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SAFETY AND ECONOMIC IMPACTS OF TEXAS TRAVEL INFORMATION CENTERS: AN UPDATE

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EXECUTIVE SUMMARY

The Texas Department of Transportation (TxDOT) currently operates and maintains 12 Travel Information Centers that serve travelers entering the state. These public facilities serve a broad range of visitors, including vacation/recreational travelers, commercial vehicle operators, commuters, travelers on bus tours, and motorcyclists. Travel Information Centers provide the distinct advantage of quick and convenient access, some with facilities that are open 24 hours per day. A majority of travelers stopping at Travel Information Centers obtain travel and tourism information, use the restroom, or simply take a break from driving to rest and stretch. Other patrons use the Travel Information Center visit for other purposes such as using vending machines, giving relief to children or pets, conducting vehicle checks and maintenance, going picnicking, changing drivers, or even sleeping.

Travel Information Centers are an integral component of TxDOT's DriveTexas™ Highway Conditions service. Current information on highway closures, construction, accidents, and weather-related travel conditions are displayed on an interactive map at www.DriveTexas.org and provided via TxDOT's toll-free Travel Information line at 1-800-452-9292. Highway conditions information is provided on this line via an Interactive Voice Response (IVR) system, and callers also have the option of speaking to a travel counselor during the hours that the Travel Information Centers are open. During emergency events, this line serves as an emergency information conduit for the traveling public. In case of evacuations, hurricanes, winter storms, or other emergency conditions, Travel Information Center staff dispense information on a variety of subjects including emergency shelter information, fuel availability, food and water availability, and emergency medical resources, in addition to weather and highway conditions information. Throughout the year, Travel Information Centers partner with TxDOT District Safety Officers, the Texas Department of Public Safety, local law enforcement, and other organizations to host safety awareness events for the public.

Conditions of a recent legislative appropriation prompted TxDOT to reassess the functional value of Travel Information Centers and their economic and safety impact. Although it is generally known that Travel Information Centers possess many intrinsic benefits to travel and tourism in the state, the safety and economic impacts associated with Texas Travel Information Centers have only recently been quantified. This study revisits the recent assessment of the safety and economic impacts of Travel Information Centers as well as the functional values of these facilities. The overall goal of this research was to gather additional data to further quantify the impact of Texas Travel Information Center staff and services on the safety of travelers on TxDOT roadways. Researchers used data and analytical tools that quantify the value of person-to-person contact with visitors by providing information on travel route, road condition, destination, weather, and disaster evacuation. Several tasks were performed as part of this research to help achieve this goal.

In 2014, a four-tiered approach was established to provide evidentiary data supporting the safety impact of Texas Travel Information Centers, by means of the following methodologies:

- Sourcing existing literature and current precedent research studies that are relevant to establishing baselines of safety benefits of Travel Information Centers, particularly for risks of drowsy/fatigued driving, impacts of large trucks, and influences of traveler behaviors.
- Analysis of several years' worth of crash data for stretches of roadway preceding and following access to and from Travel Information Centers, demonstrating notable reduction in crash rates for roadway driving immediately downstream following Travel Information Center facilities.
- Collection and analysis of on-site visitor surveys at Texas Travel Information Centers, and assignment of weighted safety index corresponding to each response.
- Analysis of dramatic peaks in DriveTexas –800 phone line calls handled by Texas Travel Information Center staff during emergency or extreme weather events affecting roadways (ice, snow, hurricanes, flood, road closures, etc.) to obtain valuable traveler safety information during the midst of emergency/weather events.

The research began with a comprehensive literature review of the safety benefits of Travel Information Centers. Next, the research team conducted site visits in 2014 to observe the operations of travel information centers in Texas and the services they provide. Researchers performed face-to-face user surveys at four Travel Information Centers (Harlingen, Orange, Amarillo, and Gainesville) in 2014 and at two (Harlingen and Waskom) in 2016 to better understand the impact of the Travel Information Center visits on drivers' safety. TxDOT personnel then conducted the same surveys at all Texas Travel Information Centers. Crash data for the last three years were collected and analyzed to determine potential safety impacts due to the presence or absence of Travel Information Centers.

The research team identified several safety benefits of Travel Information Centers:

- Reduction of driver fatigue and other wellness issues.
- Transmission of critical information on safety and hazardous road and weather conditions.
- Reduction of driver or passenger discomfort and distraction.
- Reduction of highway shoulder stops.
- Reduction of excess travel to get services.

In 2016, a new study was performed on the effect of the Gainesville, Orange, and Amarillo Travel Information Centers on crash rates along the highway segments where they are located. Analysis of crash data revealed statistically significant reduction in crash rates due to the existence of the centers at Orange and Gainesville. The proximity of the Amarillo center to city services makes it difficult to determine how much of the crash reduction is directly attributable to the center; however, there was a reduction in the number of crashes

for all three Travel Information Centers studied. In a previous study, the Texas A&M Transportation Institute (TTI) identified significant crash reduction due to the upgrade of the Amarillo and Anthony Travel Information Centers. Crash analysis for the Harlingen Travel Information Centers was not included because of the existence of cofactors such as adjacency of urban centers, which create a high margin of error for the results.

In addition to directly quantifying the safety benefits of the centers with locations favorable for measurement, a safety index was developed to estimate how Travel Information Center users perceive the impact of the usage on the safety of their travel experience. This safety index was based on the results from the field questionnaires. Results suggested that Travel Information Centers have significant impact on the safety of the travelers as remarked by the computed value of the proposed safety index.

The economic impact of Texas Travel Information Centers has been established through data collection via surveys conducted on-site at the center locations, combining analysis of annual visitation, self-reported visitor behavior, and the average daily per-person spending figures from D.K. Shifflet & Associates, Ltd., in conjunction with the travel research office of the Office of the Governor—Economic Development and Tourism (EDT). Chapter 6 of this report has the full results of the Economic Impact study for Fiscal Year 2015 and Fiscal Year 2016.

The economic benefits of Travel Information Centers include:

- Comfort and convenience.
- Promotion of in-state tourism.
- Enhancement of public safety.
- Reduction of excess travel to obtain services.
- Savings on vehicle operation and maintenance.
- Benefits to specific business enterprise.
- Reduction of traffic diversion into communities.

After taking into account the tourism benefits evaluated in this study, the economic analysis showed that all Travel Information Center facilities are considered economically viable. For Fiscal Year 2016,* the economic benefits of Travel Information Centers included \$127,389,309 in increased visitor spending, 1,274 jobs supported by the centers, and \$7,859,920 in state tax revenue generated by these centers. The economic study did not quantify other economic benefits of Travel Information Centers such as comfort and convenience benefits, and reduction of excess travel to access similar services if the Travel Information Center did not exist or were not assessed. Several published studies that quantified these benefits concluded that they exceed the tourism benefits. As such, Travel Information Centers have a significant economic benefit to Texas. Although economic

* As of October 1, FY 2016 budget has not yet been closed out.

benefit-cost analysis was not formally performed in this study, based on the TTI study and estimates from this study, the economic benefit-cost ratio of Texas Travel Information Centers may be well above 10:1. The study estimated the direct visitor spending generated by the Travel Information Centers at about \$242 million for the last two years compared to a cost of about \$12 million to maintain and operate the centers—an impressive benefit-to-cost ratio by itself.

The results of this research demonstrate that the Travel Information Centers are economically viable with a very high benefit/cost ratio and contribute to significant reduction of crashes, especially fatigue-related crashes. The unquantified additional benefits associated with crash reduction and availability of travel information for safety purposes such as weather information and road closures further improve the benefit/cost ratio of Travel Information Centers significantly.

CHAPTER 1: INTRODUCTION

STATEMENT OF PROBLEM

Travel Information Centers, typically located at entry points to states, have long been recognized to serve a myriad of purposes. These include providing an efficient way for travelers to rest, relax, and obtain various types of travel-related information such as official state travel maps and guides and promotional literature featuring state attractions, recreation activities, and accommodations. Travel Information Centers also have the following objectives:

- Reducing driver fatigue and other adverse physiological effects.
- Reducing in-vehicle driver distraction.
- Reducing roadside and shoulder stops.
- Providing a safe refuge under hazardous weather, visibility, and roadway conditions.
- Reducing roadside stops for vehicle maintenance and inspection.
- Providing safety-related information to drivers (King, 1989).

Most relevant, previously completed safety-related research was focused on safety rest areas in general. A Travel Information Center includes a safety rest area but also provides additional services. Little research has been conducted on the impact of Travel Information Centers on safety, e.g., impacts of information provided at Travel Information Centers on travelers' behavior, characteristics of users, and the motivation to stop at a center.

Rider 34 of TxDOT's appropriation under H.B. 1, 84th Legislature, Regular Session, 2015, requires an update to the study required by Rider 37 under S.B. 1 of the 83rd Legislature, Regular Session in 2013. To comply with this legislative requirement, TxDOT has worked to quantify the Travel Information Centers' impact on driver and traveler safety, and identify the tangibles in order to measure impacts on safety. Data and analytical tools have been developed to quantify the value in terms of visitor safety of person-to-person contact with a travel counselor who provides travel routes, road conditions, destination, weather, and emergency travel information. In addition, safety impacts in the form of crash reduction have been evaluated.

STUDY GOAL AND OBJECTIVES

The purpose of this research was to quantify Texas Travel Information Center impacts on driver and traveler safety, beyond serving as safety rest areas, under the previously developed methodology to measure these impacts. The methodology includes data collection from the 12 Texas Travel Information Centers located across the state and the implementation of survey tools to assess their safety impacts on drivers. Data collected include Travel Information Center operations, the services provided, visitor information,

and incident data. In-person traveler surveys were also conducted at all Texas Travel Information Centers. Researchers performed an extensive statistical analysis of the survey results. The outcome of the proposed research is an updated assessment of the safety impacts of Texas Travel Information Centers and statistical quantification of the measurable safety benefits of the project to TxDOT. In addition, detailed crash analysis on road segments potentially affected by three of the Travel Information Centers was performed. Similarly, researchers used the surveys collected from the centers' visitors for the last two years to estimate the economic impacts of the Travel Information Centers.

SUMMARY OF TASKS

The following tasks were performed in order to accomplish the aforementioned study objectives:

- Perform a review of the operations of travel information centers in Texas.
- Perform a comprehensive literature review of the safety benefits of Travel Information Centers.
- Survey users of Travel Information Centers to identify the economic and safety benefits of the centers.
- Collect and analyze crash data to estimate potential safety impacts of travel information centers,
- Perform an analysis of the economic benefits of Travel Information Centers.
- Develop conclusions pertaining to the economic and safety value of Texas Travel Information Centers.

CHAPTER 2: LITERATURE REVIEW

INTRODUCTION

Travel Information Centers—and to a lesser extent, most safety rest areas—offer a critical venue at which highway authorities and other public agencies can reach out to highway travelers. A driver who receives accurate and useful weather, road, and traffic information will most likely use it to find a safer, more convenient route or time for his/her trip. This type of benefit can only be confirmed if a Travel Information Center user reports it, and the real value depends on the user's perception. Therefore, it is necessary to quantify this type of benefit through the implementation of user surveys.

Although one of the main purposes of safety rest areas and Travel Information Centers is travel safety, there is little research that quantified the impact of these facilities on the number of road crashes, even though the link between drivers' fatigue and crash risk is well-established. The main reason for this is attributed to the difficulty in quantifying the traveler's performance before and after a stop, and how the stop directly impacts his/her driving performance and behavior on the road, which are major factors in crash potential. The Travel Information Centers and safety rest areas can only be effective when used—like seatbelts, for example. To that effect, an Australian study (Austroads, 2008) noted that facilities such as Travel Information Centers and rest areas could be effective only if supported by non-engineering interventions, e.g., encouraging travelers to make proper use of them. A safety rest area forum organized by the Federal Highway Administration (FHWA, 1999) emphasized that education is critical for addressing driver fatigue. For example, the study noted that drivers are not adequately notified or informed of available parking at safety rest areas and that Intelligent Transportation Systems technology might be needed to help direct travelers to available parking space in safety rest areas and Travel Information Centers.

Travel Information Centers nationwide have long been recognized to serve a myriad of purposes such as disseminating travel information, enhancing tourism, and offering a rest stop. In Texas, the Travel Information Centers also play an emergency response role. Tourism researchers continue to conduct studies on the benefit of Travel Information Centers. Most of the research on Travel Information Centers has focused on studying two broad areas. The first is the Travel Information Center users. For example, Mason (1975), Muha (1977) and Fesenmaier (1994) studied the demographic characteristics of Travel Information Center users at different states. Howard and Gitelson (1989) and Stewart et al. (1993) examined the differences between these users and other travelers who do not stop at the Travel Information Centers. Other studies investigated the factors that led travelers to stop at Travel Information Centers (e.g., Fesenmaier, 1994; Howard and Gitelson, 1989; Gitelson and Perdue, 1987).

The second area of research was the impact of stopping and the information provided at Travel Information Centers on travel behavior. For example, Gitelson and Perdue (1987) investigated how the travel information at the Travel Information Centers helped influence travelers' current and future visits. Other studies investigated the impact of information obtained at Travel Information Centers on travelers' behavior, such as increasing spending and extending duration of stay in the Travel Information Center's state (e.g., Fesenmaier, 1994; Fesenmaier and Vogt, 1993; Roehl et al., 1993; Tierney, 1993; Fesenmaier et al., 1993).

DRIVER FATIGUE AND DROWSINESS

The National Sleep Foundation's poll found that 60 percent of adult drivers said they had driven a vehicle while feeling drowsy or fatigued (Drobnich, 2005). A more alarming statistic from the poll is that more than one-third of those polled had actually fallen asleep while driving. This agrees with an earlier survey study by McCartt et al. (2000) who reported that 47.1 percent of the truck drivers in New York had fallen asleep while driving. Vanlaar et al. (2008) reported that 59 percent of a sample of Canadian drivers admitted to driving while fatigued and 15 percent admitted that they had fallen asleep while driving. Ohayon et al. (2010) reported that working outside regular daytime hours was associated with shorter sleep duration, sleepiness, and driving collision risk. They found that night driving disrupted sleep habits the most, resulting in excessive sleepiness and sleep attacks during driving.

Various predisposing and situational factors can cause drivers' drowsiness and fatigue. Brown (1994) and Brill et al. (2003) listed the length of continuous work spells and daily duty periods, time available for rest and continuous sleep, and the arrangement of duty, rest, and sleep periods within each 24-hour cycle as major factors. Williamson et al. (2001) noted that drivers experienced high fatigue mostly in the early morning and to a lesser extent in the early afternoon. Long driving hours and problems with loading and unloading were among the main fatigue-causing factors. Stutts et al. (2003) found that drivers in sleep-related crashes were more likely to work multiple jobs, night shifts, or other unusual work schedules. They averaged fewer hours of sleep per night, reported poorer quality sleep, were less likely to feel they got enough sleep, were sleepier during the day, drove more often late at night, and had more prior instances of drowsy driving. Compared with drivers in non-sleep-related crashes, they had been driving for longer periods of time, had been awake more hours, and had slept fewer hours the night before. Otmani et al. (2005) reported similar observations but also remarked that the driver age was another contributing factor. They also noted that young drivers were significantly less alert than middle-aged drivers at low traffic flow or when driving between 11:00 p.m. and 6:00 a.m.

Drivers' behaviors and lifestyles were also found to be major factors in creating situations of driving while fatigued or drowsy. For example, one can eliminate these situations by obtaining a good night's sleep before driving, planning ahead, and avoiding medications that can cause drowsiness (Austroads 2012). Medical conditions can also aggravate the driver's

condition. Gurubhagavatula et al. (2008) reported that drivers with sleep apnea were more likely to be involved in fall-asleep crashes. The National Highway Traffic Safety Administration (NHTSA) lists a number of chronic predisposing factors and acute situational factors that increase the risk of drowsy driving and related crashes:

- Driving patterns, including:
 - Driving between midnight and 6 a.m.
 - Driving a substantial number of miles each year and/or a substantial number of hours each day.
 - Driving in the mid-afternoon hours (especially for older persons).
 - Driving for long times without taking a break.
- Use of sedating medications, especially prescribed anxiolytics, hypnotics, tricyclic antidepressants, and some antihistamines.
- Untreated or unrecognized sleep disorders, especially sleep apnea syndrome and narcolepsy.
- Consumption of alcohol, which interacts with and adds to drowsiness.

Williamson et al. (2001) reported that the contract and working conditions might prompt drivers to drive while drowsy or fatigued. For example, paid-by-trip/flat load drivers reported fatigue more often than drivers who were paid hourly wages. Rodriguez et al. (2003) found that the driver's pay, job tenure, and percentage of miles driven during winter months increased the likelihood of crashes more than demographic factors, with low-paid drivers being involved in more crashes.

FATIGUE-RELATED ACCIDENTS

Fatigue is one of the major causes of traffic accidents that, according to NHTSA estimates, results in 1,500 fatalities and 71,000 injuries in the United States every year (Knipling and Wang, 1994). However, an NHTSA (2011) report estimated the fatalities to be slightly above 1,000 per year for the 2005 to 2009 period and noted that this number might be an underestimate. The majority of evidence concerning the effect of fatigue on accident risk have come from studies of driving performance. Most of these studies have inferred a relationship between travel driving and risk, from the study of driving performance and fatigue. Motor vehicle crashes involving fatigue-related driving are more likely to cause fatalities and serious injuries compared with non-fatigue-related driving crashes (ALDOT, 2012; NHTSA, 2011; Pack et al. 1995) – 40-50% of these crashes result in fatalities or injuries. It is widely believed that fatigue-related crashes are generally underreported (Carson et al., 2011) because “Driver asleep” or “Driver fatigued” observations are self-reported by the involved driver or inferred by the investigating officer. Many researchers suggested that fatigue-caused crashes result in higher injury and death rates than actually reported (e.g., Bunn et al., 2005; Connor et al., 2002; and Garbarino et al., 2001). The reason that driver fatigue is mostly self-reported is the absence of a universally accepted

definition of fatigue (Dobbie, 2002). Even among traffic and highway authorities, the exact definition of a fatigue-related crash can be subjective and varies among different jurisdictions. According to the NHTSA (Banerjee et al., 2009), an archetypical collision related to sleepiness has the following characteristics:

- The incident occurs during late night/early morning or mid-afternoon.
- The crash is likely to be serious.
- A single vehicle leaves the roadway.
- The crash occurs on a high-speed road.
- The driver does not attempt to avoid a crash.
- The driver is alone in the vehicle.

Based on an Australian operational definition, transportation researchers in Canada (Highway Safety Roundtable, 2008) suggested a more realistic definition of fatigue that included the following criteria:

- Police or coroner identified fatigue as a contributing factor.
- Vehicle condition: No Apparent Defect.
- Driver did not exceed speed limit and did not travel at a speed too fast for his/her condition at the time of the crash.
- Driver was not impaired by alcohol or drugs.
- Driver has no medical or physical disability.
- Crash occurred on a dry pavement.
- Initial impact type (head-on collisions where neither vehicle was overtaking at the time of collision, rear-end collision, and single vehicle collisions).
- Crashes that involve unlicensed drivers are excluded.
- Crashes that involve pedestrians or animals (wild or domestic) are excluded.
- Driver initiated the crash.

Using a model based on this operational definition, it was found that on Ontario roads in 2004, 18 percent of all fatal crashes and 26 percent of crashes causing injury were fatigue related. Based on an operational definition of fatigue, the Australian Transport Council (ATC, 2003) estimated that fatigue was a factor in 20–30 percent of fatal crashes. A National Transportation Safety Board study in 1990 estimated that 31 percent of crashes where truck drivers are killed are fatigue-related (Smith et al., 2005). This is in contrast with the NHTSA (2009) statistics showing just 3 percent of all fatal crashes reported annually as fatigue-related. Recent studies estimated that 15% to 33% of fatal crashes might involve fatigue-related drivers (Tefft 2010, 2014; Masten et al., 2006).

Rajaratnam and Jones (2004) asserted that sleepiness/fatigue is now regarded as the largest identifiable and preventable cause of accidents in all modes of transportation. Horne and Reyner (1996) observed that most single-vehicle crashes occurred without prior braking, and that their highest incidence occurred during the periods between 2:00 a.m. and

6:00 a.m., and between 2:00 p.m. and 4:00 p.m. Furthermore, Sagberg (1999) found that the odds of fatigue or sleep being the cause increased by a factor of 6 when crashes occurred between midnight and 6:00 a.m. Dobbie (2002) reported that the critical times for fatigue-related crashes were midnight to 6:00 a.m. and 2:00 p.m. to 4:00 p.m.

COMMERCIAL TRUCKING AND CRASH RISK

Truck drivers use Travel Information Centers and safety rest areas for sleeping purposes, and nighttime stays of several hours as they must comply with federal hours-of-service regulations, (FMCSA, 2014). Most importantly, a certain amount of off-duty time is required after driving for either 10 or 11 hours. A survey by Flegler et al. (2002) indicated that commercial truck stops and travel centers were preferred for long duration stops, while safety rest areas were preferred for quick naps.

