be adjusted accordingly to ensure an on-time arrival. For example, a planning time index of 2.0 means that 30 minutes should be provided for a trip that takes 15-minutes during free flow conditions. The planning time index also serves as a useful normalized performance measure for agencies, particularly when used in conjunction with the travel time index, which is computed in the same manner but utilizing the average (or median) travel time rather than the 95^{th} percentile travel time.

COMMUNICATION OF RELIABILITY INFORMATION USING MIDRIVE

As MDOT continues to improve and modify MiDrive, consideration must be given towards distinguishing MiDrive from the variety of other popular real-time traffic information websites, such as traffic.com, Google, Bing, MapQuest. Because much of the information found on other websites relates primarily to current traffic information, MDOT can satisfy a currently unmet need by adding reliability-related information to MiDrive. Such information will assist travelers and the freight industry in the planning process for both near-term and future departures.

A common theme found throughout the review of the state-of-the-art and practice was that traffic information should be provided to road users in a variety of formats, including both tabular and graphical displays, to satisfy the needs of a broad range of users. Perhaps the best example of this technique that should be considered for emulation by MDOT is provided by the travelmidweststats.com website. This website provides freeway traffic conditions for the

southern Lake Michigan region, including the Milwaukee and Chicago Metropolitan areas along with northwest Indiana and southwest Michigan and is maintained by RoadStats, LLC (24). Figure 31 displays a screenshot of the travel information provided for a section of Chicago freeway from travelmidweststats.com, which provides a broad range of reliability related information that may be utilized for trip planning purposes, including:

- Segment name, length, and current time-of-day
- Travel time data for the current time-of-day
  - Current segment travel time
  - Average segment travel time and number of days in the sample (specific day of week)
  - Difference between current travel time and average travel time
- Graphical representation of travel time data by time-of-day
  - Current travel time (green line)
  - Average travel time for the day of the week (red line)
  - "Normal" range of travel times representing approximately 68 percent of all travel times for the day of the week (yellow area)

Displaying travel time reliability in this manner provides information relevant for nearly all stages of travel planning. For example, travelers preparing for a near-term departure can utilize the current travel time information (green line) to determine the departure time. If on-time arrival is critical, then the user may consider basing departure on the upper bound of the normal range of travel times (yellow area) to determine additional buffer time necessary to account for unexpected delays. For those concerned with route reliability, comparison can be made between the relative magnitudes of the normal travel time ranges between various routes to determine the route with the lowest travel time variability for the time period of interest.

Another useful feature of the travelmidweststats.com website is the ability to perform custom queries. Upon clicking on the "custom query" hyperlink in the center of the page, the user is directed to a subsequent page displaying additional criteria, including the ability to display information for two segments, and selection of a customized range of dates (or simply month and year) and specific day(s) of the week. However, as displayed in Figure 32, the graphical output provided by the custom query simply displays separate average travel time lines for the two road segments and the normal range is not provided.

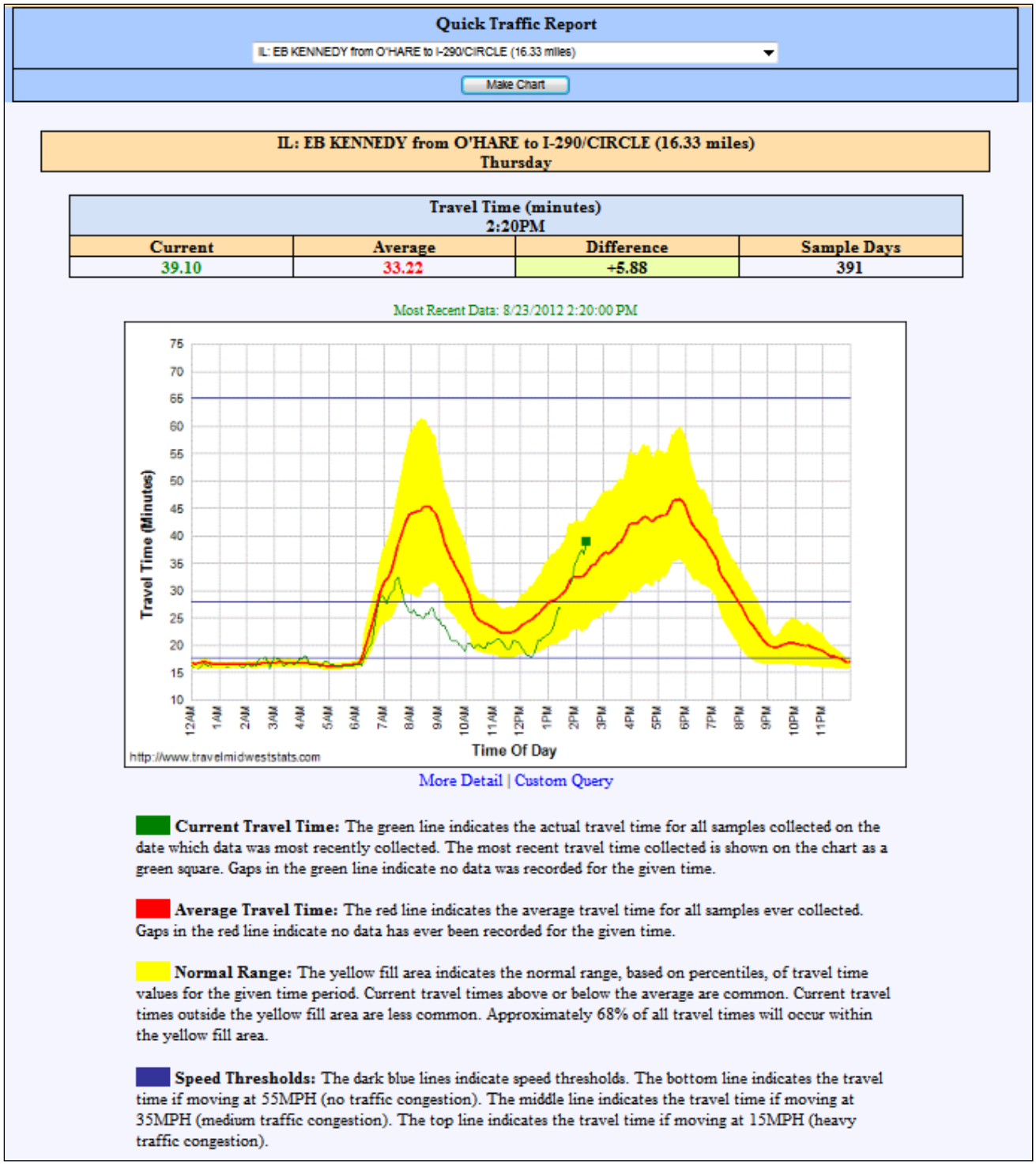
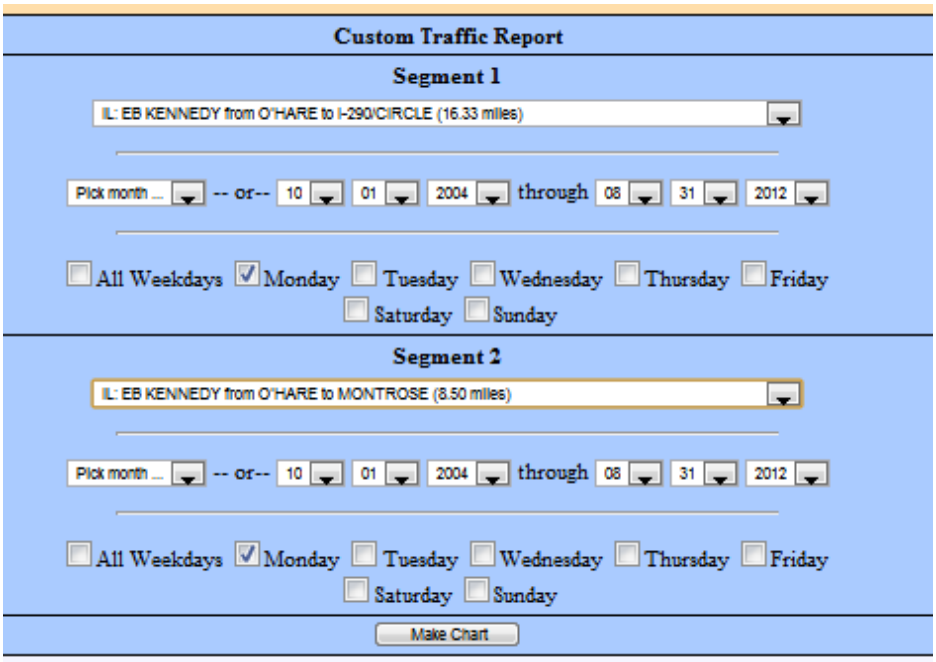
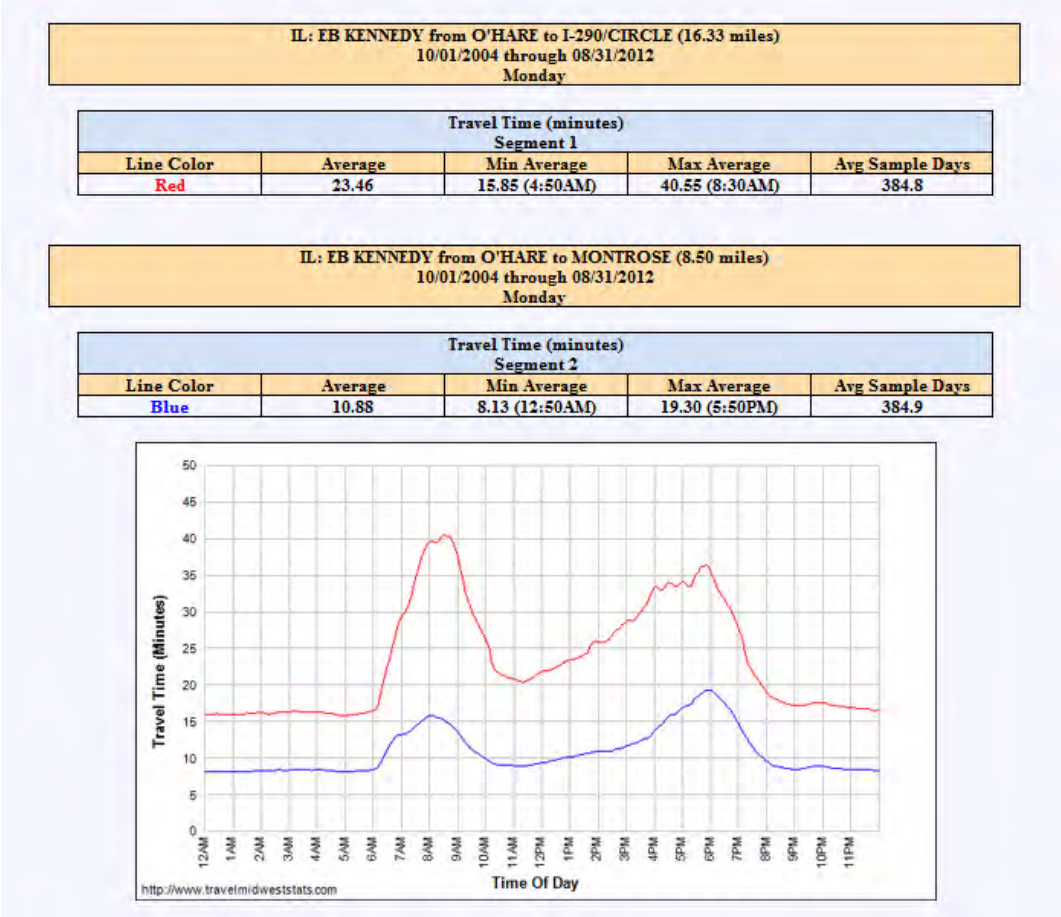


Figure 31. Online Display of Travel Time and Reliability Information from travelmidweststats.com (24).





IL: EB KENNEDY from O'HARE to I-290/CIRCLE (16.33 miles)
10/01/2004 through 08/31/2012
Monday

Travel Time (minutes) Segment 1				
Line Color	Average	Min Average	Max Average	Avg Sample Days
Red	23.46	15.85 (4:50AM)	40.55 (8:30AM)	384.8

IL: EB KENNEDY from O'HARE to MONTROSE (8.50 miles)
10/01/2004 through 08/31/2012
Monday

Travel Time (minutes) Segment 2				
Line Color	Average	Min Average	Max Average	Avg Sample Days
Blue	10.88	8.13 (12:50AM)	19.30 (5:50PM)	384.9

Figure 32. Custom Display Interface and Output from travelmidweststats.com (24).

Although the online data displays provided by travelmidweststats.com include a broad range of valuable information to assist with travel planning, slight modifications are recommended, as follows:

- Increase the upper end of the normal range (yellow area in the graph). The current range of 68 percent does not provide a high enough level of confidence for critical on-time performance. A more appropriate upper threshold for the freight industry is the 95th percentile travel time. The best strategy would be to allow the user to select the percentile representing at least the upper limit of this range.
- Provide additional segment reliability statistics in the table, including: buffer time and index and planning time and index.
- Report the current average or median travel speeds along the segment in the table.
- Allow for the ability to either customize the segment start and end points (preferred) or the combination of multiple predetermined segments into a single segment, as opposed to the two discrete segments displayed in the custom query interface of travelmidweststats.com.
- Eliminate the horizontal speed threshold lines from the graph.

It is recommended that access to such an online travel time and reliability data resource be provided to users directly from the main MiDrive traffic condition map by simply clicking on the desired segment. It may also be of value to provide the basic segment reliability statistics, such as current travel time, average travel time, buffer time, and/or planning time either as a map layer and/or as a table in a small pop-up window that is displayed upon hovering the cursor above the particular segment.

COMMUNICATION OF CURRENT TRAFFIC CONDITIONS

Changeable Message Signs

Changeable message signs are effective for communicating current mobility information to travelers en route. As travelers that are already en route have limited trip flexibility, basic information pertaining to downstream travel conditions is most helpful to assist with route choice decisions (if multiple options exist) and/or communication of travel delays to the destination.

Changeable message signs should continue to be utilized by MDOT to provide segment travel time information to help satisfy the information needs of travelers already en route.

Travel time information should be formatted in one of two ways, dependent on whether one route or multiple reasonable routes are available to a destination. MDOT's current practice of displaying freeway distance and travel time information to an interchange or destination is in-line with nationwide practice and is recommended. If only a single reasonable route is available, then distances and travel times to one or more major interchanges along the route should be displayed to motorists. If two routes are available, then distances and travel times via each route to the same destination should be displayed. An example of each is provided below.

TRAVEL TIME TO		
M-39	5 MI	4 MIN
I-275/M-14	16 MI	15 MIN

a. Single Route Option

TRAVEL TIME TO I-94		
VIA I-96	12 MI	12 MIN
VIA M-39	12 MI	13 MIN

b. Multiple Route Options

Figure 33. Typical Changeable Message Sign Displays

Travelers en route also desire information pertaining to current incidents, road work, or other congestion information. Incident or road work related messages should preempt travel time information when such information will assist travelers in making route-related decisions.

MiDrive

MiDrive currently utilizes a statewide traffic map to display real-time mobility information, including segment travel speeds, current and future road work locations and information, freeway cameras, among other information. It is recommended that real-time mobility information continue to be displayed on MiDrive in this manner. It is also recommended that travel times for common travel routes be displayed alongside the map similar to the displays utilized by the Washington DOT or Arizona DOT as shown in the following figures. While the Washington DOTs simplistic color coded display of information is preferred, the information should be displayed in conjunction with the traffic condition map in a manner similar to the Arizona DOT.