The Federal Motor Carrier Safety Administration (FMCSA, 2014) reported that of the 3,341 fatal crashes involving commercial trucks in 2011, more than 10 percent were attributed to driver fatigue. The estimated total costs of these fatal crashes are \$87 billion. Driver fatigue has been identified as a major factor (FMCSA, 2006) because a driver's performance can easily deteriorate due to long hours of driving or irregular working schedules. A new report from the National Academies of Sciences, Engineering, and Medicine asserts that approximately 4,000 fatalities occur due to truck and bus crashes each year, 10 percent to 20 percent of which are estimated to involve fatigued drivers (NAP, 2016). Several studies have shown that lack of sleep can seriously affect a truck driver's safety performance (Dinges et al., 1997). In their study on the effect of driver fatigue in truck crashes, Chen and Xie (2014) noted the following:

- Statistical analyses suggest that increasing the total duration of rest breaks does have an increasingly positive safety impact.
- During a 10-hour trip, taking one or two rest breaks can significantly reduce commercial truck drivers' crash risk. Compared to trips without any rest breaks, having one and two rest breaks can reduce the probability that a truck driver will be involved in a crash by 30 percent and 11 percent, respectively.
- The durations of the rest breaks can also have a significant impact on crash risk. The results suggest that a 30-minute rest break is generally considered adequate and cost-effective for truck drivers.

Studies have revealed that driving performance worsens with the duration of driving time (Campagne et al., 2004; Feyer et al., 1997). Long-distance truck drivers exhibit worse driving performance than ordinary drivers, with driving time being the main factor affecting their driving ability (Otmami et al., 2005; Philip et al., 2003). The duration of the driving time, the monotonous environment, and circadian effects have been shown to negatively influence driving performance (Rossi et al., 2011; Wang and Pei, 2014). Haitao (2009) suggested that a rest break of 20 minutes every two hours prevented fatigue compared to a

trip with no rest. Wang and Pei (2014) remarked that driving time and rest time have significant effects on driving performance and driver recovery. When driving continuously for 2–4 hours, all aspects of driving performance are influenced significantly. However, a 15–30 minute rest break will restore the perception and reaction performance and the attention and operating performance.

The most frequently reported symptoms of sleepiness in driving, revealed by a questionnaire of 154 trucks and bus drivers, were conducted by Berg and Landström (2006). The study revealed the following remarks:

- About 14 percent of the drivers reported regular sleepiness while driving, 33 percent had occasionally fought sleepiness while driving, and 8 percent had experienced nodding of the head while driving.
- The majority of the drivers had once been so tired that they had to stop driving.
- Sleepiness normally occurred at the end of longer trips.
- Poor sleep and poor working hours were considered the most important causes of sleepiness.
- Eye tiredness, yawning, difficulty concentrating on the road, and difficulty keeping one's thoughts together: these were the most frequently reported symptoms of sleepiness.

Mackie and Miller (1978) remarked that driving performance has been found to begin to deteriorate after 8–9 hours of driving in the case of truck and bus drivers, while the frequency of accidents during the last half of the journey has been shown to be twice that during the first half. Bin et al. (2007) confirmed that reaction and attention abilities have been shown to decrease significantly after 8–12 hours of driving, while perceptions and operating abilities are not significantly affected for commercial drivers. MacLean et al. (2003) reported that changes in driving characteristics have been found to include increased variability of speed and lateral lane position. The speed coordination of drivers following another car has been shown to deteriorate after 2.5 hours of driving (Brookhuis et al., 1994).

REASONS FOR STOPPING AT TRAVEL INFORMATION CENTERS

Several researchers studied the reason and motivation for stopping at a Travel Information Center by conducting surveys of random samples of Travel Information Center users. Tierney and Hass (1988) reported that the use of restrooms is the most popular reason for stopping. Gitelson and Perdue (1987) reported that a substantial proportion of North Carolina Travel Information Center visitors stopped for restroom use and to pick up information. Those visitors remarked that they would use the information for decisions on both current and future trips. Fesenmaier and Vogt (1993) found that the majority of Travel Information Center visitors in Indiana stopped to use restrooms (62 percent), and approximately 25 percent of the respondents indicated they stopped to

stretch/exercise/nap or to obtain sightseeing information. About 10 percent of those surveyed indicated that they stopped specifically to obtain travel information. Results of many travel and tourism studies (e.g., Fesenmaier et al., 1993; Tierney and Hass, 1988; Gitelson and Purdue, 1987; Muha, 1977) contended that obtaining travel information was one of the major reasons for stopping at Travel Information Centers.

CHARACTERISTICS OF TRAVEL INFORMATION CENTER USERS

Results from the studies on the characteristics of Travel Information Center users were not conclusive and largely inconsistent. Muha (1977) analyzed data from 243 Travel Information Centers at 43 states and reported a significant difference not only between users and non-users of Travel Information Centers but also between first time and frequent users. He found that compared to all travelers, Travel Information Center users were younger, were traveling in larger parties, had above-average incomes, were on pleasure trips, and were on non-weekend, vacation trips. He also found that first-time users tend to be younger, travel in larger travel parties, have lower incomes, stay in tents or travel trailers, and stop to get travel information primarily about campgrounds.

Tierney and Hass (1988) reported that Travel Information Center users and non-users in Colorado differed significantly in terms of their socio-demographic and trip characteristics. The most significant differences between users and non-users concerned the expenditures during their trips. When compared to non-users of Travel Information Centers in Texas, Stewart et al. (1993) found that users were more likely to reside in a nonadjacent state, were older, drove more miles within Texas, were associated with a longer trip planning horizon, had higher expenditures per party, and were more likely to be on a vacation/leisure trip.

In contrast, Howard and Gitelson (1989) examined whether vacation travelers who use Travel Information Centers in Oregon are different from those who do not and concluded that no differences existed between the socio-demographic characteristics of users and non-users. Based on this finding, they suggested that Travel Information Center users might be representative of all highway travelers in the state. A study by Fesenmaier et al. (1993) also did not find significant differences in the socio-demographic characteristics between users and non-users of Travel Information Centers in Indiana except for the income level: users had slightly higher income levels.

TRAVEL INFORMATION CENTERS AND FATIGUE

It is well known that fatigue related crashes are more common on long stretches of rural highways (Kang et al., 2015; McArthur et al., 2013). Fatigue can be more effectively managed when drivers take breaks that coincide with periods of fatigue (Feyer and Williamson, 1995; Stave, 1977). For example, they suggested that taking just a 4-minute break from a 3-hour trip at the point during which major driving decision errors began to occur led to an almost complete elimination of errors following the break. A study by Clark

(1979) recommended taking 10-minute stops every hour. However, Lisper and Eriksson (1980) found that breaks with food intake were more effective in enhancing driving performance than rest breaks that involved doing nothing. Drory (1985) reported that the adverse fatigue-related effects could be reduced by periodic rest, exercise, and the moderate use of mild stimulants, such as caffeine. Taking a break that includes a short nap and/or drinking coffee is more effective in reducing drowsiness than taking a rest break alone and doing nothing (Reyner and Horne, 1997; Horne and Reyner, 1996). Dalziel and Job (1997) found a significant negative correlation between length of total rest time and number of accidents in a study involving taxi drivers. The National Sleep Foundation highly recommends stopping at a safe roadside facility if a driver notices any fatigue symptoms (NSF, 2014).

The FHWA (1996) study noted that about 30,000 more parking spaces were needed at Travel Information Centers and public rest areas across the country. The shortage was more urgent for truck parking for long-term or overnight parking. The study also noted that public and private parking facilities are not necessarily direct substitutes for each other, but are complementary. The FHWA study warned that failing to “solve the truck parking shortage could pose significant risks to the traveling public by forcing tired drivers to continue driving, or park in inherently dangerous locations such as ramps and shoulders.” A subsequent study by the American Trucking Association (ATA, 1996) also warned that “increasingly, truck drivers seeking rest are parking illegally along highway shoulders and entrance and exit ramps, rather than at either public rest areas or private truck stops.” These observations are consistent with the findings of Hartley et al. (1996) who reported that drivers suggested that improving roadside rest facilities would help reduce fatigue. In 2002, the *California Department of Transportation Journal* released a Master Plan for Safety Roadside Rest Areas that recommended constructing 80 new rest areas in addition to creating more space in existing ones (Berthelsen, 2002). The National Cooperative Highway Research Program (NCHRP) of the Transportation Research Board undertook a study to identify countermeasures for reducing crashes of fatigued drivers (Stutts et al., 2005) and providing safe stopping and resting areas was the among the top recommended countermeasures.

A study by the Main Roads Western Australia (MRWA, 2007) stressed the need for enhancing the road network infrastructure including increasing the numbers of Travel Information Center-like facilities that encourage fatigued drivers to rest. They predicted that improvements in the safety of roads and roadside rest areas could reduce fatal crash rates in Western Australia by as much as 43 percent. A subsequent Austroads report (Austroads, 2009) documented similar recommendations and noted that the availability of more Travel Information Center-like facilities could help reduce the frequency of fatigue-related crashes. A variety of prevention programs and campaigns over the past 10–15 years resulted from the strong links made between fatigue and road crashes. Initiatives included hours-of-service regulations, advertising and education campaigns, as well as dedicated works across research and public policy (Smolensky et al., 2011).

Several researchers indicated that spacing of Travel Information Centers and safety rest areas is one of the main factors when considering reducing fatigue of truck drivers. However, the optimal distance between these facilities has been a subject of great debate. For example, the Montana Rest Area Plan states that in 1985 Montana identified 70 miles as the target spacing on roadways with over 750 vehicles per day or 100 miles on roadways with over 1,000 vehicles a day; however, Montana currently recommends a spacing of 54 miles, or the length of one hour of travel time (Banerjee et al., 2009). The Minnesota Department of Transportation recommends that a spacing of 50 miles is “desirable.” Gardner (2002) determined that the ideal distance between rest areas (or Travel Information Centers) would be 55 miles for truck drivers. Similarly, the American Association of Highway and Transportation Officials suggests a distance of 60 miles between rest areas (Perrault, 2008). However, a University of Maine study claimed the distance covered in one hour is too long, and recommended a 30-mile spacing between stops (Gardner, 2002). Gates et al. (2009), after reviewing several studies, noted that the vast majority recommend distances shorter than the current FHWA recommendations of 50 miles or 1-hour drive time on major highways. Austroads (2012) developed a method for determining optimal locations for heavy-vehicle rest areas on designated freight routes using data on directional volume and vehicle mix, crash rates, roadway functional classification, and roadway geometry.

McArther et al. (2013) studied the effects of travel information centers and rest areas on fatigue-related crashes with five-year crash data (2006–2010) from Michigan and demonstrated that the proximity of a given road segment to the nearest travel information center or rest area significantly influenced the rate of such crashes. More recently, detailed analyses of fatigue-related crashes in Alabama (Kang et al., 2015) for an 11-year period (2001-2011) revealed that these crashes are higher in rural stretches of highways and the crash rates are positively correlated with the distance from the nearest rest area (or travel information center) Taylor et al. (1999) investigated the relationship between the average distance between rest areas on highways and the percentage of overall crashes involving single heavy vehicle crashes, and found a significant increase in single heavy vehicle crashes when the distance between rest areas exceeded 30 miles. More recently, O’Brien and Morris (2006) also found that commercial vehicle crash rates in Minnesota were higher where the distance between rest areas (or Travel Information Centers) exceeded 30 miles. A Minnesota study (SRF, 2007) showed similar results, reporting that frequencies of truck crashes increased at distances greater than 30 miles beyond a rest area during all times of the day. Banerjee et al. (2009) performed an analysis of both fatigue and non-fatigue collisions, and found that the number of collisions due to fatigue significantly increased for distances beyond 30 miles from rest areas and Travel Information Centers.

When evaluating the effectiveness of Travel Information Center-like facilities in reducing accidents in the United Kingdom, Reyner et al. (2010) compared accident frequency in the 10 miles upstream and downstream from these facilities after the service areas with crashes in the 10 miles prior to the service areas; these researchers found a 14 percent

reduction in casualty crashes and a 22 percent reduction (statistically significant) in fatigue-related crashes. Gates et al. (2012) performed an analysis of fatigue-related crashes in the vicinity of rest areas and welcome centers (travel information centers) in Michigan along the main route served by the facility. They found that such crashes increase with the distance from the rest area or Travel Information Center. Crash reduction modeling indicated that the greatest safety impacts were associated with facilities on roadways with the highest mainline traffic volumes and turn-in rates. They estimated that Michigan rest areas and Travel Information Centers reduced fatigue-related crashes system wide by 273 crashes within 20 miles upstream and downstream of the facilities, i.e., 3.37 crashes per facility per year on average.

TRAVEL INFORMATION CENTERS AND EXCESS TRAVEL

Studies have shown that some drivers would leave the highway (for various reasons) if there were no Travel Information Centers or rest areas available. Excess travel can be estimated as the arithmetic difference between the net distance (or time) traveled to access the next closest alternate commercial service facility (fast-food restaurant, gas station, or truck stop) and the net distance (or time) traveled to access the particular rest area (Gates et al., 2012). King (1989) estimated the excess travel resulting from that to be in excess of 2.5 billion miles per year. Gates et al. (2012) reported that 62 percent of the travelers they surveyed would have diverted to a nearby commercial service facility if a Travel Information Center or rest area was not available. Excess travel will unquestionably result in more crashes. However, it will be almost impossible to estimate the number of crashes that would result from excess travel.

TRAVEL INFORMATION CENTERS AS REFUGE

A Travel Information Center-like facility can serve as a safe refuge in several situations when driving becomes hazardous. For example, when a vehicle malfunctions, the driver will need to stop for a mechanical check or apply the necessary service or maintenance. Common problems such as low tire pressure need attention within a short distance after detection. Fixing these problems need to be done at a safe place and not on the roadside shoulder. The vehicle can be parked at the Travel Information Center while waiting for professional assistance to address serious problems such as braking, steering, and lighting malfunctions. Equally important is the opportunity for proactive drivers to check the performance of their vehicle periodically at Travel Information Center-like facilities. Occurrence of natural hazards on the road such as severe weather, icy roads, or low visibility are similar situations where Travel Information Centers can prevent the risks of continuing driving or stopping on the roadside. During these situations and major road closures, travelers can stop at Travel Information Centers and receive guidance on when and how to resume travel. A contributing factor to crashes is driver distraction, which can be due to in-vehicle disturbance because of a distressed passenger, an agitated child, or an unruly pet. Such distractions are likely to be reduced by appropriately spaced safety rest areas. Also, drivers can make the necessary

phone calls or send text messages at Travel Information Centers, reducing the risk of doing so while driving. All of the abovementioned benefits of Travel Information Centers are challenging to quantify.

TRAVEL INFORMATION CENTERS AND SHOULDER PARKING

A study conducted by FHWA (1997) reported that 3 percent of all crashes involved vehicles on the shoulder. Howell et al. (1985) reported 42 fatal crashes resulting from shoulder stops in California with approximately half involving a truck parked on the shoulder. King (1986) reported that excess travel (caused partially by the lack of Travel Information Center-like facilities) increased the number of accidents on roads and provided some estimates on this increase. In a 1989 report, King stated that the lack of Travel Information Center-like facilities resulted in heavy vehicle drivers parking on road shoulders and increasing the number of roadside accidents, and asserted that these crashes are underreported. He estimated that the absence of such facilities would have increased the number of accidents involving vehicles parked on a road shoulder by 50 percent. King then concluded that these accidents are most likely to be underreported as they do not include sideswipe or rear-end crashes involving vehicles entering or leaving the shoulder, or crashes involving dismounted motorists likely as a result of a shoulder stop. Smith et al. (2005) reported that on routes where the supply of rest areas and Travel Information Centers is limited, heavy vehicle drivers tended to park on highway shoulders and ramps, creating a significant safety hazard. A recent study (SRF, 2007) found that during nighttime hours, there was a significant increase in single-vehicle crashes related to shoulder parking beyond rest areas and Travel Information Centers.

ECONOMIC IMPACT OF TRAVEL INFORMATION CENTER USE

Numerous studies have been conducted to evaluate the level of information use, the types of information obtained, and the effect of information on travel behavior. Travel and tourism researchers found that most travelers did use information obtained at Travel Information Centers (e.g., Fesenmaier et al., 1993; Gitelson and Perdue, 1987). Gitelson and Perdue (1987) indicated that substantial percentages of the individuals stopping at Travel Information Centers cited receiving various types of trip-related information as reasons for stopping. An even larger percentage was likely to pick up information once they stopped even though that was not the primary reason for the stop. Most importantly, the respondents also indicated that they were likely to use the information they received at the Travel Information Centers for current and/or future trip decisions. Tierney and Haas (1988) reported that the impacts of information obtained at state Travel Information Centers included a 25 percent increase in visitors' average daily expenditures. The results also showed that Travel Information Centers had a significant impact on travel decision making. Fesenmaier et al. (1993) found that the information provided at Travel Information Centers actually did influence the travel behavior of many of their users. A large proportion of those surveyed indicated that they were more likely to use the information obtained at

Travel Information Centers to plan future trips, suggesting that information was often collected and then stored for future use. Fesenmaier and Vogt (1993) reported that one-third of respondents spent additional money, 21 percent stayed longer than initially planned, and 29 percent visited places not originally planned as a result of the information obtained at the Travel Information Center.

The economic benefits of travel information centers are derived from the comfort and convenience they offer, their contribution to reduction of excess travel and crashes, and their role in promoting in-state tourism (Gates et al., 2012; Carson et al., 2011; Vogt and Holecek, 2010; King, 1989). Several studies estimated the monetary equivalent of comfort and convenience offered by these facilities. However, Gates et al. (2012) demonstrated that the comfort and convenience benefit of a Travel Information Center exceeds that of a safety rest area by 35%, and Vogt and Holecek (2010) found that 60% of vehicles visiting a Travel Information Center had one or more occupants enter the information service area. They further found that 12.5% of those entering the information service area had increased their in-state spending by an average of \$147. Overall, Gates et al. (2012) estimates the benefit/cost ratio for 14 Michigan travel information center and reported an average benefit/cost-value of 4.9 (1.3-11.7). Carson et al (210) reported that benefit/cost for safety rest areas and Travel Information Centers along several Texas corridors ranged from 8.7 to 29.5, with a majority of the benefits for Travel Information Centers due to tourism enhancement.

SUMMARY

A summary of the literature review is provided below:

- Travel Information Centers have many safety benefits such as reducing driver fatigue and other adverse physiological effects; reducing roadside and shoulder stops; providing important safety information; reducing excess travel to get services such as toilets and water; reducing in-vehicle driver distraction; providing a safe refuge during severe weather and hazardous visibility and roadway conditions; reducing roadside stops for vehicle maintenance and inspection; and providing safety-related information to drivers.
- It is challenging to directly quantify the safety benefits of Travel Information Centers and safety rest areas. Nonetheless, researchers have suggested some estimates, noting that the benefits are most likely underestimated.
- National studies emphasize the need for safe stopping and resting areas along major highways.
- Research has shown that the information provided at Travel Information Centers has impacts on travelers' behavior and spending.
- Benefit/cost ratios for Travel Information Centers are well above 1.0 (mostly above 5.0), especially for Texas.

CHAPTER 3: SITE VISITS TO TEXAS TRAVEL INFORMATION CENTERS

Texas has 12 Travel Information Centers that serve travelers entering the state as shown in Figure 1. The centers are staffed by professional travel counselors working for TxDOT's Travel Information Division who welcome visitors to Texas, help with driving directions, and provide information on nearby facilities, attractions, events, and weather and road conditions. The centers also provide a place for travelers to rest and relax and, in many cases, serve as a refuge during inclement weather and road conditions. The information provided includes the Texas Official Travel Map, Texas State Travel Guide, Texas Public Campgrounds and Texas Events Calendar, and other travel literature, including maps, pamphlets, booklets and brochures from local and statewide destinations, points of interest, special events, lodging and restaurants. Most of the Travel Information Centers provide free wireless internet service, a video theater for Texas attractions and destinations, and access to the Weather Channel inside the main building. At most centers, amenities outside the main building include rest rooms, covered picnic areas, and vending machines. Except for the Texas Travel Information Center located inside the Capitol Visitor Center in Austin, the Travel Information Centers operate and are staffed between 8:00 am and 5:00 pm daily and until 6:00 pm from Memorial Day weekend through Labor Day. Travel Information Centers are closed only on Easter, Thanksgiving, Christmas Eve, Christmas Day, and New Year's Day. Eight of the twelve have 24-hour access to restroom facilities.

In 2014, the research team arranged visits to four Travel Information Centers to obtain adequate and comprehensive information about the operation of Texas centers and prepare for the site surveys on the center users to be performed later (Task 3). The following Travel Information Centers were selected for initial visits: (1) Rio Grande Valley, (2) Orange, (3) Amarillo, and (4) Gainesville (Figure 1). During these visits, members of the research team examined the information provided at the centers, interviewed supervisors and staff on the operation of the centers, the services provided, the amenities in the center, the frequency of visitors, and the most frequently requested information by visitors, and gathered information about the visitors.

These four Travel Information Centers also distributed a survey to random samples of their visitors. The center staff provided input on how to set up the survey administration in terms of when, how and where to approach travelers during their visits. The research team gathered information from the Travel Information Center staff on center operations, amenities, services offered and the nature of help provided for visitors.



Figure 3.1. Texas Travel Information Centers. The four centers whose visitors were surveyed are identified by name.

VISIT TO RIO GRANDE VALLEY TRAVEL INFORMATION CENTER

A research team member visited the Rio Grande Valley Travel Information Center on 03/01/2014. This center is the most frequently used Travel Information Center by Winter Texans. Although Winter Texans stop at other centers, this particular center offers the opportunity to meet a large number of these travelers during a short period. A summary of the discussion points with center staff is provided below. The statistics provided below (e.g., regarding the visitor characteristics) are approximate and not official and only provided to help in preparing the site surveys.

- There are three parking lots attached to the center: off of the US 77 service road, off of Harrison Avenue, and off of Tyler Avenue.
- The busiest entrance to the center is through the service road.
- Wi-Fi service is available inside the building only.
- All restrooms are inside the building and are available only during the hours the center is open.
- Friday and Saturday are the busiest days of the week.
- The busiest time of the day is between 10 am and 1 pm.
- Some travelers stop after 5 pm and before 8 am.
- Some travelers stay overnight inside their vehicles.
- Trucks also stop at the center.
- About 5-10% of the center users speak Spanish only.
- The center personnel answer questions about road closures by phone.
- Many travelers ask about how safe it is to go to Mexico. Although employees do not make recommendations, they direct travelers to where to find security information.
- Many travelers know the travel and tourism information offered at the Travel Information Centers is the most unbiased and accurate.
- Because a large portion of this center's users are Winter Texans, its peak visitation takes place between October and April rather than during the summer travel season.
- Families, including children, use the center more frequently in the summer time. The most sought information at the center are directions and tourist attractions and activities.
- There is a viewing room for weather information and tourism videos.
- The center safety awareness and tourism events are held throughout the year.
- The center is open daily from 8 am to 5 pm, and from 8 am to 6 pm between Memorial Day weekend and Labor Day.
- The center extends hours as needed during emergencies (such as hurricane evacuations or winter storms) that generate high call volume to TxDOT's toll-free Travel Information Line.



Figure 3.2. Aerial view of the Rio Grande Valley Travel Information Center



Figure 3.3. Main entrance to the Rio Grande Valley Travel Information Center viewed from Tyler Avenue



Figure 3.4. Inside the Rio Grande Valley Travel Information Center

VISIT TO ORANGE TRAVEL INFORMATION CENTER

A research team member visited the Orange Travel Information Center on 03/08/2014. This center is the busiest in Texas and is located in an area affected by tropical storms and hurricanes. A summary of the discussion points with the center staff is provided below. These statistics (e.g., regarding the visitor characteristics) are approximate and not official and only provided to help in preparing the site surveys.

- The access to the Orange Travel Information Center is similar to a standard Safety Rest Area.
- The center operates like an unstaffed safety rest area after business hours.
- Wi-Fi service is available inside the building only.
- Restrooms are available inside the building. These are available when the center is open. There are also restrooms outside of the main center building that are available after hours.
- Friday and Saturday are the busiest days of the week.
- The busiest time of the day is between 10 am and 1 pm.
- Some travelers stop after 5 pm and before 8 am.
- Some travelers stay overnight inside their vehicles.
- Trucks also stop at the center.
- The center personnel answer questions about road closure by phone.
- There is an auditorium in the main building where a TV set is tuned to weather information.
- The center was opened around the clock during catastrophic events such as hurricane Katrina to provide support to the stranded motoring public.
- Families including children use the center and are attracted by the boardwalk attached to the main building that extends over the adjoining bayou and allows for viewing of wild life such as alligators, raccoons and snakes.
- The most frequently asked questions at the center are directions and tourist attractions and activities.
- The center hosts special events in conjunction with other organizations such as local law enforcement, the Department of Public Safety and TxDOT Traffic Safety specialists.
- The appeal of the center to passing drivers could be increased by providing playground equipment for children.
- There is a viewing room for weather information and tourism videos.
- The center safety awareness and tourism events are held throughout the year.
- The center is open from 8 am to 5 pm daily, and from 8 am to 6 pm between Memorial Day weekend and Labor Day.
- The center extends hours as needed during emergencies (such as hurricane evacuations or winter storms) that generate high call volume to TxDOT's toll-free Travel Information Line.



Figure 3.5. Aerial view of the Orange Travel Information Center



Figure 3.6. Main entrance to the Orange Travel Information Center



Figure 3.7. Inside the Orange Travel Information Center and behind the information counter

VISIT TO AMARILLO TRAVEL INFORMATION CENTER

A research team member visited the Amarillo Travel Information Center on 03/19/2014. This center is not located at the Texas border but it is used by travelers who come to Texas from several other states as it serves a number of highways. A summary of the discussion points with the center staff is provided below. The statistics provided below (e.g., regarding the visitor characteristics) are approximate and not official and only provided to help in preparing the site surveys.

- The center was built in 2003.
- There are two parking areas: one for cars/RVs and the other for trucks.
- The vending machines are open 24 hours and outside restrooms are open between 5 pm (6 pm in the summer) and 8 am the next morning.
- Restrooms inside the main building are open from 8 am to 5 pm.
- Wi-Fi service is available inside the building only.
- The busiest period is between late May and mid-August.
- Friday and Saturday are the busiest days of the week, followed by Thursday.
- The busiest times of the day are between 10 am and 1 pm and 4pm to 6pm.
- Some travelers stay overnight inside their vehicles.
- Many trucks and RVs stop at the center.
- About 50-60% of the center users talk to attendants.
- Many foreign travelers (especially from Europe) use the center.
- The center serves 300 -350 travelers per day during the summer months.
- The center personnel answer questions about road closure through phone.

- Many travelers know the travel and tourism info offered at Travel Information Centers is the most unbiased and accurate.
- Families including children use the center more frequently in the summer time.
- The most requested information at the center are directions, tourist attractions and activities, hotels, and information related to the Amarillo Medical Center.
- The center is used by travelers for sheltering in place during storms.
- The center serves as a refuge during major road closures (due to winter conditions).
- The center has safety literature focused on driving during inclement weather and US driving info and laws for foreigners.
- The center collaborates with the local National Weather Service office on some education and outreach events.
- The center serves as a staging center for emergency services.
- The center was once used as triage unit during a major car pile-up caused by icy road conditions and a staging area for the Red Cross for displaced families during the wildfires.
- There is a viewing room for weather information and tourism videos.
- The center's safety awareness and tourism events are held throughout the year.
- The center is open from 8 am to 5 pm daily, and from 8 am to 6 pm between Memorial Day weekend and Labor Day.
- The center extends hours as needed during emergencies (such as hurricane evacuations or winter storms) that generate high call volume to TxDOT's toll-free Travel Information Line.



Figure 3.8. Aerial view of the Amarillo Travel Information Center



Figure 3.9. Main entrance to the Amarillo Travel Information Center



Figure 3.10. Inside the Amarillo Travel Information Center

VISIT TO GAINESVILLE TRAVEL INFORMATION CENTER

A research team member visited the Gainesville Travel Information Center on 03/22/2014. This Travel Information Center is among the busiest in Texas and serves travelers coming from or returning through Oklahoma. A summary of the discussion points with the center staff is provided below. The statistics provided below (e.g., regarding the visitor characteristics) are approximate and not official and only provided to help in preparing the site surveys.

- There are two parking areas: one for cars/RVs and the other for trucks.
- The vending machines and outside restrooms are open after hours.
- The restrooms inside the main building are open from 8 am to 5 pm. The outside restrooms are available after hours.
- About 95% of the visitors are southbound.
- The center has several picnic areas.
- Visitors represent all age groups, but there are more older people than younger ones.
- Wi-Fi service is available inside the building.
- The busiest period is between June and August.
- Friday and Saturday are the busiest days of the week, followed by Thursday.
- The busiest time of the day is between 10 am and 1 pm.
- Some travelers stay overnight inside their vehicles.
- Many trucks and RVs stop at the center.
- About 50 % of the center users talk to attendants.
- The center serves 500 -600 travelers per day during the summer months.
- The center personnel answer emergency questions about weather and road closure by phone
- Many travelers ask about maps, directions, attractions in the area, and hotels.
- Families including children use the center more frequently in the summer time.
- The most sought information at the center are maps, directions, tourist attractions and hotels.
- The center is used by travelers for sheltering in place during storms.
- The center organizes two safety events annually: Safety Awareness Week, and a Work Zone Safety event.
- There is a viewing room for weather information and tourism videos.
- The center safety awareness and tourism events are held throughout the year.
- The center is open from 8 am to 5 pm daily, and from 8 am to 6 pm between Memorial Day weekend and Labor Day.
- The center extends hours as needed during emergencies (such as hurricane evacuations or winter storms) that generate high call volume to TxDOT's toll-free Travel Information Line.



Figure 3.11. Aerial view of the Gainesville Travel Information Center



Figure 3.12. Main entrance to the Gainesville Travel Information Center



Figure 3.13. Inside the Gainesville Travel Information Center

CHAPTER 4: SURVEYS OF TRAVEL INFORMATION CENTER USERS

INTRODUCTION

The objective of this chapter is to describe the travelers' safety survey instrument conducted at the Travel Information Centers. The survey responses are analyzed and discussed to address the travelers' plans as they stop at the Travel Information Centers. These responses were also used to study the centers' impact on the safety of the travelers. The chapter will conclude with a summary of the findings.

The survey instrument conducted in this study was similar to the one completed by Sharif et al. (2014). However, to emphasize the role of digitized online information and electronic handheld devices, a slight modification to the current survey was implemented in this version of the study.

SURVEY STRUCTURE

Questions on the survey were designed to gather information relevant to travelers' safety. The survey structure consists of three folds; 1) travelers trip duration before and after the stop, 2) reasons or preferences for stopping at the Travel Information Centers or other comparable facilities during their trip and 3) services they use at the centers and if that was helpful for their travel plans.

A copy of the survey is included in Appendix A. For each question, multiple answer choices were given to assist in quick response. Considering the fatigue of the travelers and their inherent pressure to resume their trips, the survey was planned so that it may be completed in no more than two minutes. The surveys were handed out to the travelers during their stop at the Travel Information Center facilities through the staffed extended summer operating hours from 8 am until 6 pm. Two Travel Information Centers, Harlingen and Waskom, were surveyed by the researchers during the spring break of March 2016. Each center was surveyed for three days in an effort to collect a target of 300 surveys.

In an attempt to collect a statistically representative sample of survey responses, another cycle of survey collection was conducted during the month of July 2016 for the twelve Travel Information Centers. This cycle was handled by the center employees and the completed forms were mailed to the researcher for analysis. The total number of surveys completed at all centers was 3080 and the breakdown for each center is presented in Figure 4.1.

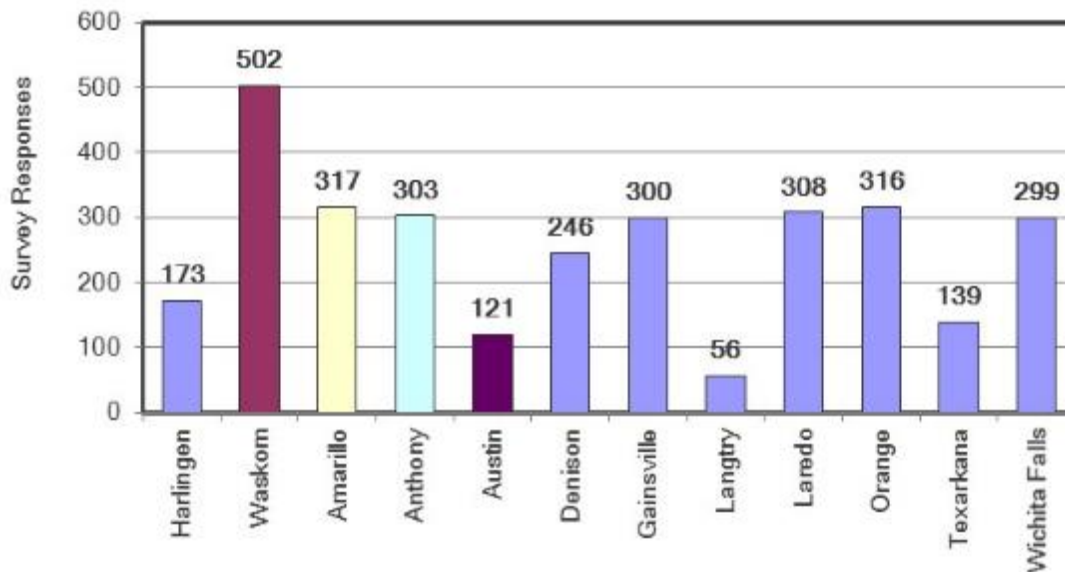


Figure 4.1. Number of surveys completed at Travel Information Centers

SURVEY RESPONSES AND DATA ANALYSIS

Travelers were asked questions regarding their trip duration prior to and after their stop at the Travel Information Centers. The multiple choices assigned to these questions were: under 1 hour, 1-2 hours, 2-3 hours, and more than 4 hours. Figures 4.2 and 4.3 suggest that the majority of the travelers were long-distance travelers. Results showed that 32 and 25% of the travelers had more than 4 hours of driving prior to and after their stop at the Travel Information Centers. Most of the travelers stated that their final destinations are at metropolitan areas which are greater than four hours of driving from the Texas border where the travel centers are located. These figures also suggest that the stop at the Travel Information Centers was necessary for a short break given the duration of driving the travelers have to complete.

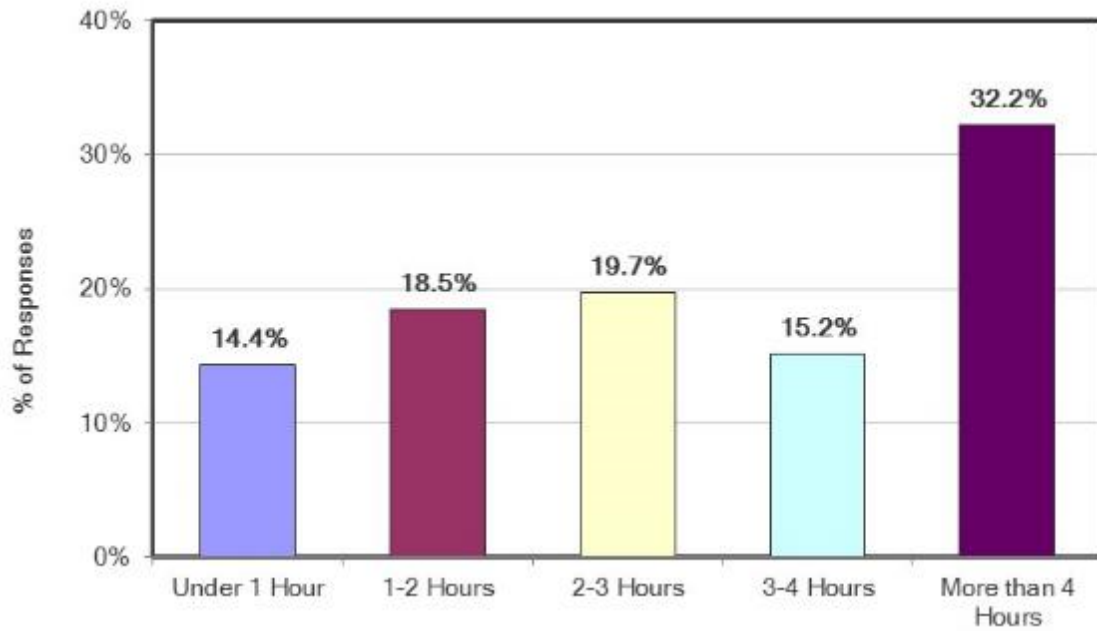


Figure 4.2. Travelers trip duration prior to the stop at the Travel Information Center

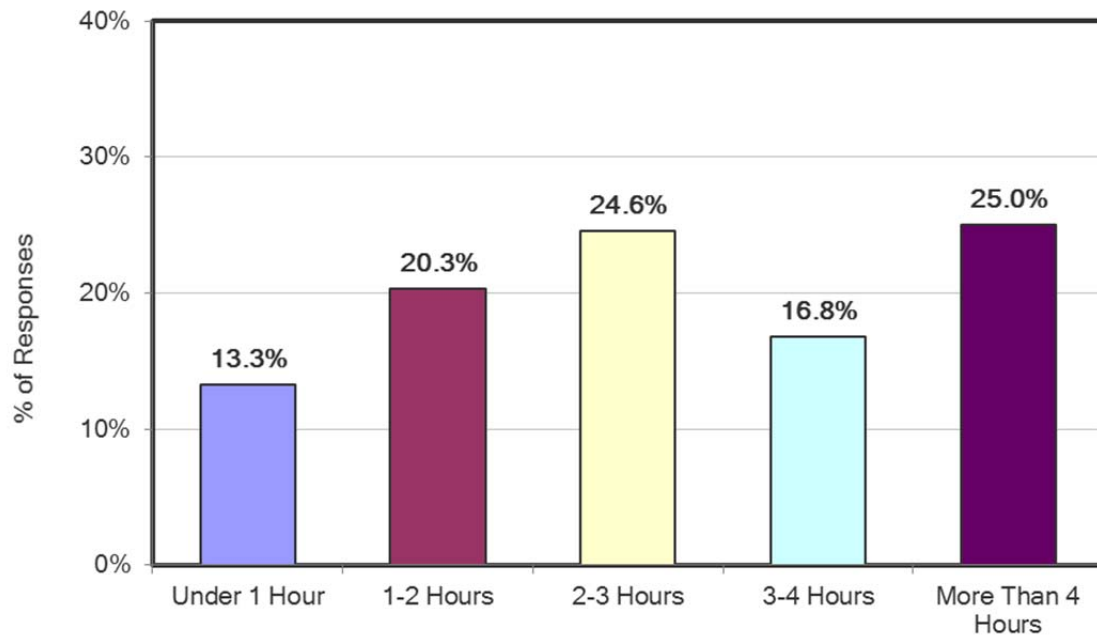


Figure 4.3. Travelers expected trip duration after the stop at the Travel Information Center

The travelers were asked about the reasons for their stop at the Travel Information Centers. Multiple answer choices were offered including: use restroom, obtain travel information, take a break, children and pet relief, check vehicle, eat, sleep, use wi-fi or vending machine. The travelers were given the choice to select more than one answer in this question as shown in Figure 4.4. The responses suggest that the top three reasons were to use restroom, obtain travel info or take a break with a response rate of 71%, 69%, and 46%,

respectively. Other answers were not statistically significant due to a selection rate of 11% or less.

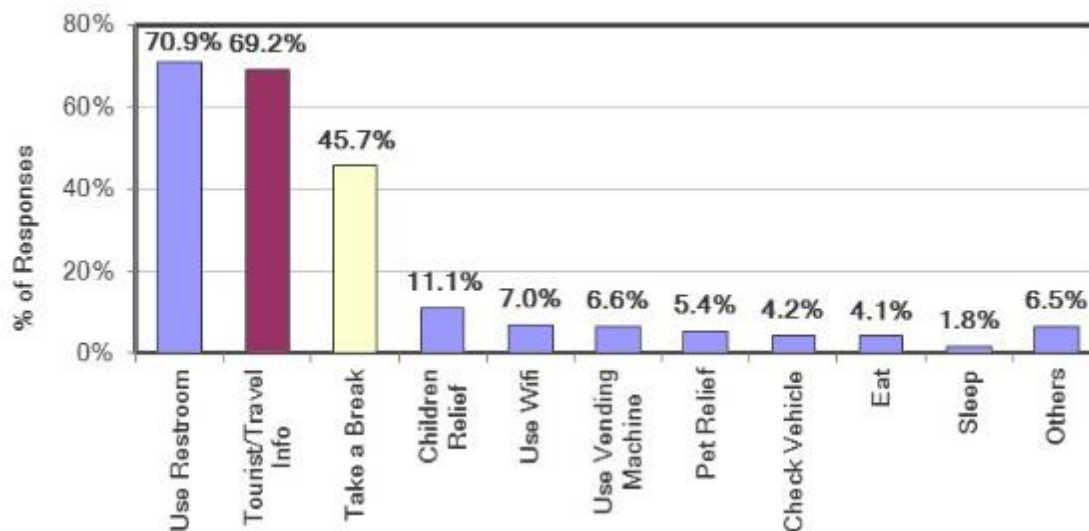


Figure 4.4. Reasons for stopping at the Travel Information Center

The researchers attempted to determine the reasons that attract travelers to stop at the Travel Information Centers as opposed to other comparable facilities such as gas stations and restaurants. The survey question offered multiple answer choices, including tourist/travel info, cleanliness of facility, easy access to highway, need to rest, traveling with children and pets, parking availability, nearest available option. Travelers were given the choice to choose multiple relevant answers if any. Results suggested that obtaining tourist and travel information were the top reason for the travelers' choice to stop at the centers as shown in Figure 4.5. Cleanliness of facility, easy access of highway and need to rest were also remarked as other reasons to stop with response rate of 38, 23 and 17%, respectively. Other factors were found insignificant with a selection rate of less than 10%.