State Route/ Interstate	Route Description	Distance (miles)	Average Travel Time (minutes)	Current Travel Time (minutes)	Via HOV (min.)
167	Auburn to Renton	9.8	11	12	10
405	Bellevue to Bothell	9.7	14	19	12
405 5	Bellevue to Everett	26.1	41	38	29
405 5	Bellevue to Federal Way	24.6	42	39	26

Figure 34. Sample of Washington DOT Online Travel Time Information for Seattle-Area

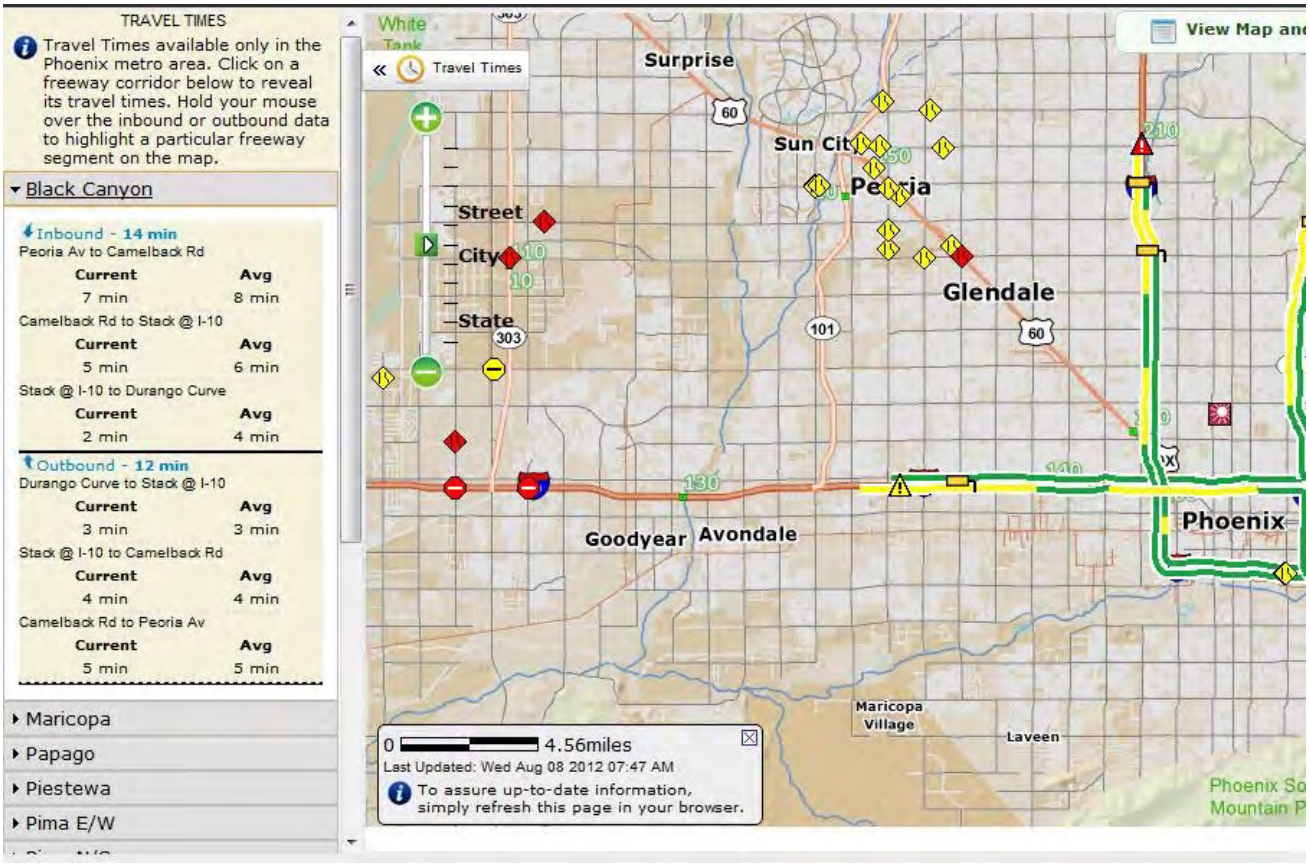
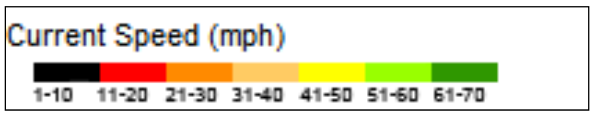
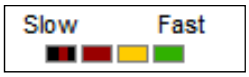


Figure 35. Arizona DOT Online Traffic Condition Map with Phoenix-Area Travel Times

Modifications to the color coded speed scale shown on the MiDrive traffic condition map are also recommended. MiDrive currently utilizes a quantitative speed scale that includes 10 mph speed increments, which is shown in Figure 36 compared to other common traffic websites that are more qualitative in nature. While such an absolute numeric scale provides an accurate measure of the current speed of the traffic stream, it is somewhat misleading when viewing urban non-freeway routes on the color coded map as such routes will display as orange or yellow rather than green during free flow conditions due to the lower speed limits. On the other hand, qualitative scales, including those utilized by the Washington DOT, traffic.com, Google, and Bing, use color coding to indicate traffic flow or speed relative to free flow conditions along the route. For example, "free flowing" or "fast" traffic conditions along the segment are indicated as green, while slower traffic flow is indicated as yellow, orange or red. It is recommended for the MiDrive speed scale to be modified to a qualitative scale so that the non-freeway color coding scheme provides an indication of relative traffic flow conditions along a segment rather than absolute conditions. This will also make MiDrive consistent with other common online traffic flow maps. A qualitative scale similar to that displayed on traffic.com is most preferable as it provides more descriptive captions for the color coded classifications.



a. MiDrive website



b. Google maps and Bing maps

c. Traffic.com website

d. Washington DOT website

Figure 36. MiDrive vs. Traffic.com Traffic Map Speed Scales

MIDRIVE USER INTERFACE AND ALERT NOTIFICATIONS

Modification of MiDrive to include a customizable user interface would provide users with greater flexibility by allowing for users to establish the default map view, including the default region/route and map layers, along with incident and/or congestion notifications for specific routes. These features would apply to both the traditional website and the smartphone application. The current version of the traditional and particularly the mobile websites require the user to maneuver through a series of menus in order to display traffic-related information as shown in Figures 37 and 38, respectively.