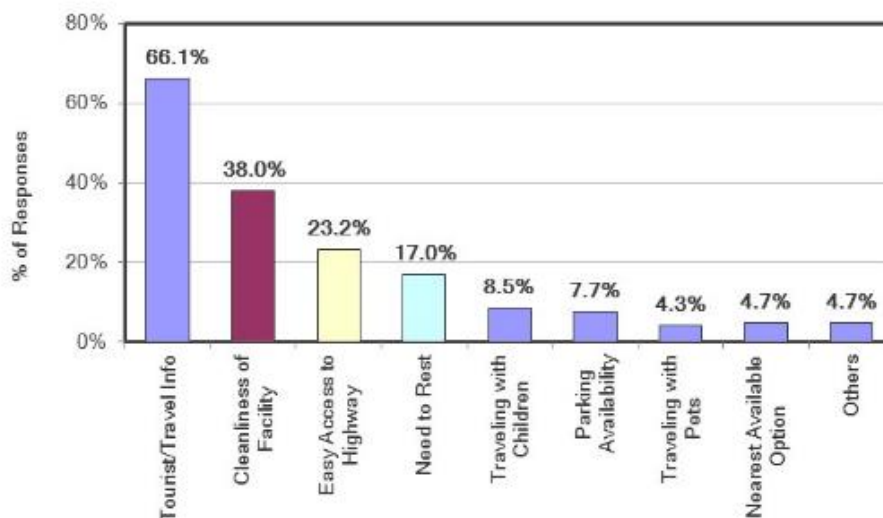


Figure 4.5. Travelers' preference to stop at Travel Information Centers over comparable facilities

To determine the travelers' preferences to stop due to common interruption activities associated with their trip, a question was dedicated on the facility type they prefer. The survey asked travelers to choose their preferred facility to stop for a particular trip interruption activity. The interruption activities include: use restroom, take short break or long rest, eat a meal, check vehicle, and children/pet relief. The facilities options include Travel Information Center, safety rest area, private facility (e.g., restaurant, hotel and gas station), or no preference. More than 67%, 53%, and 39% of the travelers suggest that Travel Information Centers are their preferred stop for restroom, short breaks and long rest as compared to other facilities as shown in Figure 4.6. However, the travelers had no preference to stop for children or pet relief and checking their vehicles as suggested with a response rate of 46%, 58%, and 39%, respectively. With the exception of short break, safety rest areas are less likely to meet the travelers need for all trip interruption activities with a selection rate of less than 15%. Private facility was the major choice for 42% of the travelers when it comes to eating a meal.

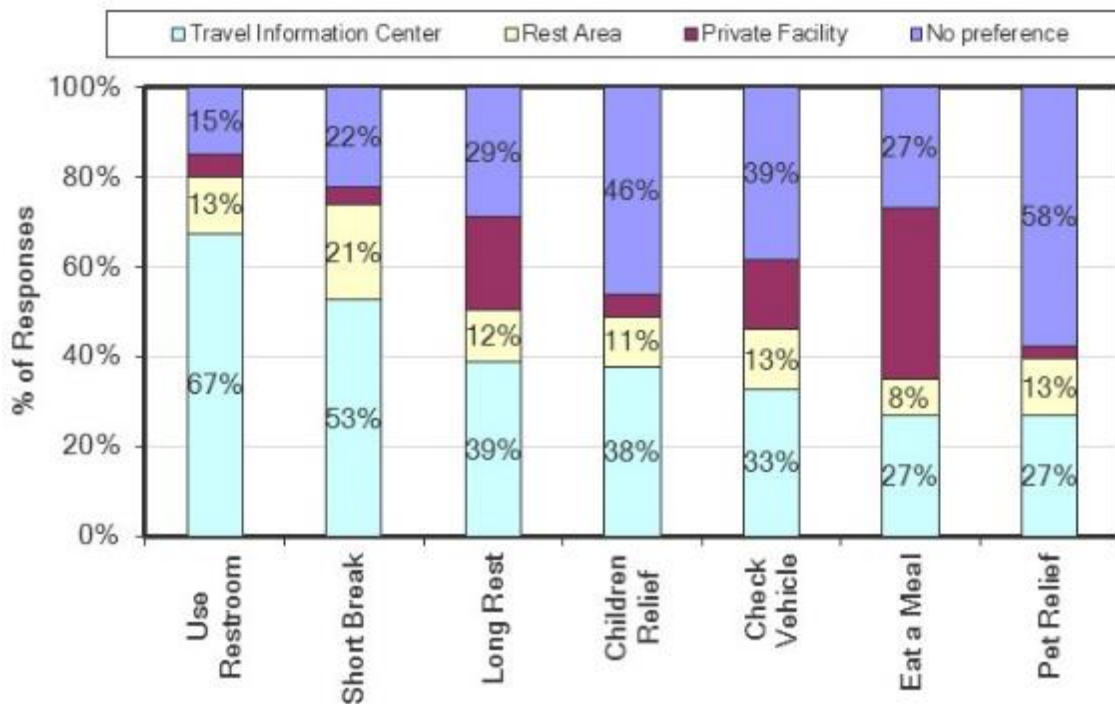


Figure 4.6. Travelers' preference facility for specific trip interruption activities

A question was offered to quantify the role of using mobile applications and internet on the travelers' preference for planning their trips as compared to using the travel centers' services. With the option to choose more than one answer, 65% of the travelers suggested that the maps and talking to counselors are their preference trip planning as compared to 50% and 23% who preferred using internet and mobile apps, respectively, as shown in Figure 4.7.

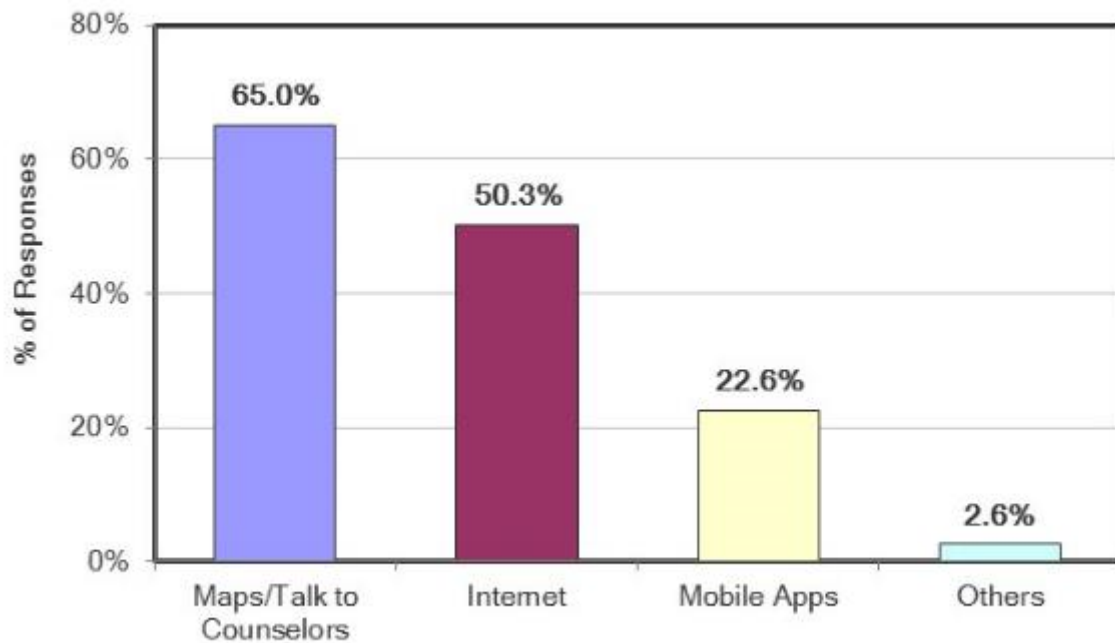


Figure 4.7. Travelers' preferences for planning their trips

Considering previous trips, travelers were asked what means they had used in the past that influenced their travel plans. Several means were offered, including: brochures/maps, Internet, travel magazines, speaking with counselors, mobile apps, and TV/radio ads. The travelers were asked on how these means influenced, somehow influenced, not influenced or were never used for planning their travels. Figure 4.8 shows that using brochures and TV/Radio ads had the highest and lowest influence on travelers' plans respectively. Using brochures/maps, internet and travel magazines had influenced at least 81% of travelers' plans, and consulting with Travel Information Center travel counselors influenced 73% of travelers.

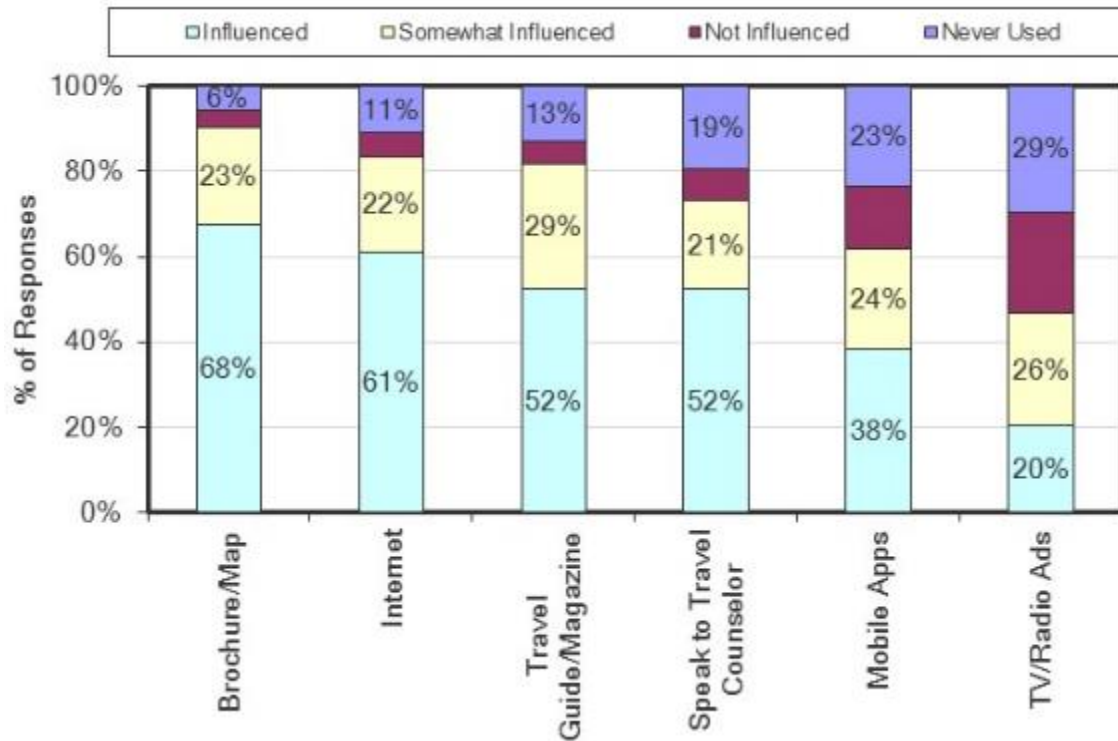


Figure 4.8. Travelers' preferences for planning their trips

Another question requested selecting the services that travelers used in the current or previous stops that assisted their travel plans as shown in Figure 4.9. Choices offered included: Texas map, tourist attractions, travel plans (e.g., lodging and restaurants), weather conditions, road closures/traffic conditions, and emergency travel conditions. Picking up a map and obtaining attractions recommendations were the most-used services for 78% and 62% of travelers, respectively. Only 22%-31% of travelers stopped for the purpose of obtaining travel plans, weather and roads conditions. Emergency conditions information was the least-requested service for the vast majority of travelers.

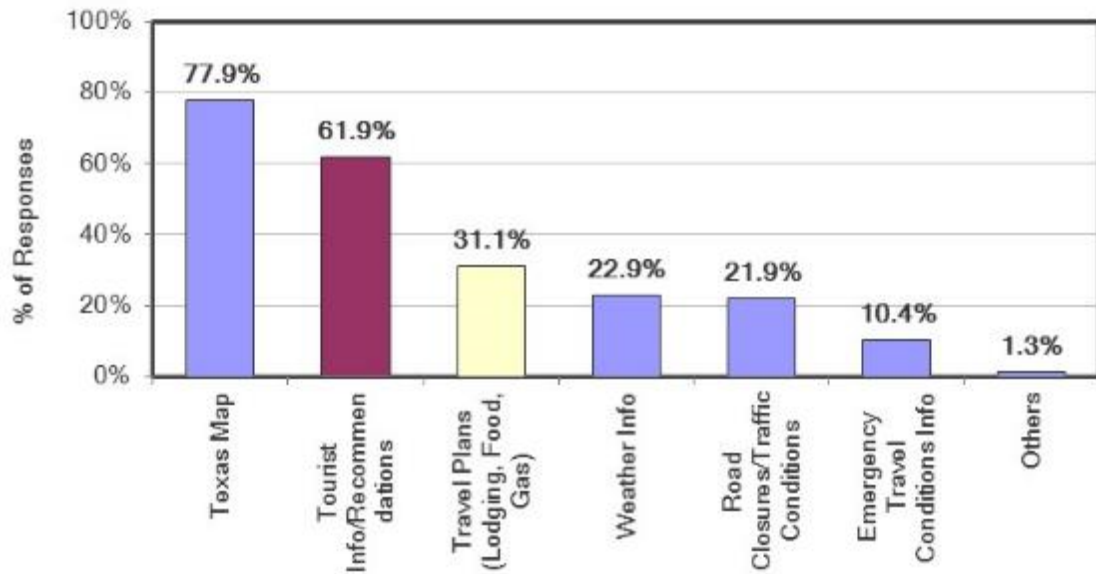


Figure 4.9. Services used by travelers during their stops at Travel Information Center

The final question asked the travelers for their overall opinion about the services of Travel Information Centers. More than 96% of the travelers indicated that the services/information offered at the centers influenced their travel plans, as shown in Figure 4.10.

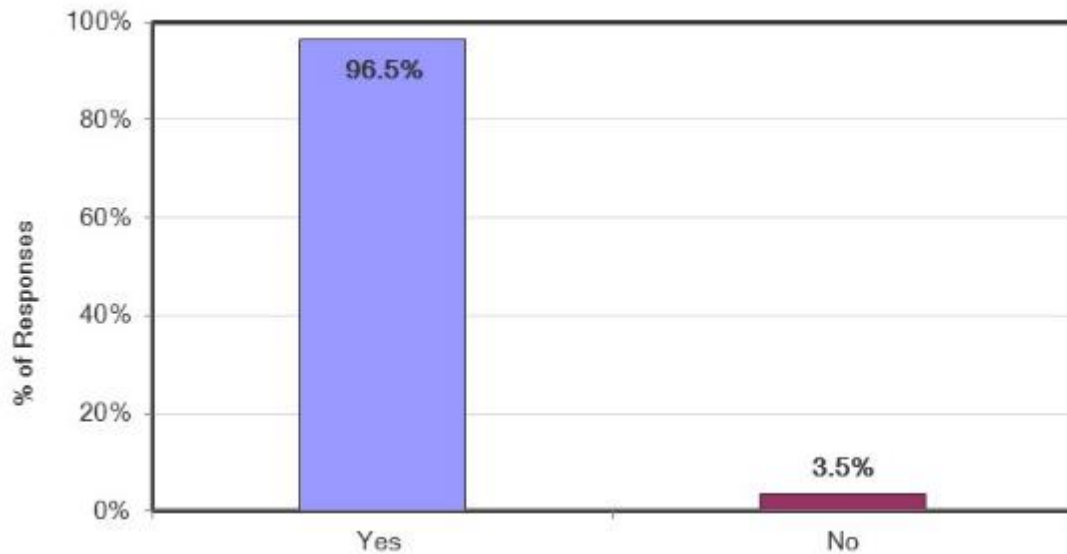


Figure 4.10. Overall travelers' opinion on Travel Information Center services for influencing their travel plans

SUMMARY

An on-site survey was conducted to collect travelers' feedback of using the amenities offered at 12 Travel Information Center locations across the state of Texas. Surveys were conducted during the spring and summer of 2016 to ensure that a representative sample of the travelers visiting Texas and stopping at the centers was included in the study. For the most part, responses to the current survey were similar to the one conducted by Sharif et al. (2014)

Survey responses suggest the following conclusions:

- About 47% of the travelers had driven continuously for at least three hours, and 52% expected to travel another four hours or more following their stop. This suggests that the travelers are in urgent need to stop for a break and that the Travel Information Center served as an incentive to rest.
- At least 45% of the travelers chose to stop at the Travel Information Centers to use clean restrooms, obtain travel information, and take a short break.
- The unique advantage of the Travel Information Centers in attracting travelers to stop as opposed to comparable facilities is the availability of tourist and travel information.
- The Travel Information Centers were the preferred facility for travelers to use restrooms and take a short break as compared to safety rest areas or private facilities.
- Most travelers' preferences for planning their trip were to use travel brochure/maps or using internet. Using travel magazines and speaking with a travel counselor were also ranked highly for planning.
- The most-used services at the Travel Information Centers are picking up Texas maps and obtaining attractions/tourist information and travel plans.
- More than 96% of the travelers (up from 80% from the previous survey) claimed that the services offered at the Travel Information Centers influenced their travel plans.

CHAPTER 5: SAFETY BENEFITS PROVIDED BY TRAVEL INFORMATION CENTERS

INTRODUCTION

The objective of this chapter is to quantify the role of the Travel Information Centers on the safety of travelers through the three approaches below:

- Analyzing the number of calls to the toll-free Travel Information Line answered by Travel Information Center staff during hazardous conditions such as winter storms, tropical storms and flooding events.
- Computing the overall safety index determined through the travelers' responses to the survey instrument.
- Analysis of crash data near three TICs.

ROLE OF TRAVEL INFORMATION CENTERS DURING STORMS AND HAZARDOUS CONDITIONS

Travelers can call TxDOT's Travel Information Line at 1-800-452-9292 at any time for automated information via an Interactive Voice Response (IVR) system on road conditions, weather updates, evacuation routes, road closures, etc. If the caller opts to speak to a representative, these calls are routed to the 12 Travel Information Centers for immediate response by the center staff, regardless of the center's proximity to the affected area. All Travel Information Centers have full access to current weather and road conditions to disseminate to the public.

Records of total calls received by the IVR and routed to the Travel Information Centers from September 2010 to March 2016 are shown in Figure 5.1. During this period, numerous storms affected Texas and surrounding states. The figure shows that, during these storms, spikes in call volume were evident as many users sought help or information from the 1-800 line. Some of these calls were routed to the Travel Information Centers for further help and assistance. The average monthly call volume was 46,912 received by the IVR system and 9,802 handled by travel counselors during severe weather events, and 8,250 received by the IVR and 2,687 handled by travel counselors during non-hazardous conditions. This suggests that Travel Information Centers play a vital role in providing crucial safety information for travelers during road hazardous conditions.

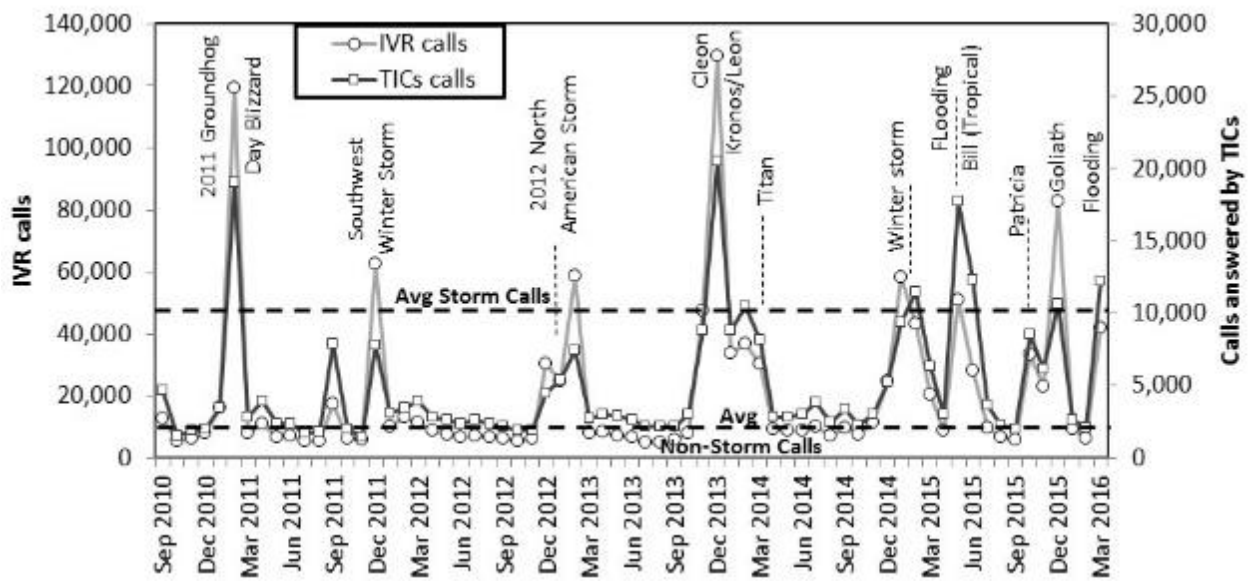


Figure 5.1. Number of calls handled by the automated IVR vs. calls answered by Travel Information Center staff from 2010-2016

Figure 5.2 shows that the overall percentage of calls answered by Travel Information Centers drops during severe weather events compared to other periods. The average percentage of calls answered by Travel Information Centers with respect to the total IVR calls is 24% and 33% during severe weather and non-hazardous conditions, respectively. This can be attributed to call volume exceeding the limitations of Travel Information Center staffing; the IVR operates to ensure that callers can receive information even if they cannot speak with a travel counselor.

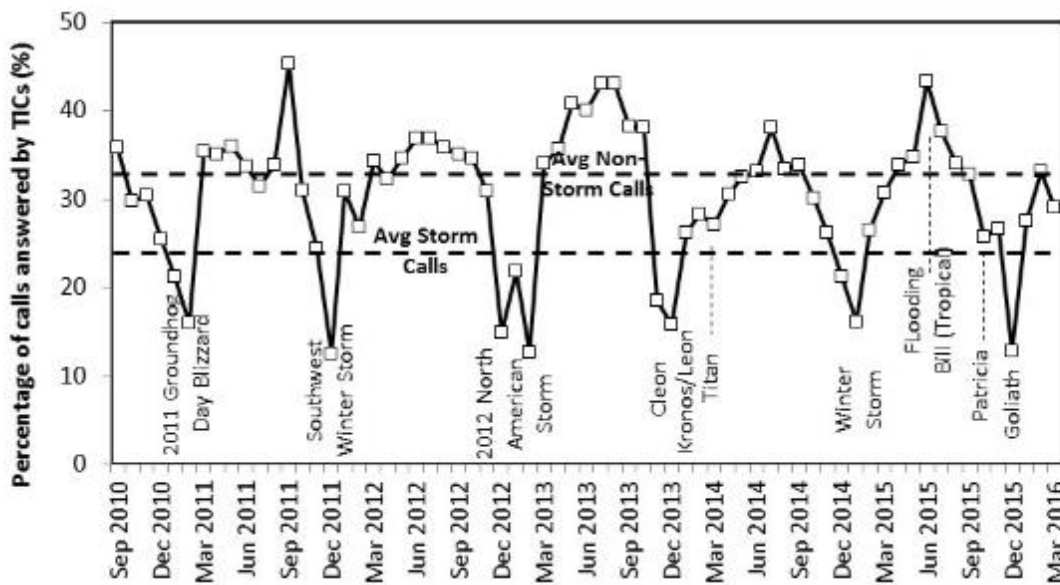


Figure 5.2. Percent of calls answered by Travel Information Centers from 2010-2016

Figure 5.3 presents the percentage of calls received by the IVR and calls handled by Travel Information Centers during the storm events from 2013-2016 as reported by TxDOT. The figure shows that calls handled by Travel Information Centers represent an average of 23% of the total number of calls received. Winter Storm Goliath and Tropical Storm Bill account for the lowest and highest percentage of calls answered by Travel Information Centers at a rate of 11% and 46%, respectively.

The breakdown of total calls during 2013, 2014 and 2015 is shown in Table 5.1. The number of severe weather events in Texas has risen in the last two years, and the number of calls is highly dependent on the severity and duration of the storm. For instance, the number of calls received during Winter Storm Cleon in December 2013 exceeds by 50% the total number of calls received during severe weather events in 2014. However, the percent of calls routed to the Travel Information Centers increases from 15% to 21% from 2013-2015 as shown in Table 5.1. This suggests that callers' reliance on Travel Information Centers to provide guidance and assistance in hazardous conditions has increased over time.

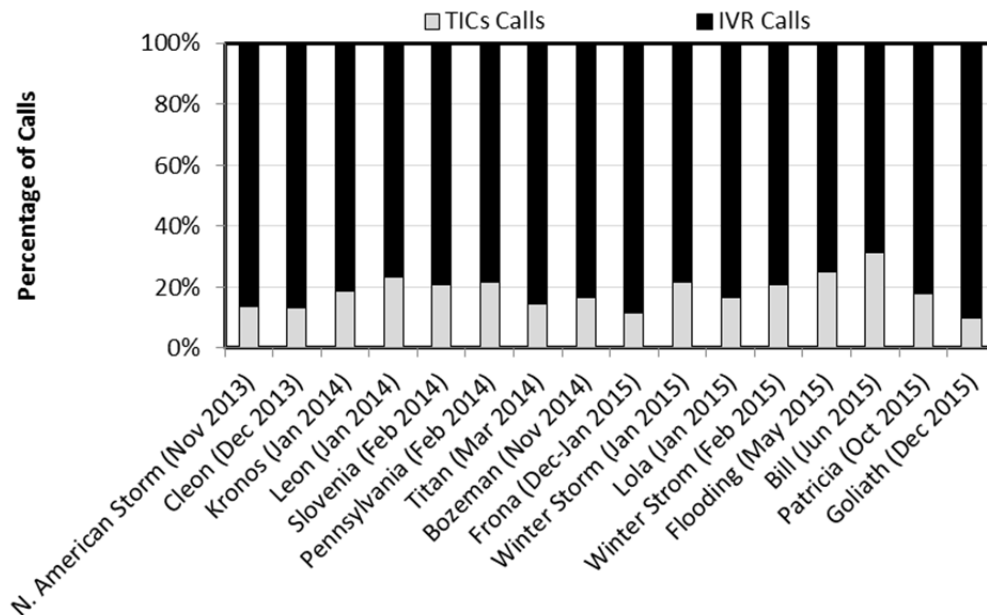
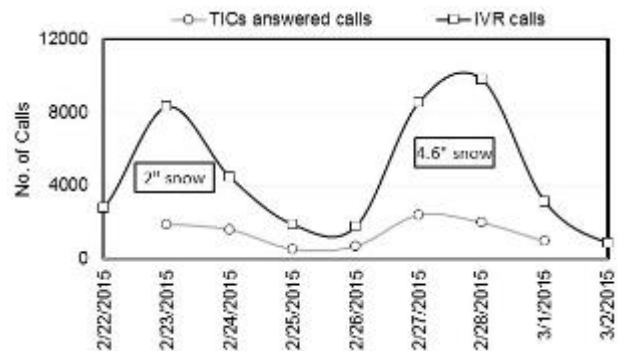
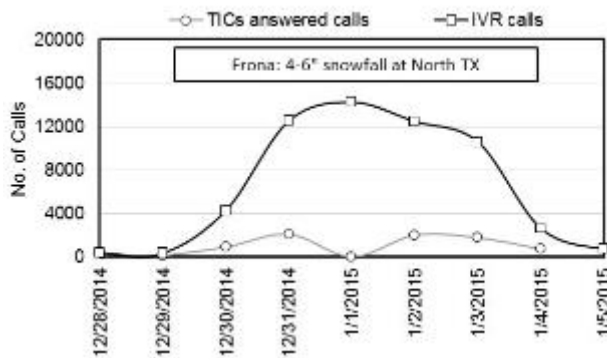


Figure 5.3. Calls distribution between IVR and calls referred to Travel Information Centers during 2013-2015

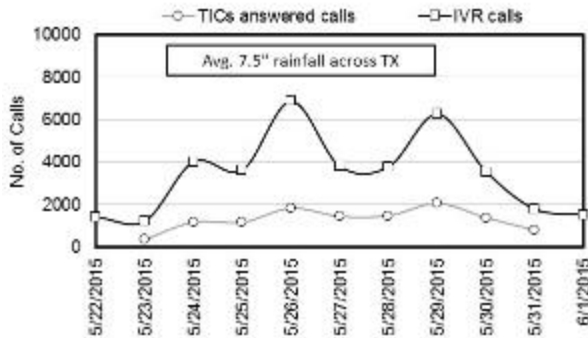
Table 5.1. Breakdown of the distribution between IVR and calls referred to Travel Information Centers during the storm events from 2013-2015

| Year | Storm | IVR Calls | TICs Calls | Total IVR calls per year | Total calls answered by TICs per year | % calls answered by TICs per year |
|------|------------------------------|-----------|------------|--------------------------|---------------------------------------|-----------------------------------|
| 2013 | N. American Storm (Nov 2013) | 40,784 | 6,382 | 144,149 | 22,333 | 15% |
| | Cleon (Dec 2013) | 103,365 | 15,951 | | | |
| 2014 | Kronos (Jan 2014) | 17,214 | 3,960 | 95,389 | 18,824 | 20% |
| | Leon (Jan 2014) | 8,230 | 2,486 | | | |
| | Slovenia (Feb 2014) | 9,873 | 2,579 | | | |
| | Pennsylvania (Feb 2014) | 5,603 | 1,554 | | | |
| | Titan (Mar 2014) | 21,741 | 3,632 | | | |
| | Bozeman (Nov 2014) | 4,213 | 833 | | | |
| | Frona (Dec-Jan 2015) | 57,030 | 7,560 | | | |
| 2015 | Winter Storm (Jan 2015) | 4,501 | 1,254 | 220,479 | 46,792 | 21% |
| | Lola (Jan 2015) | 6,859 | 1,372 | | | |
| | Winter Storm (Feb 2015) | 37,842 | 9,912 | | | |
| | Flooding (May 2015) | 34,918 | 11,669 | | | |
| | Bill (Jun 2015) | 15,555 | 7,083 | | | |
| | Patricia (Oct 2015) | 15,873 | 3,407 | | | |
| | Goliath (Dec 2015) | 76,416 | 8,315 | | | |

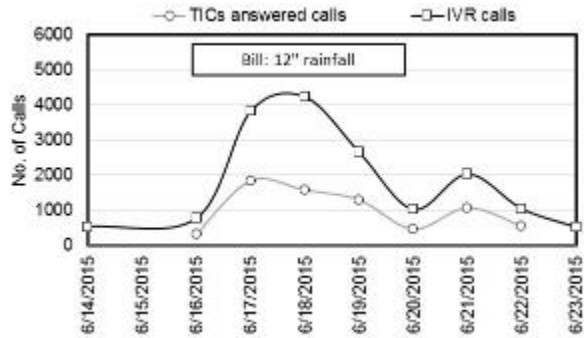
A breakdown of the daily calls received by the IVR and handled by Travel Information Centers during severe weather events is shown in Figure 5.4. There is a pattern in the call volume as it rises or diminishes with respect to the location and severity of each event. Winter storms during late December, when many travelers are on vacation trips (e.g., W.S. Goliath) are more critical for travelers than tropical storms during the summer season (e.g., T.S. Bill). Flooding events associated with major highway corridors such as Interstate 10 at the Texas-Louisiana border are also a critical event for many travelers and commercial trucks (e.g., flooding event in March 2016). The closure of Interstate 10 as a result of flooding caused call volume to multiply fourfold.



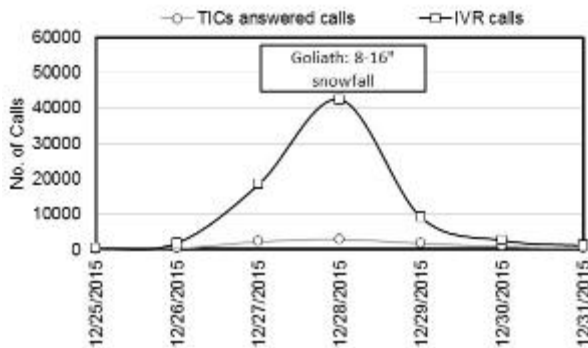
Winter Storm Frona (20% response rate)



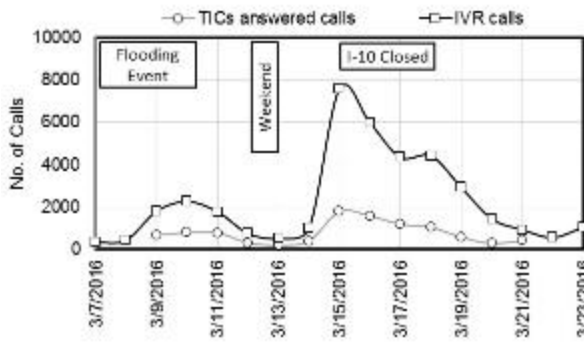
Winter snow storm (27% response rate)



Flooding event (34% response rate)



Tropical Storm Bill (47% response rate)



Winter Storm Goliath (20% response rate)

Flooding event (30% response rate)

Figure 5.4. Daily breakdown of number of calls received during the hazardous conditions

It is noteworthy that the Travel Information Center call-handling rate as documented by the daily breakdown during the peak time of severe weather events has increased to an average of 28% of the total calls received by the IVR. As the number of calls increases, the number handled by the Travel Information Centers is limited by the number of staff members. The maximum number of calls answered by the Travel information Center was 2,800 on December 28, 2015 during Winter Storm Goliath, accounting for 7% of the record high number of 42,443 calls received by the IVR. On the other hand, during Tropical Storm Bill, the highest number of calls handled by the Travel Information Centers was 1,840 on June 17, 2015, coming to 47% of the total IVR calls of 3,815.

Real-time up-to-date road conditions are also available online at www.DriveTexas.org. Figure 5.5 displays the number of website visits from 2010 to 2016 as provided by TxDOT. As expected, during hazardous conditions and severe weather events, the number of visits spikes into the millions. The website has also gained popularity among users over the years. For instance, the average number of website visits in 2015 is 1.0 million, up from 32,000 in 2011. Also, given the increasingly widespread use of mobile devices, website visits via computer or mobile device has surpassed the number of IVR calls by a factor of thirty in 2015, up from a factor of two in 2011. Although road conditions information is readily available online, the website cannot provide personalized recommendations for each user's specific situation. Therefore, the experienced staff members at Travel Information Centers continue to be an important line of support for thousands of travelers.

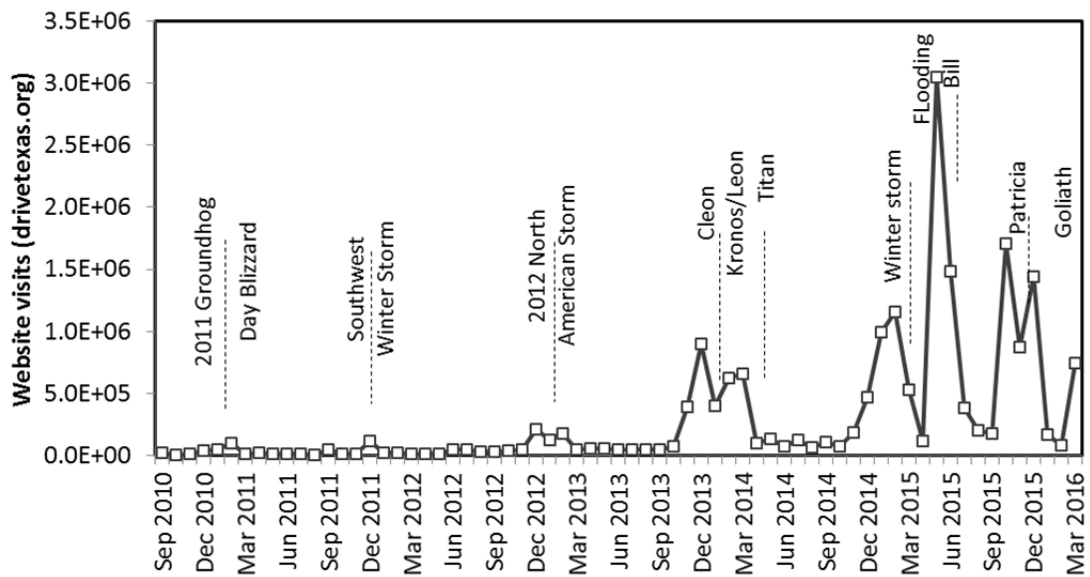


Figure 5.5. Number of visits to Drivetexas.org from 2010-2016

SAFETY INDEX

The survey responses discussed in the previous chapter were used to determine the significance of the Travel Information Centers in promoting travelers' safety. This was accomplished by identifying weight factors for the travelers' answers to the safety-related questions in the survey instrument. The safety-related questions are identified as questions 1-4 and question 7 of the survey instrument in Appendix A.

The procedure for identifying the weight factor is mainly associated with the role of the question responses on the safety of the travelers. For example, in question 1, the responses highlight the time the travelers spent and expected to spend on the road before and after the stop at the Travel Information Centers. The safety impacts on the visitors who spent more hours driving (e.g., 4 or more) prior to the stop is more significant than for those who spent fewer hours. Therefore, the safety weight factor will be higher for answers with longer driving time as opposed those with shorter ones. The same weighting concept applies to the rest of the questions. In question 2, the "use of restroom" and "taking a break" are the top factors with great influence on travelers' safety as compared to "using WiFi" or "vending machine." The weight factors are determined in a scale of 1 to 5, where 1 represents a less significant impact and 5 represents a highly significant impact on safety.

It is noted that the weight factors are chosen based on the researchers' rationale, feedback from travelers and literature review on previous safety studies. Examples of the weight factors are shown in Table 5.2. The weight factors along with the survey responses were used to establish the safety index for each question according to Equation 1 as follows:

$$Safety\ Index = \frac{\sum_1^n No.of\ Responses\ X\ Weight\ Factor}{Total\ No.of\ Responses} \quad (5.1)$$

where n is referred to the number of travelers' responses in the question. The equation applies for questions with single (e.g., Question #1) or multiple answers (e.g., Questions #2-4 and #7). After quantifying the safety index for each question, the overall safety index is determined by applying the equation to all questions collectively. All questions have scored an index greater than 3.0 as shown in Table 5.3. Results suggested that the Travel Information Centers have significant impact on the safety of the travelers as supported by an overall safety index of 3.68.

Table 5.2. Identification of the weight factors for survey responses

| Question # | Survey answers | Weight factor |
|------------|---------------------------|---------------|
| 1 | > 4 hrs | 5 |
| | 3-4 hrs | 4 |
| | 2-3 hrs | 3 |
| | 1-2 hrs | 2 |
| | < 1 hr | 1 |
| 2 | use restroom | 5 |
| | take a break | 5 |
| | travel/tourist info | 4 |
| | check vehicle | 4 |
| | sleep | 3 |
| | children relief | 2 |
| | pet relief | 2 |
| | use vending machine | 1 |
| | use WiFi | 1 |
| | eat | 1 |
| | other | 1 |
| 3 | need to rest | 5 |
| | nearest available option | 4 |
| | easy access from highway | 4 |
| | tourist/travel info | 4 |
| | parking availability | 3 |
| | traveling with children | 2 |
| | traveling with pets | 2 |
| | cleanliness of facilities | 1 |
| | other | 1 |
| 4 | restroom | 5 |
| | short break | 5 |
| | check vehicle | 4 |
| | long rest | 3 |
| | children relief | 2 |
| | pet relief | 2 |
| | eat a meal | 1 |
| 7 | weather info | 5 |
| | road closures/traffic | 5 |
| | emergency travel | 5 |

| | | |
|--|---------------------------------|---|
| | conditions | |
| | travel plans | 4 |
| | tourist info/recommendations | 4 |
| | Texas map | 3 |
| | other | 2 |

Table 5.3. The overall safety index using travelers' responses to survey questions

| Question | 1 | 2 | 3 | 4 | 7 | Overall |
|--------------|------|------|------|------|------|---------|
| Safety Index | 3.32 | 4.04 | 3.17 | 3.67 | 3.89 | 3.68 |

CRASH DATA ANALYSIS

The following section will discuss the crash data analysis performed by the research project. This crash data analysis relied on crash records provided by the Crash Records Information System (CRIS). CRIS is a statewide crash reporting system maintained by TxDOT and updated by standardized crash reports generated by peace officers in the field. TxDOT is responsible for the collection and analysis of crash data submitted by law enforcement on form CR-3, Texas Peace Officer's Crash Report. A statistical analysis was performed on roadway segments within the area of influence of several TICs that were also evaluated through field surveys and user questionnaires for which the results are summarized in other sections of this research report.