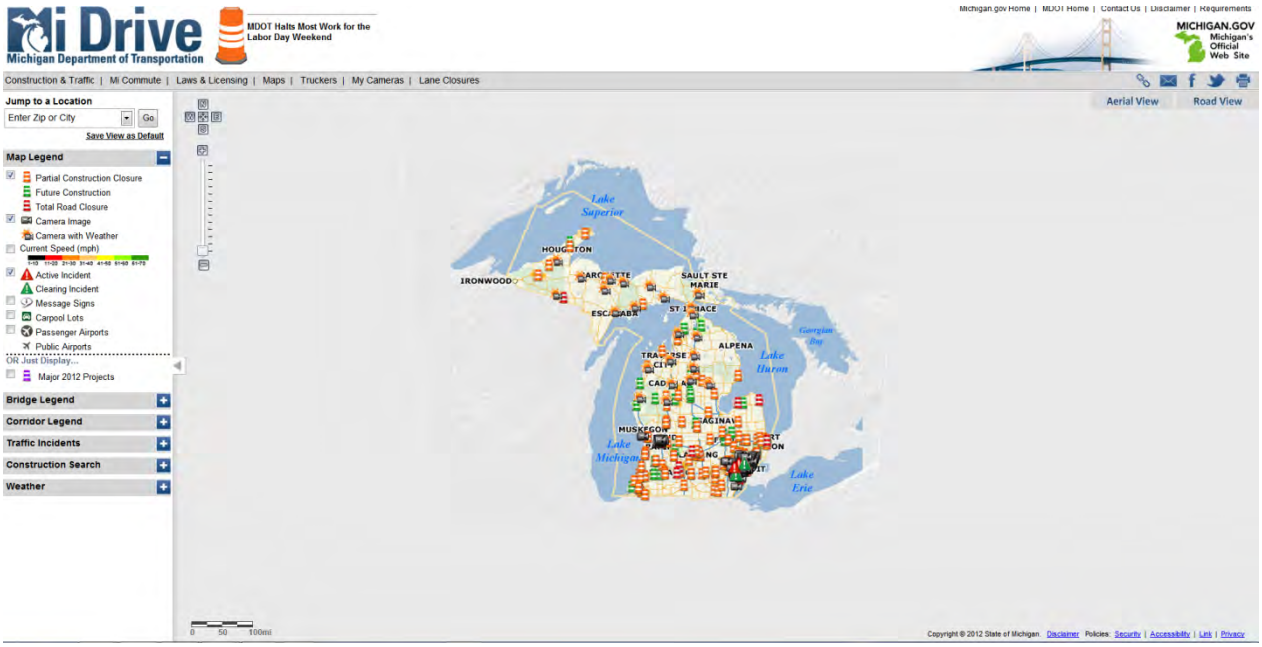
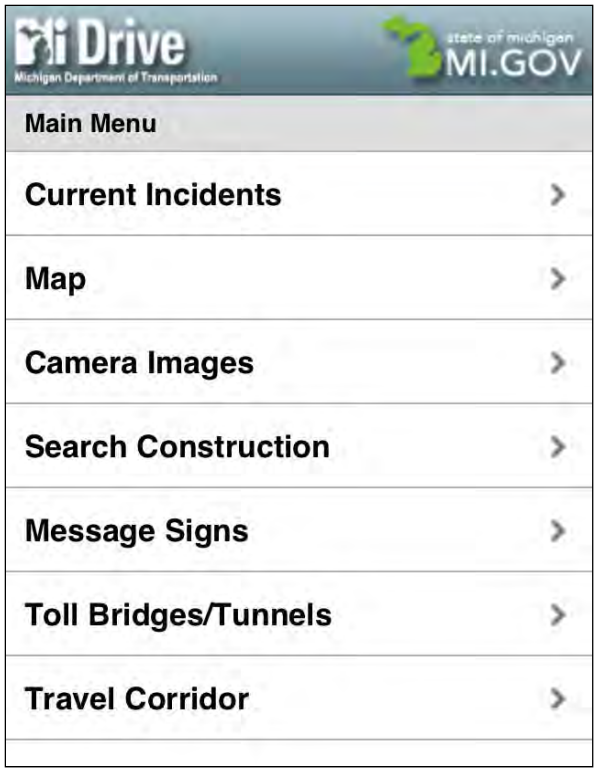
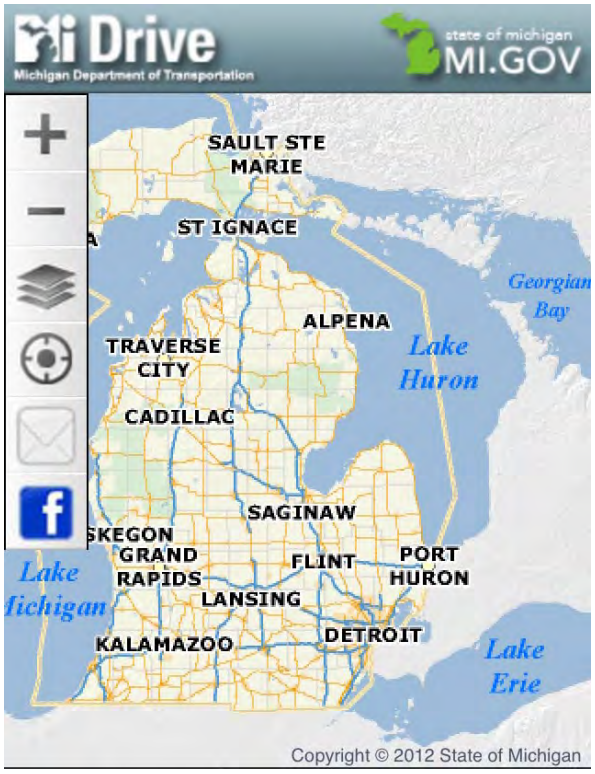


Figure 37. Current Default View for MiDrive Traditional Website

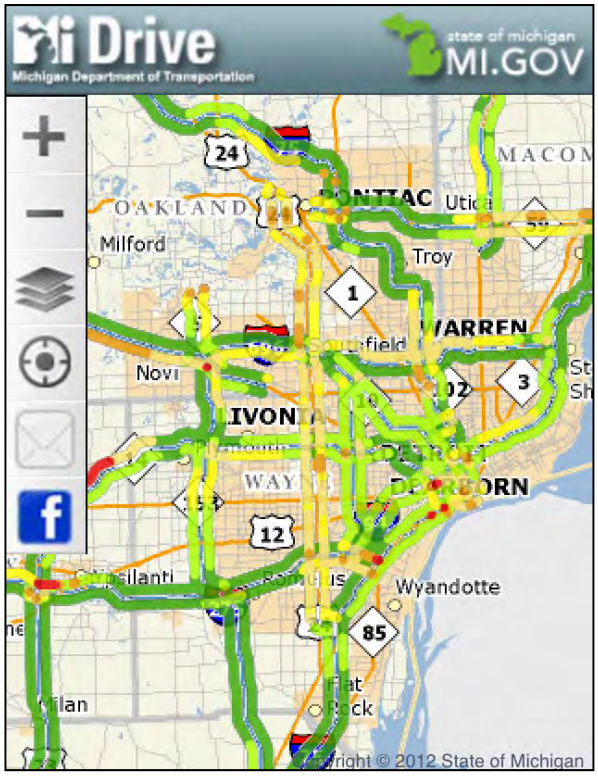


a. Opening Screen



b. Initial Map View

c. Map Layer Selection



d. Current Speeds (Southeast Michigan)

Figure 38. Current Default Views for MiDrive Mobile Website

As shown in Figure 38a, the current default opening screen for the MiDrive Mobile website displays a menu of options, including current incidents, map, camera images, construction, and others. Upon selection of "map", the default view displays the state map, but without any traffic related information, as shown in Figure 38b. To add traveler information to the map, the user must select the "layer" icon, followed by selection of one or more layers to be displayed, as shown in Figure 38c. Figure 38d displays an example of current travel speeds along major routes in southeast Michigan. MiDrive users would benefit from the ability to create and store a desired default viewing window that is displayed each time the website is accessed.

It is also recommended that MiDrive be modified to include customized traffic alerts that are sent via email, text, or "push" notification to the MiDrive mobile (smartphone) website. Such an alert system would greatly enhance the functional capability for users. "Push" alerts are common features within many smartphone applications and work by automatically sending notifications to the subscribed user's phone. This notification is typically provided via a small icon overlaid onto the website icon, which serves to alert the user while the application is closed. An audible alert may also be included at the user's discretion. An example of how the MiDrive iPhone icon may appear with a push notification is shown in Figure 39.

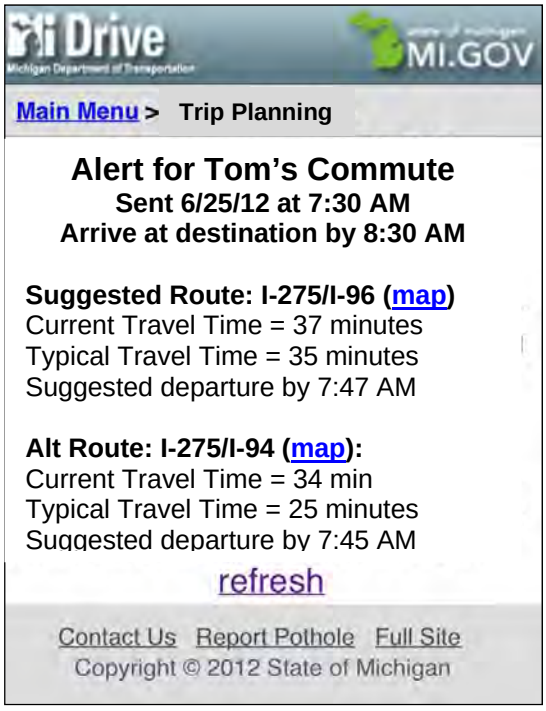
The registration process for traffic alerts should be designed in a manner that is similar to that used by the Illinois DOT's "Traffic Alert Website" http://www.iltrafficalert.com/. After establishing an online user account, the user may then register for free customized traffic alerts sent via email or text message. Flexibility is provided to the user in terms of selection of roadway segments, directions, times of day, days of week, and types of alerts (incidents, construction, congestion and/or travel times). Additionally, the user is provided with the ability to establish a minimum average speed threshold for the selected roadway, below which an alert will be triggered. Navteq's traffic.com website provides a similar traffic alert feature and also allows for users to create a personal account for storage of all user information. Traffic.com also provides users with suggested alternate routes based on current traffic conditions. A personal MiDrive account would allow users to store all settings related to alerts, the default interface, and other features.