CRIS data is obtained via download from a TxDOT-maintained, web-based system. This data comes in the format of a single zip file containing eight individual comma-separated value (CSV) files. Data is summarized on a yearly basis and contains all reportable crashes for a period of one year. From the eight individual files that encompass an end-of-year summary, of particular interest to this analysis are the Crash file and the Unit file for reasons to be summarized below.

The Crash File acts as a master file for all the other supporting files and contains summary information about a crash event including several key variables such as georeferenced information, latitude and longitude of the crash event, and a unique identifier for the crash in the form of a CRASHID variable that allows for connections with the remaining data tables in the crash file. Several other variables can be also retrieved from the Crash File table, such as time of the crash, and road surface conditions such as wet and dry. A key variable in the analysis to be reported in this chapter is of course the latitude and longitude of the crash. This provides a way of spatially linking the crash event to the roadway alignment and the establishment of crash data sets that are within the area of influence of a specific TIC. However, the latitude and longitude information of a given crash event started becoming increasingly available for the last five years of CRIS data – 2011 through 2015 – as GPS

locator availability became more widespread on peace officer's cruisers. Table 5.1 offers a summary of the Crash file dimensions for the years 2011 through 2015. The total number of recorded crashes in CRIS for the five years is over 2.6 million with an average per year of about 523 thousand crashes.

Also of relevance for the crash analysis reported herein is the Unit file. Basically, the Unit file summarizes the vehicles and driver information for each crash event, allowing for the analysis of issues like the direction of travel for each vehicle involved in a crash event, a summary of the number of vehicles involved, driver license information such as state of origin and vehicle state of origin.

Of particular relevance for the analysis reported in this chapter is the direction of travel of each vehicle. As expected, since there could be multiple vehicles involved in a specific crash event, the Unit file is much larger in record count when compared to the Crash file. As discussed before, the Unit file may be linked to the Crash file through the unique variable CRASHID. Table 5.2 summarizes the statistics for the 2011 through 2015 Unit files. The total number of vehicles involved in crashes for the three years is over 5.1 million with an average of about two vehicles per crash event after performing a quick analysis of Tables 5.1 and 5.2.

Table 5.4. Crash file yearly statistics

| Year | Crashes |
|--------------|------------------|
| 2011 | 456,018 |
| 2012 | 495,519 |
| 2013 | 510,584 |
| 2014 | 554,753 |
| 2015 | 596,853 |
| Total | 2,613,727 |

Table 5.5. Unit file yearly statistics

| Year | Records |
|--------------|------------------|
| 2011 | 891,045 |
| 2012 | 975,212 |
| 2013 | 1,006,296 |
| 2014 | 1,100,118 |
| 2015 | 1,185,535 |
| Total | 5,158,206 |

This crash data is cross-referenced with TxDOT’s Road Highway Inventory Network Offload (RHINO). RHINO data provides georeferenced information about the TxDOT-maintained road network and includes information such as segment length and traffic volumes that will later be used to calculate crash rates.

Crash rate calculations consist of a straightforward process that is summarized by the implementation of the following equation (Equation 5.1) for each of the RHINO road segments under analysis. The crash rate R in Equation 5.1 is represented in terms of crashes per Million Vehicle Miles Traveled (MVMT).

$$R = (N * 1,000,000) / (L * V * 365) \quad (5.2)$$

Where:

N = Number of crashes along the study roadway segment per year

L = Length of roadway segment in miles

V = Average Daily Traffic Volume along the roadway

STATISTICAL METHODOLOGY FOR CRASH ANALYSIS

T-tests and Analysis Of Variance (ANOVA) are widely used statistical methods to compare group means. In our particular application of evaluating the crash reduction potential of TICs, the crash statistics from CRIS are arranged so that it is possible to test the statistical significance of the difference in mean crash rates in two opposing directions of a highway using a paired t-test. With this paired t-test procedure, we are able to compare the significance of the differences in average crash rates for segments that benefit from the potential stopping of a driver to rest and relax at the TIC, with the average crash rates of drivers in the opposite direction that may have been driving for an extended period of time with the associated effects on crash probability caused by driver’s fatigue. In statistical jargon, this is our research hypothesis. The significance of the test is measured by the null hypothesis that there is no difference between the crash rates in the two opposing directions and there is a probability of alpha of accepting the null hypothesis. Usually, alpha is set at 5% for these types of studies.

Examples of these paired scenarios are observed at several TICs that are placed at the borders of Texas with adjoining states.

The paired comparisons assumes that for crash rate comparisons of roadway segments on opposite directions, factors such as roadway geometry, traffic volumes and heavy vehicle

percentages are similar for the opposing directions roadway segments and that these effects would then cancel out in the analysis.

Using the Gainesville TIC as an example, it is possible to identify a stretch of IH35 that stretches several miles southward from the Gainesville TIC, where southbound drivers who had an opportunity to stop at the TIC would take a much-needed rest break to improve driving safety conditions before resuming their trip towards the DFW area. On the opposite direction of IH35, northbound, the opportunities for resting at a safety rest area are many miles away, at the Hill Country stop which was opened in the fall of 2013 midway between Dallas/Ft. Worth and Waco.

The statistical methodology employed to determine the crash reduction impacts of TICs consists of the following steps and was applied for crash data spanning the calendar years 2011 to 2015:

1. Identify roadway segment for analysis.
2. Retrieve crash data from CRIS's Crash Table.
3. Execute a spatial proximity algorithm using GIS tool in order to associate the crash information with the road segments established by RHINO.
4. Combine data from the Crash Table with the Unit Table data so as to determine direction of travel for the crash events associated with road segments in step 2.
5. Calculate crash rates by road segment for opposing directions using RHINO traffic information and geometry of the segments such as length.
6. Implement-paired t-tests on the resulting paired data set of crashes per segment and analyze statistical significance.

GAINESVILLE TIC CRASH ANALYSIS

The Gainesville analysis will be detailed using the six steps documented previously and will serve as a summary explanation for the analysis procedure that was applied for the remaining TICs.

Step 1: Identify roadway segments for analysis

The Gainesville TIC is located and the border of Texas with Oklahoma on IH35 and serves the traffic entering Texas and heading south on IH35. The segment for crash analysis is selected so that it does not encompass the DFW Metroplex area. The segment for analysis is defined as including segments and crashes with latitude greater or equal to 33.299, which is the latitude of the IH35/FM3163 intersection. This analysis segment is about 30 miles long. Figure 5.6 depicts the GIS map of the segment with the RHINO data block for a specific segment 1.243 miles long that needs to be spatially related to the crash data from CRIS. There are 50 road segments that comprise the Gainesville study route.

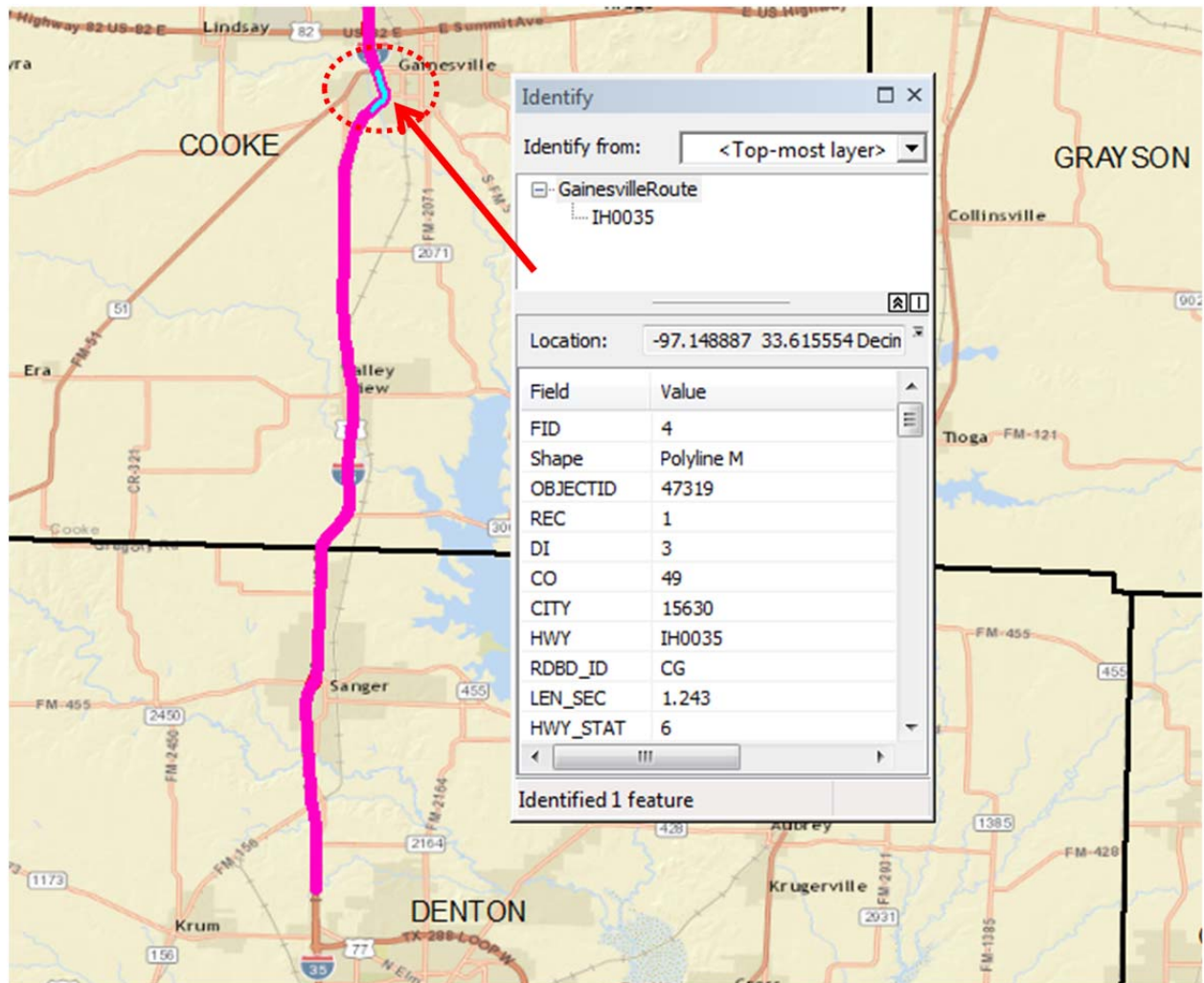


Figure 5.6. Gainesville segment identified for crash analysis

Step 2: Retrieve crash data from CRIS's Crash Table

Using the latitude parameter identified in the previous step, crashes that meet the criteria are imported into a GIS environment (ArcMap) for further analysis. The processing of the CRIS crash table for the analysis years is performed by custom written computerized routines using the SAS programming language. Results of this analysis are depicted in Figure 5.7 which shows the crash points for the year 2012 together with the data block for one of the crashes. The specific data block depicted in Figure 5.7 belongs to a crash that happened at Latitude 33.40 and Longitude -97.176 on 6/12/2012 at 3 PM on IH35. The unique CRASHID variable for this specific crash as recorded in the CRIS tables is 12750720. There were a total of 214 recorded crashes in the study segment for the year 2012 for the north and south directions combined.

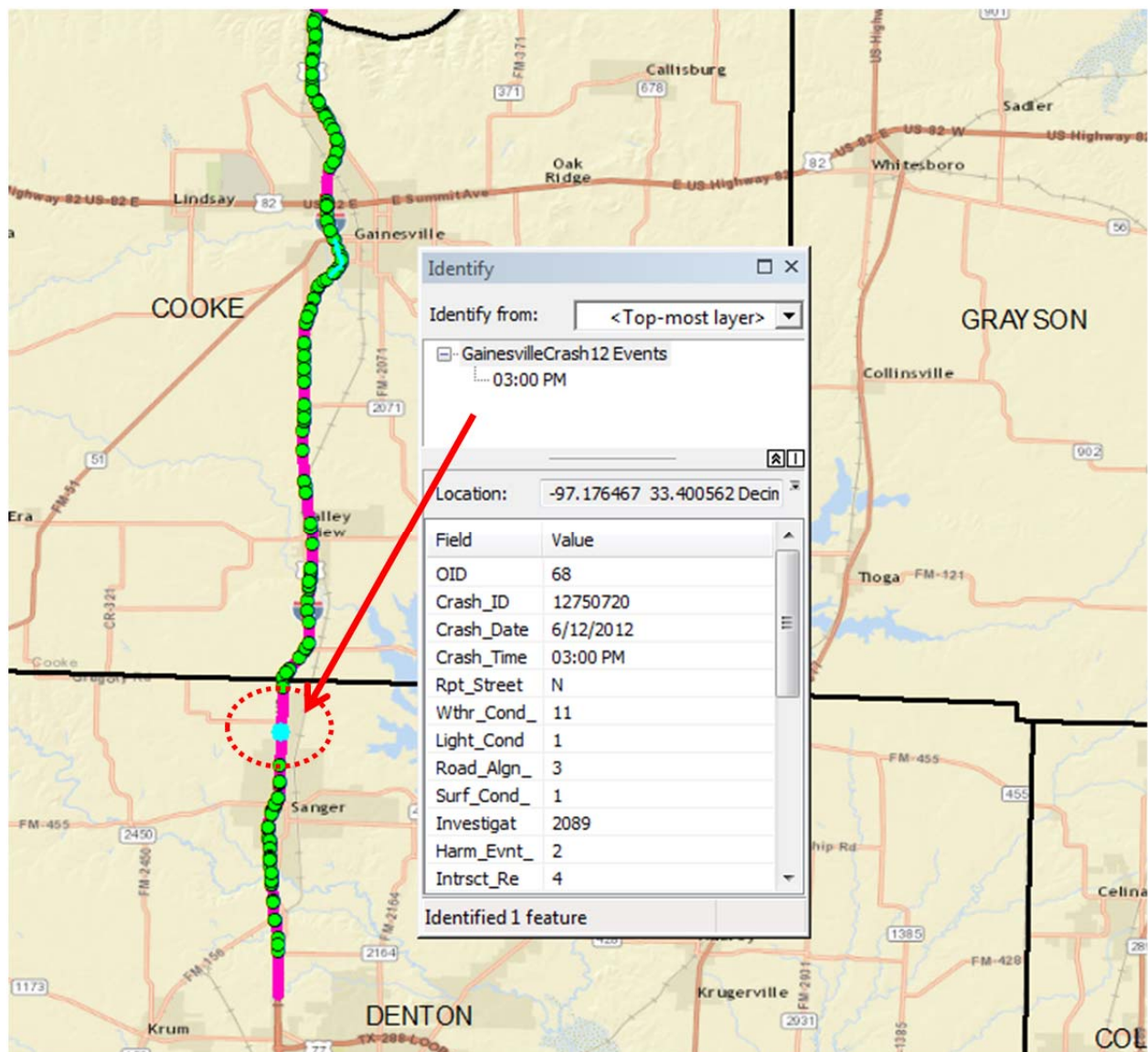


Figure 5.7. Gainesville 2012 crash events

Step 3: Proximity algorithm

Once the data layer containing the crash events for a given year is available in the GIS system ArcMap, it is possible to use a geoprocessing routine called a proximity algorithm to spatially match the CRIS crash data depicted in Figure 5.7 with the roadway segments defined by RHINO and depicted in Figure 5.6. The result of this process is a set of RHINO road segments that contain the crash events depicted in Figure 5.7. However, these results need to be exported to the SAS system to allow for data clean up involving deletion of duplicate crash events and matching with the Unit data of CRIS to allow for the split of the crash data between north and south directions. Figure 5.8 depicts the results of the proximity algorithm for a specific segment in the route together with the data block for one point in the GIS map that actually represents two crashes that happened in the segment with OBJECTID of 47318 which is actually a 1.59 mile segment. The two crashes happened

on different dates during the year 2012. The tabular data resulting from this proximity algorithm is then exported to SAS for further processing.

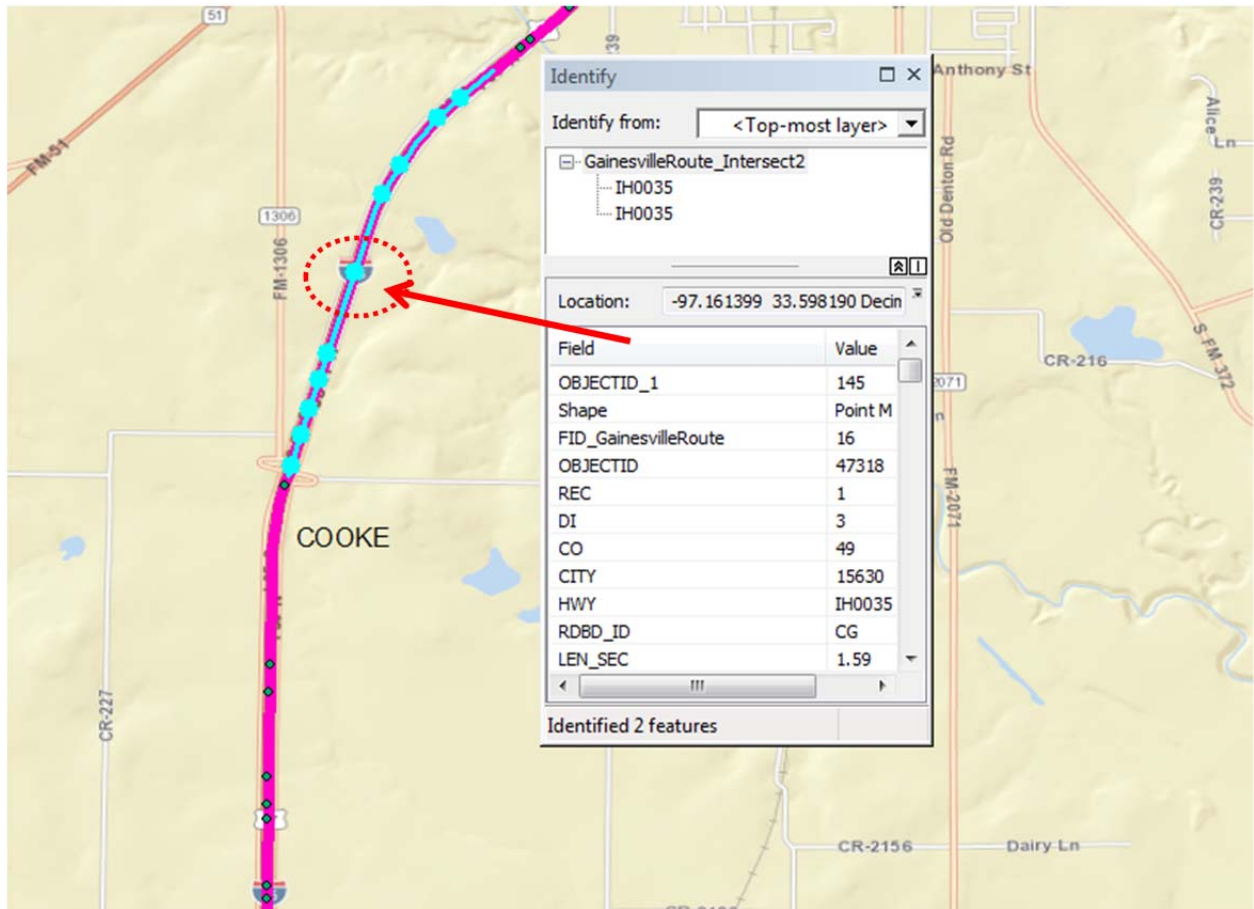


Figure 5.8. Gainesville 2012 proximity algorithm results

Step 4: Direction of travel determination

Using custom written computerized routines written in SAS, the results of the proximity algorithm are processed to generate a crash distribution by segment. For this purpose the direction of travel for the first vehicle involved in a specific crash needs to be retrieved from the CRIS data table containing the Unit file. Results for the segment with OBJECTID 47318 highlighted in Figure 5.8 for the year 2012 are summarized as follows to illustrate the results of the process implemented using SAS for all segments in the Gainesville crash study route. For a total of 13 crashes in the roadway segment with an OBJECTID of 47318, 8 crashes happened in the northbound direction and 5 in the southbound direction.

Step 5: Crash rate calculations

Crash rates are calculated using Equation 5.1 and the information on crash frequencies by segment generated in Step 4 combined with the RHINO traffic volume statistics corrected

for the specific crash year data. The roadway segment with OBJECTID 47318 depicted by Figure 5.8 is used again to illustrate the calculation process for the 2012 crashes. Results are summarized by Table 5.6 where the crash rate calculations lead to 0.83 and 0.52 per million Vehicle Miles Traveled (VMT). The process is repeated for all the 50 segments in the Gainesville study route for the years 2011 through 2015.

Table 5.6. Crash rate calculations for a given segment

| Segment ID | Direction | Length (miles) | Crashes 2012 | ADT | VMT | Crash Rate |
|------------|-----------|----------------|--------------|--------|--------|------------|
| 47318 | North | 1.59 | 8 | 16,637 | 26,452 | 0.83 |
| 47318 | South | 1.59 | 5 | 16,637 | 26,452 | 0.52 |

Step 6: Statistical analysis and levels of significance of t-paired tests

The final dataset of crashes to be analyzed by the paired t-test described at the beginning of this chapter encompassed 100 pairs of segments for the crash data spanning the years 2011 through 2013. Table 5.7 summarizes the number of crashes included in the analysis, for a total of 372 crashes northbound and 292 crashes southbound. Table 5.8 summarizes the statistics for the average crash rates northbound and southbound.

Table 5.7. Crashes in the Gainesville study segment 2011 to 2015

| Year | # Crashes North | # Crashes South |
|--------------|-----------------|-----------------|
| 2011 | 120 | 89 |
| 2012 | 121 | 93 |
| 2013 | 131 | 110 |
| 2014 | 119 | 116 |
| 2015 | 156 | 124 |
| Total | 647 | 532 |

Table 5.9 summarizes the statistical results for the means of the crash rates in the study road segment for the Gainesville TIC. Table 5.9 shows that the mean crash rates for the northbound and southbound directions are different, with the northbound crash rate mean being higher than the southbound crash rate mean. The number of pairs reported in Table 5.8 does not match the total number of segments in the study route that add up to 50, fifty segments for each of the five years because some segments in the study route during the 2011 to 2015 period did not experience any crashes.

Next, the statistical significance of this difference in mean crash rates for northbound and southbound will be evaluated using a paired t-test comparison. The paired t-test results are summarized in Table 5.9, where it may be observed that the calculated t-value is 1.96 which leads to a probability of 5.12%. This supports the statement that indeed the crash rate averages for the Gainesville study route are different and that there is a crash rate reduction

possibly associated with the presence of the Gainesville TIC, which encourages rest stops for drivers driving southbound into Texas.

However, it should also be noted that crash analysis is far from a precise science with crash rates being possibly affected by factors such as weather, work zones and other factors that the paired comparison may be unable to filter out of the analysis.

Table 5.8. Mean crash rates for the Gainesville study segment 2011 to 2015

| Variable | # Pairs | Mean | Standard Deviation | Minimum | Maximum |
|------------------|---------|-----------|--------------------|---------|---------|
| Crash rate South | 177 | 0.6226554 | 0.7222111 | 0 | 4.28 |
| Crash rate North | 177 | 0.7859322 | 0.8457819 | 0 | 7.85 |

Table 5.9. Paired comparison for the Gainesville study segment 2011 to 2015

| Difference | Degrees of Freedom | t-value | Probability |
|-----------------------------------|--------------------|---------|-------------|
| Crash rate north-Crash rate south | 176 | 1.96 | 0.0512 |

ORANGE TIC CRASH ANALYSIS

The same detailed process used for the Gainesville TIC crash analysis was used for the Orange TIC crash analysis. The analysis segment for the Orange TIC encompassed IH10 from the Orange TIC to the Chambers County Rest Area, which has a longitude of -94.6107. This longitude together with the IH10 alignment was used to filter the crash data for the years 2011 to 2015. Figure 5.9 depicts the study road segment together with the crash events for the year 2011. The data block depicted in Figure 5.9 is for a crash that happened 11/22/2011 at 10:43 AM. The total number of crashes for eastbound and westbound directions recorded in this segment for the year 2011 was 874. The length of the study segment is about 67 miles. Table 5.10 summarizes the number of crashes split by eastbound and westbound directions for the years 2011 through 2015.

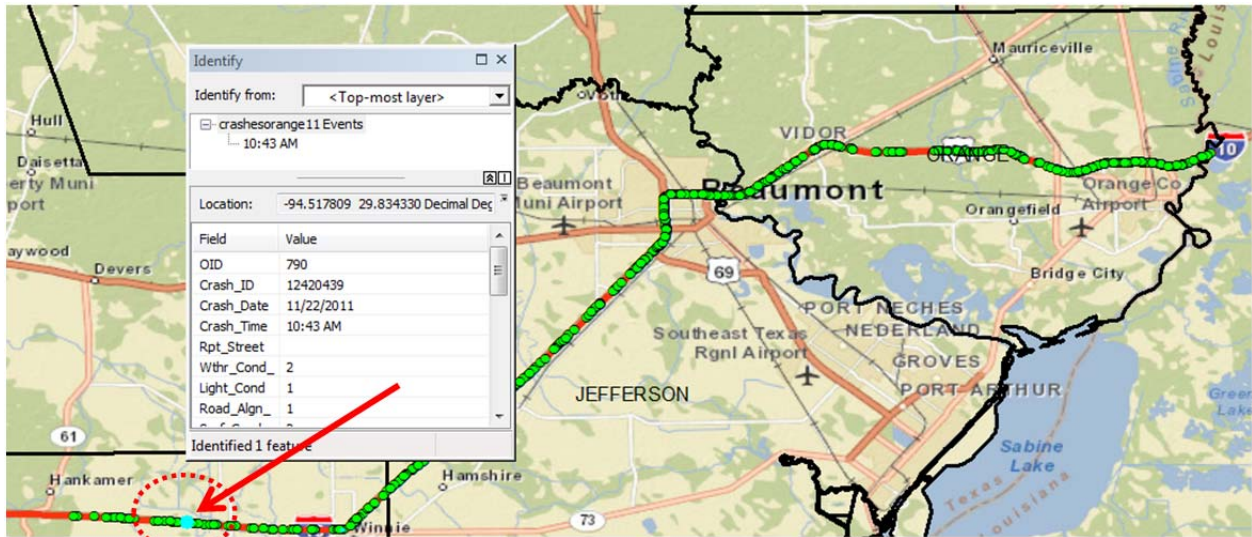


Figure 5.9. Crashes in the Orange TIC study segment for 2011

Table 5.10. Crashes in the Orange study segment 2011 to 2015

| Year | # Crashes East | # Crashes West |
|--------------|----------------|----------------|
| 2011 | 455 | 419 |
| 2012 | 574 | 509 |
| 2013 | 545 | 448 |
| 2014 | 672 | 519 |
| 2015 | 791 | 713 |
| Total | 3,037 | 2,608 |

The statistical analysis and levels of significance of t-paired tests are reported in Tables 5.11 and 5.9 respectively. The paired t-test results are summarized by Table 5.12, where it may be observed that the calculated t-value is -2.25 which leads to a probability of 2.49%. This supports the statement that indeed the crash rate averages for the Orange study route are different and that there is a crash rate reduction possibly associated with the presence of the Orange TIC, which encourages rest stops for drivers driving westbound into Texas.

Table 5.11. Mean crash rates for the Orange study segment 2011 to 2015

| Variable | # Pairs | Mean | Standard Deviation | Minimum | Maximum |
|-----------------|---------|---------|--------------------|---------|---------|
| Crash rate East | 392 | 1.75658 | 3.6431941 | 0 | 26.39 |
| Crash rate West | 392 | 1.40395 | 2.742176 | 0 | 36.58 |

Table 5.12. Paired comparison for the Orange study segment 2011 to 2015

| Difference | Degrees of Freedom | t-value | Probability |
|---------------------------------|--------------------|---------|-------------|
| Crash rate east-Crash rate west | 391 | -2.25 | 0.0249 |

AMARILLO TIC CRASH ANALYSIS

The same detailed process used for the Gainesville TIC crash analysis was used for the Amarillo TIC crash analysis. The analysis segment for the Orange TIC encompassed IH40 from the Amarillo TIC to the Donley County Rest Area, which has a longitude of -100.8353. This longitude together with the IH40 alignment was used to filter the crash data for the years 2011 to 2015. Figure 5.10 depicts the study road segment together with the crash events for the year 2013. The data block depicted in Figure 5.10 is for a crash that happened 8/31/2013 at 3:1 PM. The total number of crashes for east and west directions recorded in this segment for the year 2013 was 86. The length of the study segment is about 52 miles. Table 5.13 summarizes the number of crashes split by east and west directions for the years 2011 through 2015.

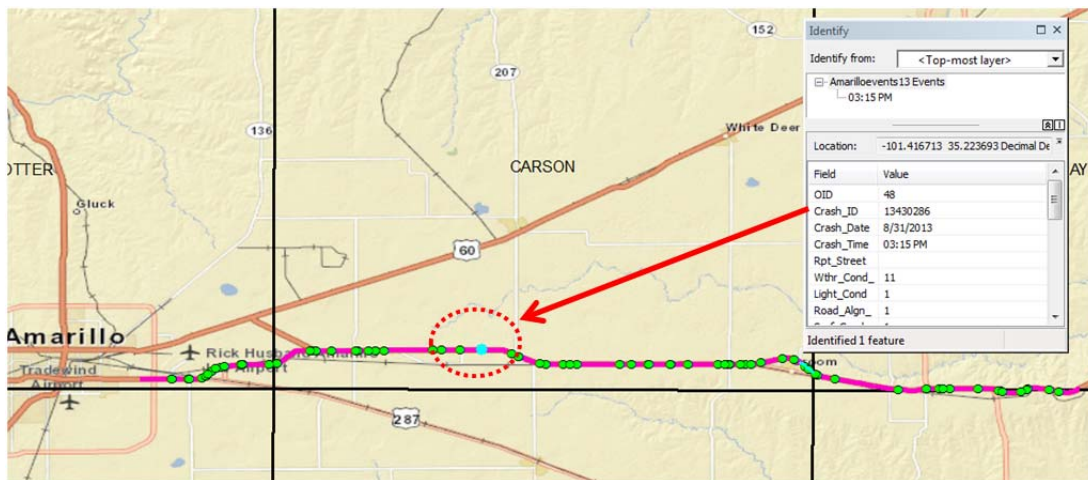


Figure 5.10. Crashes in the Amarillo TIC study segment for 2013

Table 5.13. Crashes in the Amarillo study segment 2011 to 2015

| Year | # Crashes East | # Crashes West |
|--------------|----------------|----------------|
| 2011 | 35 | 37 |
| 2012 | 27 | 40 |
| 2013 | 32 | 54 |
| 2014 | 33 | 42 |
| 2015 | 53 | 57 |
| Total | 180 | 230 |

The statistical analysis and levels of significance of t-paired tests are reported in Tables 5.14 and 5.12 respectively. The paired t-test results are summarized by Table 5.15, where it may be observed that the calculated t-value is -0.63 which leads to a probability of 53.11% thus not supporting the statement that indeed the crash rate averages for the Amarillo study route are different in the east and west directions. However, a closer examination of Table 5.13 shows a reduction of the number of crashes for the east direction as compared with the west direction, possibly showing an effect of the Amarillo TIC on the number of crashes for drivers heading on the east direction.

Table 5.14. Mean crash rates for the Amarillo study segment 2011 to 2015

| Variable | # Pairs | Mean | Standard Deviation | Minimum | Maximum |
|-----------------|---------|-----------|--------------------|---------|---------|
| Crash rate East | 170 | 0.6229412 | 1.2256618 | 0 | 8.5 |
| Crash rate West | 170 | 0.5593529 | 0.7714745 | 0 | 6.08 |

Table 5.15. Paired comparison for the Amarillo study segment 2011 to 2015

| Difference | Degrees of Freedom | t-value | Probability |
|---------------------------------|--------------------|---------|-------------|
| Crash rate east-Crash rate west | 169 | -0.63 | 0.5311 |

SUMMARY

There is no doubt that the existence of Travel Information Centers results in reduction of crashes caused by driver fatigue, shoulder parking, driver distraction, hazardous road and weather conditions, and vehicle malfunction. In addition, as the Travel Information Center user survey clearly shows that Travel Information Center users make use of the information provided at the centers, the safety information provided at centers must have positive impacts on travelers' safety. The TICs provide a line of support to travelers during hazardous conditions by handling calls received by the IVR. Assisted calls answered by the TICs during

hazardous conditions increased in 2015 compared to previous years. The number of calls answered by the centers is limited to the number of staff members available. Responders are only able to respond to about 25% of the calls due to the large volume received during weather hazards. The number of visits to TxDOT's road conditions website (DriveTexas.org) has increased significantly over the last few years. However, the calls answered by the centers provide more information and assistance not available online to address travelers' specific situations.

A safety index was proposed to estimate how the Travel Information Center users perceive the impact of the usage on the safety of their travel experience. The index was calculated using the travelers' responses to the survey instrument. The responses were weighted based on their relevance to travelers' safety. A systematic analysis using the responses count and weight factor was used to determine the safety index for individual questions and overall safety of travelers. Results suggest that the TICs provide significant impact on travelers' safety with a safety index of 3.68 (out of 5). This is slightly higher than the determined index in the previous version of the study conducted on 2014.

Different methods can be used to quantify safety impacts of Travel Information Centers such as before-after comparison, case-control analysis, and descriptive statistics. Complete geo-referenced crash data in Texas have become available only in recent years. The research team identified two Travel Information Centers where the impact on crash statistics is not affected by obvious cofactors (such as adjacency to urban centers). Crash analysis revealed a statistically significant reduction in crash rates of 25% and 26% that may be due to the Orange and Gainesville Travel Information Centers, respectively. Analysis of crash data in the vicinity of the Amarillo Travel Information Center did not reveal a statistically significant effect on crash rates. However, a smaller number of crashes was observed for the east direction for the crash history encompassing 2011 through 2015, which is consistent with the effects of travelers potentially stopping at the Amarillo TIC.

The Amarillo Travel Information Center was relocated in 2003, and the Anthony Travel Information Center was reopened in 2000 following a major renovation. Recent research conducted by Texas Transportation Institute (Carson et al., 2011) determined that the Amarillo and Anthony Travel Information Centers reduced crashes by in 6.9 and 14.8%, respectively, based on before-after analysis.

CHAPTER 6: ECONOMIC BENEFITS OF TRAVEL INFORMATION CENTERS

| Travel Information Center Economic Benefits | FY 2015 | FY 2016 |
|----------------------------------------------|---------------|---------------|
| Direct Visitor Spending Generated by centers | \$115,082,379 | \$127,389,309 |
| Jobs Supported by centers | 1,151 | 1,274 |
| State Tax Revenue Generated by centers | \$6,904,943 | \$7,859,920 |

TxDOT's Travel Information Division began exploring ways to calculate the economic impact of the twelve Travel Information Centers in 2010. For internal reference, TxDOT applied visitor behavior results from an Iowa Welcome Center survey to Texas Travel Information Center visitor numbers and average daily per-person spending figures from D.K. Shifflet & Associates, Ltd., for the travel research office of the Office of the Governor – Economic Development and Tourism (EDT).

Preliminary results from these studies were not officially reported, but recognizing the valuable information that could be derived from primary research, TxDOT and EDT began working together to develop a survey tool for the collection and analysis of Texas visitor behavior, to be administered directly at the Travel Information Centers. The methodology listed below was formulated jointly by these two agencies, with final approval of the completed survey tool and methodology given by EDT. TxDOT began reporting the results of this study at the beginning of FY 2013, and FY 2013 and FY 2014 results were provided in the 2014 edition of this report. The year-end results for FY 2015 and FY 2016 are given above.

METHODOLOGY

Surveys are collected from each center in proportion to its visitation.

- 3 per day:
 - Denison
 - Gainesville
 - Orange
 - Texarkana
 - Rio Grande Valley (Harlingen)
 - Waskom
 - Wichita Falls
- 1 per day:
 - Amarillo
 - Anthony (El Paso)
 - Capitol Visitor Center (Austin)
 - Judge Roy Bean Visitor Center (Langtry)
 - Laredo
- Surveys are collected during set time windows. If no visitors come in during the set window, no survey will be collected until the next time window.

- The travel party size used to calculate total spending is set according to travel party size results from this survey.
- The daily per-person spending figure from the most recently released D.K. Shifflet report available through EDT at the beginning of the fiscal year is used throughout the fiscal year.
- Reports are generated quarterly. At the end of the fiscal year, the quarterly totals are added to arrive at the yearly total.
- Economic impact is calculated based on two types of responses:
 - Visitors who respond that they will extend this trip longer than originally planned:
 - 2 hours and ½ day Calculated at ½ daily spending
 - One day Calculated at 1x daily spending
 - Two days Calculated at 2x daily spending
 - Three or more days Calculated at 3x daily spending
 - Visitors who respond that they will visit more attractions/points of interest in Texas on this trip than originally planned (without spending additional time):
 - Calculated at ½ daily spending
 - Visitor response “No changes to this trip, but will use the information for future trips” has an uncalculated/unreported economic impact.
 - Visitor response “None of the above” estimated to have no economic impact.
- Counselors hand out paper survey forms to visitors. Completed surveys are entered into an online database tool whose contents are maintained by TxDOT Travel Information Division Administration.

The survey tool collects additional data for internal use and analysis by TxDOT, including visitor origin and destination, purpose of travel, and customer satisfaction. Demographic information is not collected to avoid redundancy with the research done by EDT.

The survey form appears on the following page.

Survey Form

Texas Travel Information Center Survey – **Center Name**

Today's Date: _____

A trip is traveling 50 miles or more from home.

1a. In what country do you presently reside? _____

1b. If "United States," what state? _____ What ZIP code? _____

2a. What state or country is (or was) your destination on this trip?
(If you are on your way home, please tell us where you went.)

2b. If "Texas" is (or was) your destination, what city or region?

3. How many trips will you take in Texas this year? _____

4. How many are in your traveling party (including you)?

1 2 3 4 5 More than 5

5a. Which of the following are you most likely to do because of information provided at the Travel Information Center?
(Please check only one.)

- Extend this trip longer than originally planned
 Visit more attractions/points of interest in Texas on this trip than originally planned (without spending additional time)
 No changes to this trip, but will use the information for future trips
 None of the above

5b. If extending this trip, about how much longer?

- 2 hours 2 days
 ½ day 3 or more days
 One day

6. What activities will you/did you take part in on this visit? *(Please check all that apply.)*

- Visiting Friends / Relatives Historic Sites General Vacation
 Dining / Shopping Theme Parks / Amusement Parks Business Activities / Work Trip
 Museums / Art Exhibits Hiking / Camping / Outdoor Activities Special Event _____
 Other _____

7. Please rate your satisfaction with the following:

| | <i>Poor</i> | | <i>Neutral</i> | | <i>Excellent</i> |
|------------------------|-------------|---|----------------|---|------------------|
| a. Center facility | 1 | 2 | 3 | 4 | 5 |
| b. Center staff | 1 | 2 | 3 | 4 | 5 |
| c. Printed information | 1 | 2 | 3 | 4 | 5 |
| d. Overall / general | 1 | 2 | 3 | 4 | 5 |

Comments: _____

Thank you for your visit!

Office Use Only

Survey Administered by: _____

Collection

In FY 2015, 6,967 visitor surveys were collected at the Travel Information Centers. In FY 2016, there were 6,342 visitor surveys collected.

Calculation Variables

The variables listed below were used to calculate Travel Information Center economic impact for FY 2015 and FY 2016. Unless otherwise specified, figures given are drawn from the Travel Information Center Visitor Survey results:

| | <u>FY 2015</u> | <u>FY 2016</u> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------|
| Daily per person spending | \$122* | \$129.40** |
| Number of travel parties who received a travel counseling session at a Travel Information Center | 701,447 | 695,360 |
| Average travel party size | 2.43 | 2.43 |
| % of survey respondents extending their trip longer than originally planned | 15.7% | 17.9% |
| % of survey respondents visiting more attractions/points of interest in Texas on their trip than originally planned (without spending additional time) | 57.8% | 58.3% |

*D.K. Shifflet & Associates Ltd., *2013 Texas Visitor Profile*

**D.K. Shifflet & Associates Ltd., *2014 Texas Visitor Profile*

Jobs Supported and State Tax Revenue Generated

In addition to the calculations of direct visitor spending based on the methodology above, EDT calculates that every \$100,000 in direct visitor spending supports one job. Spending also yields state tax revenue; calculated at 6% for FY 2015 and 6.17% for FY 2016.

Customer Satisfaction

The Travel Information Centers' customer satisfaction rating results are consistently very high. The Travel Information Centers received a rating of 4.97 out of 5 for overall customer satisfaction with the facility, staff, and travel literature available in FY 2015 and 4.96 in FY 2016.

Additionally, a TxDOT-wide customer service survey conducted by the Texas Legislative Council in FY 2014 yielded a customer satisfaction rating of 99% for the Travel Information Centers, making them the most highly-rated area in the agency.