In addition to the features found within both the Illinois DOT's and Navteq's traffic alert systems it is also recommended that users be provided with the ability to control the severity of the incident that would prompt an alert, for example major incidents only, major and moderate

incidents, or all incidents. Regular commuters may also benefit from regular alerts pertaining to suggested buffer or planning times sent prior to a scheduled departure to assist with selection of departure time and/or route.

After receiving an alert, the user may then enter the app to receive complete details. Incident-related alerts may be formatted in the same manner as the incident information currently found on the mobile website, as shown in Figure 40a. Incident alerts should include the following information, as a minimum: roadway, direction, location (nearest crossroad), nature of the incident, number of lanes/shoulder blocked, time the incident occurred, current time, and the stage of the incident. An example of a mocked-up planning time-related alert for determining commute departure time is provided in Figure 8b. Push notifications, particularly those related to incidents may also be applied in a similar fashion to the standard MiDrive website and other 3rd party applications, such as in-vehicle GPS navigation systems.

Figure 39. Example MiDrive Mobile Website Icon with Mock Push Alert



a. Incident Information (Actual) **b. Trip Planning Information (Mock)**

Figure 40. Example Traffic Alert Messages

CHAPTER 8:
IMPLEMENTATION STRATEGY

An assessment of transportation system reliability and trip satisfaction has provided insight for implementation of the research results in various aspects of planning and operation by MDOT. Such implementation strategies can be grouped as follows:

1. Communicating real-time travel mobility and reliability data via MiDrive. Providing realistic travel time and reliability information to the public often allows road users to make informed choices pertaining to selection of route choice and/or departure time. Such information should be quantified and presented using a variety of techniques to service a broad range of travelers and trip planners, whose needs vary based on when the information is sought along with the penalties associated with late arrival. MDOT currently possesses the data necessary to quantify real-time travel time, speed, and reliability information for major routes statewide. MDOT also maintains and continues to develop communication methods to distribute such information to the public, most notably through the MiDrive traffic information website and changeable message signs. Although MiDrive currently provides suitable display of travel mobility information, certain additional reliability-related data and modifications to the online and mobile interfaces have been recommended, as described in Chapter 7. Implementation of the recommended changes to MiDrive should be phased beginning with a pilot project either within a particular region, such as the Metro Region, or along a particular route, such as I-94. This pilot implementation project would include the addition of travel reliability data to the MiDrive interactive map along with the additional recommend modifications to the user interface, as described in Chapter 7. As the necessary current and historical travel mobility data are available to MDOT for roadways currently included in MiDrive, this pilot implementation project may be performed as soon as possible. Further, these modifications may be made at a relatively low cost as MiDrive is currently operated and maintained internally. The pilot implementation will allow MDOT to test several display strategies and make modifications prior to statewide implementation. It is recommended that MDOT perform surveys or focus groups of travelers and freight industry personnel to obtain feedback pertaining to the changes to MiDrive, including

the utility of the newly included travel reliability data and user-friendliness of the modified web interface. Statewide implementation may occur thereafter for the remaining roadways for which data are available and should not involve substantive additional costs to operate or maintain. Other items, such as customizable user accounts, may require an investigation of necessary data storage requirements and privacy issues and may be implemented at a later date if feasible.

2. Marketing and promoting MiDrive. MiDrive continues to have a relatively low level of familiarity and use among travelers. MDOT should continue to advertise MiDrive both on official State of Michigan websites and also through other sources, such as social media, Pure Michigan (michigan.org), changeable message signs, and other communication channels. The popularity of MiDrive will likely improve if MDOT continues to distinguish MiDrive from the variety of other available real-time traffic information websites, such as traffic.com, Google, Bing, and Mapquest. As much of the information found on other websites relates primarily to current traffic information, MDOT can satisfy a currently unmet need by adding reliability-related information to MiDrive. Such information will assist travelers and the freight industry in the planning process for both near-term and future departures.
3. Planning and development of alternatives that alleviate travel reliability problems. Travel reliability issues could be addressed in terms of medium and long-range transportation improvement program. The survey data identified the most problematic MDOT roadways with respect to travel time uncertainty and trip dissatisfaction. Remediation strategies could be included in future project development for these roadways, including those related to operational and/or capacity improvements.
4. Monitoring trip satisfaction for project planning and development purposes. Periodic surveying of the trip satisfaction across a broad range of travelers would help MDOT track corridor performance – particularly as it relates to travel mobility. MDOT has historically performed traveler surveys both internally and via contractors using a variety of methods, including face-to-face, via telephone, and online. It is recommended that future MDOT statewide traveler surveys, regardless of context, include one or more standard questions related to travel reliability, trip satisfaction,

and MiDrive familiarity and utilization. Data collected and reported here from traveler surveys performed at 30 rest areas statewide along with surveys of nearly 750 commuters statewide may serve as benchmarks.

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APPENDIX A:

ONLINE TRAFFIC INFORMATION RESOURCES BY STATE

Table A1. Primary Traffic Information Website, by State

State	Website
Alabama	http://alitsweb.dot.state.al.us/its/
Alaska	http://511.alaska.gov/alaska511/mappingcomponent
Arizona	http://www.az511.com/adot/files/traffic/
Arkansas	http://www.arkansashighways.com/
California	http://quickmap.dot.ca.gov/
Colorado	http://www.cotrip.org/home.htm
Connecticut	http://www.dotdata.ct.gov/iti/master_iti.html
Delaware	http://www.deldot.gov/information/travel_advisory/
Florida	http://www.fl511.com/
Georgia	http://www.georgianavigator.com/realtimetraffic.html
Hawaii	http://hawaii.gov/dot/highways
Idaho	http://hb.511.idaho.gov/main.jsf
Illinois	http://www.gettingaroundillinois.com/
Indiana	http://www.trafficwise.in.gov/
Iowa	http://hb.511ia.org/main.jsf
Kansas	http://www.ksdot.org/offTransInfo/511Info/511traffictravel.asp
Kentucky	http://511.ky.gov/kyhb/main.jsf
Louisiana	http://hb.511la.org/main.jsf
Maine	http://www.511.maine.gov/main.jsf
Maryland	http://www.chart.state.md.us/
Massachusetts	http://mass511.com
Michigan	http://mdotnetpublic.state.mi.us/drive/
Minnesota	http://hb.511mn.org/main.jsf
Mississippi	http://www.mdottraffic.com/
Missouri	http://maps.modot.mo.gov/timi/
Montana	http://roadreport.mdt.mt.gov/map/
Nebraska	http://www.511.nebraska.gov/atis/html/index.html
Nevada	http://www.safetravelusa.com/nv/
New Hampshire	http://hb.511nh.com/main.jsf
New Jersey	http://www.511nj.org/
New Mexico	http://nmroads.com/
New York	http://www.511ny.org/mapview.aspx?1344447242110
North Carolina	http://tims.ncdot.gov/tims/default.aspx
North Dakota	http://www.dot.nd.gov/travel-info-v2/
Ohio	http://www.buckeyetraffic.org/
Oklahoma	http://oktraffic.org/map.php?location=statewide

State	Website
Oregon	http://www.tripcheck.com
Pennsylvania	http://www.511pa.com/TravelConditions.aspx
Rhode Island	http://511.dot.ri.gov/hb/main.jsf
South Carolina	http://www.511sc.org/sc511/login/auth
South Dakota	http://www.safetravelusa.com/sd/
Tennessee	http://ww2.tdot.state.tn.us/tsw/smartmap.htm
Texas	http://www.drivetexas.org
Utah	http://www.udottraffic.utah.gov/
Vermont	http://511.vermont.gov/main.jsf
Virginia	http://www.511virginia.org/home.aspx?r=1
Washington	http://www.wsdot.com/traffic/
West Virginia	http://www.transportation.wv.gov/highways/traffic/Pages/roadconditions.aspx#23
Wisconsin	http://www.511wi.gov/Web/
Wyoming	http://map.wyoroad.info/hi.html

Table A2. Sample of Traffic Information Websites for Major U.S. Cities

City	Website
Atlanta	http://www.traffic.com/Atlanta-Traffic/Atlanta-Traffic-Reports.html
Atlanta	http://www.beatthetraffic.com/traffic/#!/Atlanta/report
Boston	http://www.boston.com/news/traffic/
Boston	http://www.traffic.com/Boston
Boston	http://www.beatthetraffic.com/traffic/#!/Boston/report
Chicago	http://webapps.cityofchicago.org/traffic/
Chicago	http://travelmidwest.com/lmiga/home.jsp
Dallas	http://www.traffic.com/Dallas-Traffic/Dallas-Traffic-Reports.html
Dallas	http://www.beatthetraffic.com/traffic/#!/Dallas/report
Houston	http://traffic.houstontranstar.org/layers/
Los Angeles	http://www.go511.com/traffic/map.aspx
Los Angeles	http://www.sigalert.com/map.asp?region=Los+Angeles#lat=33.98417&lon=-118.22335&z=2
Los Angeles	http://trafficinfo.lacity.org/
Miami	http://www.fl511.com/Map.aspx
Miami	http://www.traffic.com/Miami
Minneapolis	http://www.traffic.com/Minneapolis-Traffic/Minneapolis-Traffic-Reports.html
Minneapolis	http://www.minneapolistrafficmap.com/
New York	http://www.511ny.org/mapview.aspx?1345830380015
New York	http://www.beatthetraffic.com/traffic/#!/New-York-City/report
Philadelphia	http://www.traffic.com/Philadelphia-Traffic/Philadelphia-Traffic-Reports.html
Philadelphia	http://www.beatthetraffic.com/traffic/#!/Philadelphia/report
Phoenix	http://www.traffic.com/Phoenix-Traffic/Phoenix-Traffic-Reports.html
Phoenix	http://www.beatthetraffic.com/traffic/#!/Phoenix/report
San Francisco	http://traffic.511.org/traffic_map.asp
San Francisco	http://www.traffic.com/San-Francisco-Traffic/San-Francisco-Traffic-Reports.html
San Francisco	http://www.beatthetraffic.com/traffic/#!/Bay-Area/report
Seattle	http://www.wsdot.com/traffic/trafficalerts/PugetSound.aspx
Seattle	http://www.traffic.com/Seattle-Traffic/Seattle-Traffic-Reports.html
Seattle	http://www.beatthetraffic.com/traffic/#!/Seattle/report
Washington DC	http://www.traffic.com/Washington-DC-Traffic/Washington-DC-Traffic-Reports.html
Washington DC	http://www.beatthetraffic.com/traffic/#!/Washington-DC/report

Table A3. Characteristics and Availability of Online Traffic Information, by State

State	Mobile Version	Interactive Map	Road Work	Incidents	Road Conditions	Color Coded Speed/ Flow	Format of Speed/Flow Info*	Travel Time	Weather	Route Reliability
Alabama	Yes	Yes	Yes	No	Yes	Yes	Qualitative	No	No	No
Alaska	Yes	Yes	Yes	Yes	Yes	No	N/A	No	Yes	No
Arizona	Yes	Yes	Yes	Yes	Yes	Yes	Qualitative	Yes	Yes	Yes
Arkansas	No	No	Yes	No	No	No	N/A	No	No	No
California	No	Yes	Yes	Yes	Yes	Yes	Qualitative	No	Yes	No
Colorado	Yes	Yes	Yes	Yes	Yes	Yes	Quantitative	Yes	Yes	No
Conn.	No	Yes	Yes	Yes	No	Yes	Qualitative	No	No	No
Delaware	Yes	Yes	Yes	Yes	Yes	Yes	Quantitative	Yes	Yes	No
Florida	Yes	Yes	Yes	Yes	Yes	Yes	Quantitative	Yes	Yes	No
Georgia	Yes	Yes	Yes	Yes	Yes	Yes	Quantitative	No	Yes	No
Hawaii	Yes	No	Yes	No	No	No	N/A	No	No	No
Idaho	Yes	Yes	Yes	Yes	Yes	Yes	Qualitative	No	Yes	No
Illinois	No	Yes	Yes	No	No	Yes	Quantitative	No	Yes	No
Indiana	Yes	Yes	Yes	Yes	Yes	Yes	Quantitative	No	Yes	No
Iowa	Yes	Yes	Yes	Yes	Yes	Yes	Qualitative	No	Yes	No
Kansas	Yes	Yes	Yes	No	Yes	No	N/A	No	Yes	No
Kentucky	Yes	Yes	Yes	Yes	Yes	Yes	Qualitative	No	Yes	No
Louisiana	Yes	Yes	Yes	Yes	Yes	Yes	Qualitative	No	Yes	No
Maine	Yes	Yes	Yes	Yes	Yes	Yes	Qualitative	No	Yes	No
Maryland	Yes	Yes	Yes	Yes	Yes	Yes	Quantitative	No	Yes	No
Massachusetts	Yes	Yes	Yes	No	No	Yes	Qualitative	No	No	No
Michigan	Yes	Yes	Yes	Yes	Yes	Yes	Quantitative	No	Yes	No
Minnesota	No	Yes	Yes	Yes	Yes	Yes	Qualitative	No	Yes	No
Mississippi	No	Yes	Yes	Yes	Yes	Yes	Qualitative	No	No	No
Missouri	No	Yes	Yes	Yes	Yes	No	N/A	No	Yes	No
Montana	No	Yes	Yes	Yes	Yes	No	N/A	No	Yes	No
Nebraska	Yes	Yes	Yes	Yes	Yes	Yes	Quantitative	No	Yes	No
Nevada	No	Yes	Yes	Yes	Yes	No	N/A	No	Yes	No
New Hampshire	No	Yes	Yes	Yes	Yes	Yes	Qualitative	No	Yes	No
New Jersey	Yes	Yes	Yes	Yes	Yes	Yes	Qualitative	Yes	Yes	No
New Mexico	Yes	Yes	Yes	Yes	Yes	Yes	Quantitative	No	Yes	No
New York	Yes	Yes	Yes	Yes	Yes	Yes	Quantitative	No	Yes	No
North Carolina	No	Yes	Yes	Yes	Yes	Yes	Quantitative	No	Yes	No
North Dakota	Yes	Yes	Yes	Yes	Yes	No	N/A	No	Yes	No
Ohio	No	Yes	Yes	Yes	Yes	Yes	Quantitative	No	Yes	No
Oklahoma	No	Yes	No	No	No	Yes	Quantitative	No	No	No
Oregon	No	Yes	Yes	Yes	Yes	No	N/A	No	Yes	No
Pennsylvania	Yes	Yes	Yes	Yes	Yes	Yes	Quantitative	Yes	Yes	No
Rhode Island	No	Yes	Yes	Yes	Yes	Yes	Qualitative	No	Yes	No

State	Mobile Version	Interactive Map	Road Work	Incidents	Road Conditions	Color Coded Speed/ Flow	Format of Speed/Flow Info*	Travel Time	Weather	Route Reliability
South Carolina	Yes	Yes	No	Yes	No	No	N/A	No	No	No
South Dakota	No	Yes	Yes	Yes	Yes	No	N/A	No	Yes	No
Tennessee	Yes	Yes	Yes	Yes	Yes	Yes	Qualitative	No	Yes	No
Texas	Yes	Yes	Yes	Yes	Yes	Yes	Qualitative	No	Yes	No
Utah	Yes	Yes	Yes	Yes	Yes	Yes	Quantitative	No	Yes	No
Vermont	No	Yes	Yes	Yes	Yes	No	N/A	No	No	No
Virginia	Yes	Yes	Yes	Yes	Yes	Yes	Quantitative	No	Yes	No
Washington	Yes	Yes	Yes	Yes	Yes	Yes	Qualitative	Yes	Yes	No
West Virginia	No	No	Yes	No	Yes	No	N/A	No	Yes	No
Wisconsin	Yes	Yes	Yes	Yes	Yes	No	N/A	No	Yes	No
Wyoming	No	Yes	Yes	Yes	Yes	No	N/A	No	Yes	No

*Quantitative indicates that numeric ranges are utilized to describe current traffic speeds. Qualitative indicates that descriptive terms are utilized to describe current traffic speeds or flows (e.g., fast, moderate, slow, congested, free flowing, etc.).