FACILITY COSTS

In FY 2015, operating costs for the Travel Information Centers were \$3,238,686 with maintenance costs of \$2,343,893. In FY 2016, operating and maintenance costs were \$3,182,262 and \$1,409,428, respectively.†

TRAVEL INFORMATION CENTER BENEFITS

Tourism Benefits

The mission of TxDOT's Travel Information Division is to promote travel to and within Texas. The Travel Information Centers work to fulfill this mission by offering professional travel counseling services and providing routing and highway condition information. The centers are open 360 days a year, closing only on New Year's Day, Easter Sunday, Thanksgiving Day, Christmas Eve, and Christmas Day. These services are provided free of charge to the public.

In conjunction, the centers provide free services to Texas tourism organizations and attractions via a partnership model. Travel counselors are extensively trained to be knowledgeable about current tourism opportunities within the state, and participate in a state and national professional certification program. Regional, city, and private sector tourism partners underwrite educational familiarization tours and training for these counselors throughout the calendar year, thus providing extensive staff training at minimal expense to TxDOT. Through a partnership with the Texas Travel Industry Association (TTIA), iPad kiosks are available at most centers where visitors can purchase discount attractions tickets directly from participating TTIA member organizations; a percentage of revenue from these sales goes toward funding center operations. The centers also provide free literature display and distribution to promote cities, regions, and attractions throughout the state.

Comfort and Convenience Benefits

Texas Travel Information Centers are conveniently located at all major points of entry to the state, as well as in the Capitol Visitors complex in Austin and the historic Judge Roy Bean Visitor Center in Langtry. Continuing the tradition that began when the first centers were founded in 1936 to assist travelers coming to Texas for its Centennial celebrations, each center's design uniquely reflects the geography and history of its region. The centers are designed to be aesthetically pleasing as well as convenient, and feature such amenities as clean restrooms, landscaped grounds, shaded picnic arbors, free wireless internet access, "Welcome to Texas" photo ops, and viewing rooms featuring videos on Texas tourism destinations. The attractive facilities and extensive, park-like grounds promote safety by enticing travelers to stop and take a break from the road. These benefits have an additional, unquantified economic impact.

Safety Benefits

Texas Travel Information Centers perform three important safety functions for the benefit of the traveling public:

1. Travel Information Centers are an integral component of TxDOT's DriveTexas Highway Conditions service. Current information on highway closures, construction, accidents, and weather-related travel conditions are displayed on an interactive map at www.DriveTexas.org and provided via TxDOT's toll-free Travel Information line at 1-800-452-9292. This line provides automated highway conditions information as well as an option to speak with a travel counselor at one of the centers to receive personal, professional assistance.
2. During emergency events, this toll-free information line serves as an emergency information conduit for the traveling public. In case of evacuations, hurricanes, winter storms, or other emergency conditions, Travel Information Center staff are activated as a state emergency resource and dispense information on a variety of subjects including emergency shelter information, fuel availability, food and water availability, emergency medical resources, and more. Travel Information Centers may go into extended hours or 24-hour operations, depending on the nature of the emergency. In the event that an emergency evacuation route includes a Travel Information Center, the center may serve as an emergency staging location and provide personal assistance to evacuees.
3. Throughout the year, Travel Information Centers partner with TxDOT District Safety Officers, the Texas Department of Public Safety, local law enforcement, and other organizations to host safety awareness events for the public. These events tie in with such public safety campaigns as *Click It or Ticket*, impaired and distracted driving awareness campaigns, child car seat safety campaigns, and work zone driving safety campaigns. These events feature educational games and activities, promotional materials, presentations, demonstrations, and entertainment, and are well-attended by local community members as well as passing travelers.

By reducing crashes, property damage, injuries and lost time, these safety benefits have an additional unquantified economic benefit to the State of Texas.

- o *Reduction in Excess Travel*

Finally, Travel Information Centers provide the additional, unquantified economic benefit of reducing excess travel time by providing expert directional information, taking into account both the most efficient route and any delays or detours resulting from highway conditions along that route.

RESULTS

In FY 2015 and FY 2016, the Travel Information Centers demonstrated significant economic value as shown in the table below. In addition, customer satisfaction ratings continue to be very high, with the centers rated 4.96 out of 5 both years.

| Travel Information Center Economic Benefits | FY 2015 | FY 2016 |
|----------------------------------------------|---------------|---------------|
| Direct Visitor Spending Generated by centers | \$115,082,379 | \$127,389,309 |
| Jobs Supported by centers | 1,151 | 1,274 |
| State Tax Revenue Generated by centers | \$6,904,943 | \$7,859,920 |

| Travel Information Center Costs | FY 2015 | FY 2016 |
|------------------------------------------------|-------------|--------------------------|
| Center Operating Costs (Staffing, Consumables) | \$3,238,686 | \$3,182,262 [†] |
| Center Maintenance Costs (Facilities) | \$2,343,893 | \$1,409,428 [†] |
| Total | \$5,582,579 | \$4,591,690 [†] |

The Travel Information Centers are highly valued by their customers, and play an active role in the Texas travel and tourism industry. The Texas Travel Industry Association member organizations underwrite training costs to keep operating costs low and the staff educated and up-to-date. The state tax revenues that the Travel Information Centers generate further offset these costs. These estimated economic benefits can be considered conservative, as they do not take into account the additional unquantified economic benefits of comfort and convenience, safety impact, and reducing excess travel. The centers have a significant economic benefit to Texas.

[†] The FY 2016 budget will not be closed out until December 2016. Operating and maintenance costs listed are correct as of September 2016. The final figures may be slightly different.

CHAPTER 7: CONCLUSIONS AND RECOMMENDATIONS

Travel Information Centers in Texas serve a broad range of travelers, including vacation/recreational travelers, commercial vehicle operators, commuters, travelers on bus tours, and motorcyclists. Travel Information Centers provide the distinct advantage of quick and convenient access and facilities that are open 24 hours a day. The majority of travelers stopping at Travel Information Centers obtain travel and tourism information, use the restroom, or simply take a break to rest and stretch. Other patrons who use the Travel Information Center visit for other purposes, such as using the vending machines, getting relief for children or pets, conducting vehicle check and maintenance, going picnicking, changing drivers, or even sleeping. Conditions of a recent legislative appropriation prompted TxDOT to reassess the functional value of Travel Information Centers and their economic and safety impact. The overall goal of this research was to gather sufficient data to quantify the impact of Texas Travel Information Centers' staff and services on the safety of travelers on TxDOT roadways. Data and analytical tools that quantify the value of person-to-person contact with visitors and provide information regarding travel route, road condition, destination, weather, and disaster evacuation were used. Several tasks were performed as part of this research to help achieve the research objectives.

CONCLUSIONS

Travel Information Center Operations

Travel Information Centers are an integral component of TxDOT's DriveTexas Highway Conditions service. The centers are conveniently located at all major points of entry to the state, as well as in the Capitol Visitors complex in Austin and the historic Judge Roy Bean Visitor Center in Langtry. The centers are designed to be aesthetically pleasing as well as convenient, and feature such amenities as clean restrooms, landscaped grounds, shaded picnic arbors, free wireless internet access, "Welcome to Texas" photo ops, and viewing rooms featuring videos on Texas tourism destinations. The attractive facilities and extensive, park-like grounds are designed to entice travelers to stop and take a break from the road.

Travel Information Centers promote in-state tourism by offering professional travel counseling services, providing routing and highway condition information, and offering discounted tickets to several major Texas attractions. In addition, the centers provide information on highway closures, construction, accidents, and weather-related travel conditions. In case of evacuations, hurricanes, winter storms, or other emergency conditions, Travel Information Center staff are activated as a state emergency resource and dispense information on a variety of subjects including emergency shelter information, fuel availability, food and water availability, emergency medical resources, and more. The

centers may also serve as emergency staging locations and provide personal assistance to evacuees. Throughout the year, Travel Information Centers partner with TxDOT District Safety Officers, the Texas Department of Public Safety, local law enforcement, and other organizations to host safety awareness events for the public.

Safety Benefits

The research team identified several safety benefits of Travel Information Centers such as reduction of driver fatigue and other wellness issues, transmission of critical information on safety and hazardous road and weather conditions, reduction of driver or passenger discomfort and distraction, reduction of highway shoulder stops; reduction of excess travel to get services. Three highway segments where the effect of a Travel Information Center existence on crash reduction can be identified were selected. Analysis of crash data of the past five years revealed statistically significant reduction in crash rates due to the existence of two Travel Information Centers (Orange and Gainesville), and a significant crash count reduction for the Amarillo Travel Information Center based on analysis of the directions of travel that benefit from the incentive to stop and rest that the Travel Information Center provided. A previous study supported by TxDOT identified significant crash reduction due to the reopening of Anthony and Amarillo Travel Information Centers. Crash analysis for the Harlingen Travel Information Center, one of the targets for the center user surveys, was not included because of the existence of cofactors such as adjacency of urban centers, which would make the crash analysis results questionable. Acknowledging that most safety benefits of Travel Information Centers cannot be directly quantified, a safety index was proposed to estimate how the center users perceive the impact of the usage on the safety of their travel experience. Results suggested that Travel Information Centers have significant impacts on the safety of the travelers as remarked by the computed values of the proposed safety index.

User Satisfaction and Valuation of Travel Information Centers

In Fiscal Year 2015 and Fiscal Year 2016, the visitor survey yielded a total of 13,309 responses for the economic study obtained from the 12 Texas Travel Information Centers. The safety survey resulted in 3,080 additional responses. The overwhelmingly common reasons for stopping at a travel information center were to use the restroom (71 percent), obtain travel info (69 percent) and to stretch/walk/take break (45 percent). The primary reason for selecting the Travel Information Center rather than a nearby commercial facility was due to the availability of travel info (66 percent), cleanliness of restrooms (67 percent) and the quick access from the highway (23 percent). The Travel Information Centers' customer satisfaction rating results are consistently very high, receiving a rating of 4.97 out of 5 in FY 2015 and 4.96 out of 5 in FY 2016 for overall customer satisfaction with the facility, staff, and travel literature available. Moreover, 96.5 percent of the users suggested that the services/information offered at Travel Information Centers helped their travel plans.

Economic Assessment

The economic benefits of Travel Information Centers include comfort and convenience, promotion of in-state tourism, reduction of excess travel to get services, savings on vehicle operation and maintenance, benefits to specific business enterprise, and reduction of traffic diversion into communities. Only tourism benefits were evaluated in this study. The results of the economic analysis showed that all Travel Information Center facilities might be considered economically viable. The total state tax revenue generated by Travel Information Centers through tourism enhancement alone for Fiscal Year 2015 and 2016 was \$6,904,943 and \$7,859,920, respectively. Texas Travel Information Centers supported 1,151 and 1,274 jobs for those two years. The total operation and maintenance cost for those two years were \$5,582,579 and \$4,591,690, respectively. Other economic benefits of Travel Information Centers, such as reduction of excess travel to access similar services if the centers did not exist and comfort and convenience benefits, were not assessed. Several published studies that quantified these benefits concluded that they far exceed the tourism benefits. As such, Travel Information Centers have a significant economic benefit to Texas. Benefit-cost analysis was not formally performed in this study. However, based on previous TxDOT studies and estimates from this study, the benefit-cost ratio of Texas Travel Information Centers may be well above 10:1.

RECOMMENDATIONS

All Texas Travel Information Centers are economically viable facilities to operate for TxDOT and have significant safety benefits for travelers on Texas roadways. Comprehensive economic assessment is recommended for making decisions on adding a new facility or upgrading existing facilities.

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APPENDIX A SAFETY SURVEY



Texas Department of Transportation
University of Texas-San Antonio



Texas Travel Information Center Safety Survey

1. Since your most recent stop today:

How long have you been on the road?

- Under 1 hr 1-2 hrs 2-3 hrs 3-4 hrs More than 4 hrs

How much longer will you be on the road until your next stop?

- Under 1 hr 1-2 hrs 2-3 hrs 3-4 hrs More than 4 hrs

2. Why did you stop at this facility (please select your top three reasons)?

- Use Restroom Tourist/Travel Info Take a Break Eat Sleep
 Use Vending Machine Children Relief Pet Relief Check Vehicle Use WiFi

Other: _____

3. What is the main reason you chose to stop at this facility rather than a gas station or fast food restaurant (please select one)?

- Tourist/Travel Info Cleanliness of Facility Need to Rest Parking Availability
 Easy access to Highway Traveling with Children Traveling with Pets Nearest Available Option

Other: _____

4. When traveling, which is your preferred stop for the following purposes?

- | | | | | |
|-------------------------|--------------------------------------------------------|------------------------------------------------|-------------------------------------------|----------------------------------------|
| Restroom: | <input type="checkbox"/> Travel Info. center (staffed) | <input type="checkbox"/> Rest Area (unstaffed) | <input type="checkbox"/> Private Facility | <input type="checkbox"/> No preference |
| Eat a Meal: | <input type="checkbox"/> Travel Info. center (staffed) | <input type="checkbox"/> Rest Area (unstaffed) | <input type="checkbox"/> Private Facility | <input type="checkbox"/> No preference |
| Short break: | <input type="checkbox"/> Travel Info. center (staffed) | <input type="checkbox"/> Rest Area (unstaffed) | <input type="checkbox"/> Private Facility | <input type="checkbox"/> No preference |
| Long Rest: | <input type="checkbox"/> Travel Info. center (staffed) | <input type="checkbox"/> Rest Area (unstaffed) | <input type="checkbox"/> Private Facility | <input type="checkbox"/> No preference |
| Check Vehicle: | <input type="checkbox"/> Travel Info. center (staffed) | <input type="checkbox"/> Rest Area (unstaffed) | <input type="checkbox"/> Private Facility | <input type="checkbox"/> No preference |
| Children Relief: | <input type="checkbox"/> Travel Info. center (staffed) | <input type="checkbox"/> Rest Area (unstaffed) | <input type="checkbox"/> Private Facility | <input type="checkbox"/> No preference |
| Pet Relief: | <input type="checkbox"/> Travel Info. center (staffed) | <input type="checkbox"/> Rest Area (unstaffed) | <input type="checkbox"/> Private Facility | <input type="checkbox"/> No preference |

5. What is your preferred means of planning your travel?

Maps/travel literature or consult with travel counselors

Internet before traveling

Mobile apps while on the road

Other: _____

6. How have the following influenced your travel plans in the past?

- | | | | | |
|----------------------------|-------------------------------------|----------------------------------------------|-----------------------------------------|-------------------------------------|
| Brochure/map: | <input type="checkbox"/> Influenced | <input type="checkbox"/> Somewhat Influenced | <input type="checkbox"/> Not Influenced | <input type="checkbox"/> Never used |
| Speak to travel counselor: | <input type="checkbox"/> Influenced | <input type="checkbox"/> Somewhat Influenced | <input type="checkbox"/> Not Influenced | <input type="checkbox"/> Never used |
| Travel guide/magazine: | <input type="checkbox"/> Influenced | <input type="checkbox"/> Somewhat Influenced | <input type="checkbox"/> Not Influenced | <input type="checkbox"/> Never used |
| Internet: | <input type="checkbox"/> Influenced | <input type="checkbox"/> Somewhat Influenced | <input type="checkbox"/> Not Influenced | <input type="checkbox"/> Never used |
| Mobile apps: | <input type="checkbox"/> Influenced | <input type="checkbox"/> Somewhat Influenced | <input type="checkbox"/> Not Influenced | <input type="checkbox"/> Never used |
| TV/Radio ads: | <input type="checkbox"/> Influenced | <input type="checkbox"/> Somewhat Influenced | <input type="checkbox"/> Not Influenced | <input type="checkbox"/> Never used |

7. Which Travel Information Center services have you used before?

- Texas Map Tourist info./recommendations Travel Plans (lodging, food, gas)
 Emergency travel conditions info. Weather Info. Road Closures/Traffic Conditions

Other: _____

8. Overall, did the services/info. offered at this Travel Info. Center help your travel plans?

Yes

No

Thanks for your time

APPENDIX B SAFETY SURVEY RESPONSE RATES

| How long have you been on the road? | | |
|-------------------------------------|------------------|----------------|
| Answer Options | Response Percent | Response Count |
| Under 1 Hour | 14.4% | 443 |
| 1-2 Hours | 18.5% | 567 |
| 2-3 Hours | 19.7% | 604 |
| 3-4 Hours | 15.2% | 465 |
| More than 4 Hours | 32.2% | 989 |
| <i>answered question</i> | | 3068 |

| How much longer will you be on the road until your next stop? | | |
|---------------------------------------------------------------|------------------|----------------|
| Answer Options | Response Percent | Response Count |
| Under 1 Hour | 13.3% | 382 |
| 1-2 Hours | 20.3% | 585 |
| 2-3 Hours | 24.6% | 707 |
| 3-4 Hours | 16.8% | 482 |
| More Than 4 Hours | 25.0% | 719 |
| <i>answered question</i> | | 2875 |

| Why did you stop at this facility (please select your top three reasons)? | | |
|---------------------------------------------------------------------------|------------------|----------------|
| Answer Options | Response Percent | Response Count |
| Use Restroom | 70.9% | 2179 |
| Tourist/Travel Info | 69.2% | 2128 |
| Take a Break | 45.7% | 1404 |
| Children Relief | 11.1% | 341 |
| Use Wifi | 7.0% | 214 |
| Use Vending Machine | 6.6% | 204 |
| Pet Relief | 5.4% | 166 |
| Check Vehicle | 4.2% | 129 |
| Eat | 4.1% | 126 |
| Sleep | 1.8% | 55 |
| Others | 6.5% | 200 |
| <i>answered question</i> | | 3073 |

What is the main reason you chose to stop at this facility rather than a gas station or fast food restaurant (please select one)?

| Answer Options | Response Percent | Response Count |
|--------------------------|------------------|----------------|
| Tourist/Travel Info | 66.1% | 2020 |
| Cleanliness of Facility | 38.0% | 1161 |
| Easy Access to Highway | 23.2% | 709 |
| Need to Rest | 17.0% | 519 |
| Traveling with Children | 8.5% | 261 |
| Parking Availability | 7.7% | 234 |
| Traveling with Pets | 4.3% | 131 |
| Nearest Available Option | 4.7% | 143 |
| Others | 4.7% | 145 |
| <i>answered question</i> | | 3055 |

When traveling, which is your preferred stop for the following purposes?

| Answer Options | Travel Info Center (Staffed) | Rest Area (Unstaffed) | Private Facility | No Preference | Response Count |
|--------------------------|------------------------------|-----------------------|------------------|---------------|----------------|
| Use Restroom | 2145 | 403 | 157 | 476 | 3181 |
| Short Break | 1559 | 636 | 109 | 660 | 2964 |
| Long Rest | 1006 | 309 | 538 | 752 | 2605 |
| Children Relief | 934 | 276 | 127 | 1139 | 2476 |
| Check Vehicle | 861 | 351 | 407 | 1018 | 2637 |
| Eat a Meal | 720 | 222 | 1023 | 722 | 2687 |
| Pet Relief | 650 | 312 | 64 | 1405 | 2431 |
| <i>answered question</i> | | | | | 3039 |

What is your preferred means of planning your travel?

| Answer Options | Response Percent | Response Count |
|--------------------------|------------------|----------------|
| Maps/Talk to Counselors | 65.0% | 1983 |
| Internet | 50.3% | 1534 |
| Mobile Apps | 22.6% | 691 |
| Others | 2.6% | 80 |
| <i>answered question</i> | | 3051 |

| How have the following influenced your travel plans in the past? | | | | | |
|------------------------------------------------------------------|------------|---------------------|----------------|------------|----------------|
| Answer Options | Influenced | Somewhat Influenced | Not Influenced | Never Used | Response Count |
| Brochure/Map | 1983 | 666 | 116 | 163 | 2928 |
| Internet | 1666 | 614 | 151 | 298 | 2729 |
| Travel Guide/Magazine | 1457 | 813 | 152 | 355 | 2777 |
| Speak to Travel Counselor | 1449 | 576 | 206 | 534 | 2765 |
| Mobile Apps | 975 | 600 | 377 | 596 | 2548 |
| TV/Radio Ads | 514 | 664 | 598 | 741 | 2517 |
| <i>answered question</i> | | | | | 3039 |

| Which Travel Information Center services have you used before? | | |
|----------------------------------------------------------------|------------------|----------------|
| Answer Options | Response Percent | Response Count |
| Texas Map | 77.9% | 2337 |
| Tourist Info/Recommendations | 61.9% | 1859 |
| Travel Plans (Lodging, Food, Gas) | 31.1% | 933 |
| Weather Info | 22.9% | 688 |
| Road Closures/Traffic Conditions | 21.9% | 657 |
| Emergency Travel Conditions Info | 10.4% | 312 |
| Others | 1.3% | 38 |
| <i>answered question</i> | | 3001 |

| Overall, did the services/information offered at the Travel Information Center help your travel plans? | | |
|--------------------------------------------------------------------------------------------------------|------------------|----------------|
| Answer Options | Response Percent | Response Count |
| Yes | 96.5% | 2971 |
| No | 3.5% | 109 |