APPENDIX B:

EN ROUTE TRAVELER SURVEY QUESTIONNAIRE

Background Information

1) Home Zip Code:_____ Age: _____

2) Which of following best describes your job status?

☐ Full-time: Salary ☐ Part-time ☐ Student
☐ Full-time: Hourly ☐ Not Employed ☐ Retired
☐ Self Employed

About your CURRENT TRIP

3) What is the purpose of this trip?

☐ Truck Haul Route ☐ Work (on the clock)
☐ Vacation/Recreation ☐ Daily Commute ☐ Personal Business

4) What is the duration of your trip today?

☐ Less than 1 hour ☐ 1 to 2 hours ☐ 2 to 4 hours
☐ 4 to 6 hours ☐ 6 to 8 hours ☐ 8+ hours

5) Over the past 12 months, how many times have you traveled along this section of roadway?

☐ First Time ☐ 2-5 times ☐ 6-10 times
☐ 11-20 times ☐ 20-50 times ☐ 51+ times

6) What was the <u>most important</u> reason you chose this particular route for your trip today?

☐ Fastest ☐ Predictable travel times
☐ Shortest Distance ☐ No other reasonable route

7) What is considered an unacceptably late arrival to your destination today?

☐ 0 – 1 min late ☐ 1 – 5 min late ☐ 6 – 15 min late
☐ 15 – 30 min late ☐ 30+ min late ☐ not a concern

8) Please indicate any additional time budgeted into this trip to account for unexpected delays: _____ min

9) How important is each of the following with respect to your travel satisfaction today?

(1=Not Important, 5=Essential)

	1	2	3	4	5
Arriving on time (or before)	☐	☐	☐	☐	☐
Encountering no delays	☐	☐	☐	☐	☐
Traveling at high speeds	☐	☐	☐	☐	☐
Avoiding stop-and-go traffic	☐	☐	☐	☐	☐

10) Please indicate your level of satisfaction with:

(1=Very Dissatisfied, 5=Very Satisfied)

	1	2	3	4	5
Travel on this roadway today	☐	☐	☐	☐	☐
Travel on this roadway in general	☐	☐	☐	☐	☐
Michigan travel in general	☐	☐	☐	☐	☐

About TRIP PLANNING

11) Did you obtain traffic information before departure today? ☐ Yes ☐ No

Please indicate the source: ☐ Website ☐ GPS ☐ Radio ☐ TV

12) Are you familiar with MDOT's "MiDrive" traffic website? ☐ Yes ☐ No

Did you use MiDrive today? ☐ Yes ☐ No

13) How often do you use these sources to obtain <u>traffic</u> information before or during travel?

	Never	Yearly	Monthly	Weekly	Daily
MiDrive	☐	☐	☐	☐	☐
Other Website	☐	☐	☐	☐	☐
Television	☐	☐	☐	☐	☐
Radio	☐	☐	☐	☐	☐
GPS	☐	☐	☐	☐	☐

14) For <u>vacation/recreation</u> trips, which do you prefer?

☐ A slightly slower route with more reliable travel times
☐ A slightly faster route with less reliable travel times

15) For <u>regular trips, such as for work or commuting</u>, which do you prefer?

☐ A slightly slower route with more reliable travel times
☐ A slightly faster route with less reliable travel times

16) Considering a website that provides current traffic information, how important are each of the following items?

(1=Not Important, 5=Essential)

	1	2	3	4	5
Travel Speeds along a Roadway	☐	☐	☐	☐	☐
Travel Times along a Roadway	☐	☐	☐	☐	☐
Route Reliability Information	☐	☐	☐	☐	☐
Accident Locations	☐	☐	☐	☐	☐
Road Work Locations	☐	☐	☐	☐	☐
Wet/Icy Road Conditions	☐	☐	☐	☐	☐
Freeway Camera Views	☐	☐	☐	☐	☐

About your DAILY COMMUTE

17) On average, how long is your commute?

☐ 5 min or less ☐ 6-10 min ☐ 11-20 min ☐ 21-30 min
☐ 31-45 min ☐ 46-60 min ☐ 61 min or more

18) What is considered unacceptably late arrival to work?

☐ 0 – 1 min late ☐ 1 – 5 min late ☐ 6 – 15 min late
☐ 15 – 30 min late ☐ 30+ min late ☐ not a concern

19) Please indicate any additional time budgeted into your commute to account for unexpected delays: _____ min

Location: Date: Time: Survey No. Ver 5.3

APPENDIX C:

MICHIGAN COMMUTER TRAVELER SURVEY QUESTIONNAIRE

Note: Format differs from actual online survey

1. Within what region of Michigan do you work?

- ○ METRO DETROIT / SOUTHEAST (including Wayne, Oakland, Macomb, Washtenaw, Livingston, Monroe, St. Clair, and Lenawee Counties)
- ○ WEST / SOUTHWEST (including Kent, Ottawa, Kalamazoo, Calhoun, Muskegon, Allegan, Van Buren, Berrien, Cass, St. Joseph, Branch, Barry, Ionia, Montcalm, Mecosta, Oceana, and Newago Counties)
- ○ LANSING / JACKSON AREA (including Ingham, Eaton, Jackson, Clinton, Gratiot, and Hillsdale, Counties)
- ○ FLINT / SAGINAW / BAY CITY / MIDLAND AREA (including Genesee, Saginaw, Bay, Midland, Lapeer, Shiawasee, Isabella, and Tuscola Counties)
- ○ ALL OTHER AREAS OF MICHIGAN

2. Please provide the following background information:

- ✎ Home Zip Code
- ✎ Employer
- ✎ Work Street Address
- ✎ Work City
- ✎ Work Zip

3. What is your primary route or routes to/from work? (please list no more than 2)

- ✎ Roadway #1 _____
- ✎ Roadway #2 _____

4. Which of the following best describes your job status?

- ○ Full time - Salaried
- ○ Full time - Hourly
- ○ Part time
- ○ Other, please specify

5. How often do you typically use each of the following modes for your commute to/from work?

	Never	A few times a Year	A few times a Month	A few times a Week	Daily
Personal Vehicle					
Carpool/Vanpool/Rideshare					
Bus/Public Transportation					
Bicycle					
Walk					
Telecommute/Work from Home					

6. How long is your typical daily commute (one-way) using your most common travel mode?

- ○ 5 minutes or less
- ○ 6 to 10 minutes
- ○ 11 to 20 minutes
- ○ 21 to 30 minutes
- ○ 31 to 45 minutes
- ○ 46 to 60 minutes
- ○ Greater than 1 hour

7. How important are each of the following factors when selecting the travel mode for your commute?

	Not Important	Of Little Importance	Moderately Important	Important	Very Important
Convenience/Flexibility					
Cost					
Travel Speed					
Arrival Time Reliability					
Safety					
Comfort/Avoiding Stress					
Environmental Friendliness					
Other mode options are not practical					

8. What is considered an unacceptably late arrival to work?

- ○ 0 to 1 minute late
- ○ 1 to 5 minutes late
- ○ 6 to 15 minutes late
- ○ 16 to 30 minutes late
- ○ More than 30 minutes late
- ○ Not a concern

9. Assuming that an on-time arrival is necessary, how much additional time would you budget into your daily commute (one-way) to account for unexpected delays?

- ○ 0 minutes
- ○ 1 to 5 minutes
- ○ 6 to 10 minutes
- ○ 11 to 15 minutes
- ○ 16 to 20 minutes
- ○ 21 to 30 minutes
- ○ More than 30 minutes

10. If both of the following route options were available for your daily commute, which option would you prefer?

- ○ A slightly slower route with more reliable travel times
- ○ A slightly faster route with less reliable travel times

11. How important are each of the following factors as they relate to the level of satisfaction for your daily commute?

	Not Important	Of Little Importance	Moderately Important	Important	Very Important
Arriving on time (or before)					
Encountering no unexpected delays					
Traveling at your desired speed					
Avoiding heavy traffic					

12. Within the past 12 months, approximately how many trips of greater than 2 hours have you taken via motor vehicle?

- ○ 0
- ○ 1-5
- ○ 6-10
- ○ 11-15
- ○ 16-20
- ○ more than 20

13. If both of the following route options were available for a vacation/recreational trip, which option would you prefer?

- ○ A slightly slower route with more reliable travel times
- ○ A slightly faster route with less reliable travel times

14. How important are each of the following factors as they relate to your level of satisfaction for vacation/recreational travel?

	Not Important	Of Little Importance	Moderately Important	Important	Very Important
Arriving on time (or before)					
Encountering no unexpected delays					
Traveling at your desired speed					
Avoiding heavy traffic					

15. Please indicate your general level of satisfaction regarding:

	Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied
Your daily commute travel					
Travel within your region of Michigan					
Michigan travel in general					

16. Are you familiar with MDOT's "MiDrive" traffic information website (http://mdotnetpublic.state.mi.us/drive/)?

- ○ Yes
- ○ No

17. Approximately how often do you use each of the following sources to obtain traffic information?

	Never	A few times a Year	A few times a Month	A few times a Week	Daily
"MiDrive" Website					
Other Website					
Television					
Radio					
GPS					

18. How often do you use the traffic information obtained from the source(s) indicated in the previous question to change your:

	Never	Rarely	About Half the Time	Usually	Always	N/A
Travel Route						
Departure Time						
Travel Mode						

19. How frequently do you use a web-enabled smartphone to obtain traffic information?

I do not own a smartphone	Never	A few times a Year	A few times a Month	A few times a Week	Daily

20. Please indicate the importance of each of the following characteristics as they relate to a traffic information website (such as "MiDrive") that is used for travel planning purposes:

	Not Important	Of Little Importance	Moderately Important	Important	Very Important
Current Travel Speeds					
Current Travel Times					
Route Reliability (Day-to-day consistency of traffic conditions)					
Accident Locations					
Current Road Work					
Future Road Work					
Road Weather Conditions					
Freeway Camera Views					
Bus/Transit Arrival Times					
Special Event Information					

21. Considering each of the following trip purposes, would you be more likely to travel using public transportation (e.g., bus or train) if real-time arrival information was available online?

	No	Possibly	Yes
Daily commute			
Short distance recreational travel			
Long distance vacation/recreational travel			

APPENDIX D:

FREIGHT INDUSTRY SURVEY

Table D1. Freight Industry Survey Participants

Company	Phone	City	State	Major Routes Traveled				
AD Transport Express Inc	(734) 397-7100	Canton	MI	I-75	I-94			
Blainer Express LLC	(517) 944-0383	Lansing	MI	I-96				
Evans Distribution	(313) 827-9161	Detroit	MI	I-94	I-75			
Ever Fresh Farms Transportation	(616) 530-0005	Grand Rapids	MI	I-94	I-96	I-196	US 131	I-94
Farmco Distributing Inc	(517) 669-8391	Lansing	MI	I-96	I-94	I-69		
InOnTime Inc	(616) 748-7519	Zeeland	MI	I-96	US 131	I-196		
Inter Commerce Express	(616) 475-8413	Grand Rapids	MI	US 131	I-96	I-94	I-69	
Johnston Trucking Inc	(517) 882-5274	Lansing	MI	US 127	I-96	I-69		
Kerry Transport Inc	(989) 754-6871	Saginaw	MI	I-75	I-96	I-69	I-94	US 23
MAC Transport	(810) 424-4001	Flint	MI	I-75	I-69	I-96		
Magic Transportation	(616) 532-1333	Grand Rapids	MI	US 131	I-96	I-196		
Michigan Rail-Michigan Terminal	(269) 838-6410	Grand Rapids	MI	US 131	I-96			
Now Delivery LLC	(616) 893-1148	Grand Rapids	MI	I-94	I-96	I-75		
Rapid Supply & Sales Inc	(616) 534-3900	Grand Rapids	MI	US 131	US 31	I-96		
Reliable Delivery	(734) 641-1600	Romulus	MI	I-75				
Richfield Logistics Corp	(810) 233-0440	Flint	MI	US 23	I-75	I-69		
Roth Trucking Inc	(616) 784-4404	Grand Rapids	MI	I-96	I-275	I-94	I-75	M-39
Steel Transportation Services	(810) 736-1065	Flint	MI	I -69	I-75	I-96	US 23	
AC Trucking	(513) 771-3676	Cincinnati	OH	I-75	I-94			
Eldomar Logistics	(905) 795-9339	Mississauga	ON	I -69	I-94			
Hewings Transport	(519) 752-8478	Brantford	ON	I-75	I-94	I-69	I-96	
Illini State Trucking	(219) 554-6750	Hammond	IN	I-94	I-196	US 23	I-75	
Interstate Auto Transport	(219) 326-1000	Michigan City	IN	I-94	I-69	I-75		
Luckhart Transportation Limited	(519) 393-6128	Sebringville	ON	I-75	I-69			
McKevitt Trucking LTD	(807) 623-0054	Thunder Bay	ON	I-75	I-94	I-69		
MGM Express	(630) 227-3200	Bensenville	IL	I-94				
Trans-Frt. McNamara	(519) 740-6500	Ayr	ON	I-75	I-69	I-94		
Vikta Inc	(905) 232-0911	Mississauga	ON	I-75	I-69			
Worldwide Carriers LTD	(416) 213 1334	Brampton	ON	I-94	I-69	I-75		
Greyhound Bus	(313) 204-4145	Detroit	MI	I-94	I-96			
SMART Bus	(313) 223-2352	Southeast	MI	Var.				
MTA Flint	(810) 780-8813	Flint	MI	I-75				

Freight Industry Survey Telephone Questionnaire

Your Name:_____
Respondent's Name:_____
Company: _____
Direct Phone Number (Optional):_____
Email (Optional):_____

1. Which Michigan highways does your company use most frequently for truck hauling?
2. Which Michigan highways would you consider to be the most unreliable with respect to arriving on-time?
3. How do you deal with unreliable highways during trip planning (Prompt with examples: travel during off peak hours, travel at night, use alternate routes)?
4. In minutes, what is typically considered the maximum amount of time a shipment can arrive late to a destination without penalty?
    - (If something other than 0 min) -> What percent of the time may late arrivals occur?
5. On average, approximately how much extra time (in percent of the total trip time) is typically added to a haul route to account for unexpected travel delays?
6. What is the <u>most important</u> basis for determining a haul route?

    □ Lowest cost/lowest fuel usage □ Fastest route
    □ Most predictable travel times □ Shortest Distance

7. If forced to select between these two options for routing, which do you prefer? 1) A generally slower route with predictable travel times or 2) A generally faster route with unpredictable travel times
8. What resources do you utilize when planning a haul? (Examples include: mapping websites, logistics software, GPS).
9. Have you ever utilized MDOT's "MiDrive" traffic information website to assist with planning a haul?
10. On a scale of 1 to 5, where 1 is "not useful" and 5 is "very useful", please indicate the value of each of the following pieces of information found on a traffic information website as they relate to planning a truck haul route:
    - Current Road Work
    - Future Road Work
    - Route Reliability Info
    - Accident Locations
    - Current Travel Speeds
    - Current Travel Times
    - Road Weather Conditions
    - Special Event Information