# THE ECONOMIC IMPACT OF TRAFFIC CRASHES

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# THE ECONOMIC IMPACT OF TRAFFIC CRASHES

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| | |
|---|---|
| AIS | Abbreviated Injury Scale |
| AAA | American Automobile Association |
| DOT | Department of Transportation |
| FARS | Fatality Analysis Reporting System |
| FHWA | Federal Highway Administration |
| GDP | Gross Domestic Product |
| HPMS | Highway Performance Monitoring System |
| ITF | International Transportation Forum |
| LRTP | Long-range Transportation Plan |
| MPO | Metropolitan Planning Organization |
| MSA | Metropolitan Statistical Area |
| MPG | Miles per Gallon |
| NCHRP | National Cooperative Highway Research Program |
| NHTSA | National Highway Traffic Safety Administration |
| PDO | Property Damage Only |
| SCP | Safety conscious planning |
| TTI | Texas Transportation Institute |
| UA | Urbanized Area |
| VSL | Value of a Statistical Life |
| VMT | Vehicle Miles Traveled |

## SUMMARY

Roughly 40,000 people have died each year in traffic accidents in the United States over the past several decades. Although that number has declined in recent years, society as a whole has tolerated that staggeringly high number without much public outcry. By contrast, the rising level of traffic congestion is routinely a topic of public conversation. Because of the high visibility of traffic congestion, decision-makers and politicians tend to focus on congestion relief projects when allocating transportation improvement funds. The Texas Transportation Institute's biennial *Urban Mobility Report*, which attempts to quantify the economic costs of congestion in different metropolitan areas, further highlights the importance of congestion to public decision makers. No comparable report is produced for the economic costs of traffic crashes.

To compare the relative magnitude of the economic costs of congestion versus that of crashes, this research quantifies the economic cost of traffic crashes. In particular, the 2008 cost of crashes was calculated, based on the occurrence of crash-related fatalities and injuries and the economic estimates for the societal burden associated with those events, for 85 of the metropolitan areas studied in the 2009 *Urban Mobility Report*. The results show that, on average, the cost of crashes exceeds the cost of congestion at a rate of over 3 to 1.

This research is based on a previous report commissioned by the American Automobile Association (AAA) Foundation that completed a similar comparison for 2005 data. The findings of that report, although based on more conservative estimates for the societal costs associated with a crash fatality or injury, show similar results.

# CHAPTER 1
# INTRODUCTION

## 1.1 Study Overview

Since 1982, the Texas Transportation Institute (TTI) has been producing the *Urban Mobility Report*, a document that focuses on quantifying the economic costs associated with traffic congestion in different metropolitan areas across the United States. This report is typically met with a significant amount of fanfare and attention [1]. Officials who represent the areas with the “most expensive” congestion problem are put in the precarious situation of the explaining to the general public why the congestion problem is so “out of control” in their city. As such, the *Urban Mobility Report* is an important impetus to push congestion as a main topic of interest for transportation officials.

By contrast, transportation safety, or, more specifically, traffic crashes, rarely receives a similar level of public attention even though the result of a traffic crash can be much more extreme than that for congestion. In addition, traffic crashes are an important contributor to congestion and thus the two cannot always be considered individually isolated events [2]. A 2008 report commissioned by the American Automobile Association (AAA) Foundation used 2005 crash data to estimate the economic cost of traffic crashes relative to traffic congestion for 85 of the metropolitan areas considered for the TTI report. The findings for that report indicated that the cost of traffic crashes far exceeded the cost of congestion at a average of over 2 to 1 [3]. In general, this report showed that the economic cost of traffic congestion is lower than the economic cost of traffic crashes in every metropolitan area considered.

The purpose of this research is to revisit the issue of the economic cost of traffic crashes compared to the economic cost of congestion for the most recent year where data is currently available for each (2008 for traffic crashes and 2007 for congestion). The intent is to determine not only if the relationship between crash and congestion costs remain the same as in the 2008 report, but also if the absolute values have changed in any significant way (accounting for changes in traffic volume, occurrence of crashes, etc.).

This thesis is organized in the following way. Chapter 2 provides a summary of the literature on a variety of safety topics, Chapter 3 outlines the data collection efforts for this research, Chapter 4 presents the methodology used for this research, Chapter 5 presents the analysis and results of this research, Chapter 6 discusses the relationship between transportation safety and transportation planning, and Chapter 7 provides conclusions and recommendations.

# CHAPTER 2
# LITERATURE REVIEW

This chapter summarizes the literature for several areas related to transportation safety.

## 2.1 Economic Cost of Traffic Congestion

Every two years, the Texas Transportation Institute (TTI) produces a report entitled the *Urban Mobility Report*. The purpose of this report is to quantify the economic costs incurred by different urban areas due to traffic congestion. It has been produced biennially since 1982, resulting in a regular snapshot of how congestion is affecting the nation's economy. The basis for this congestion estimate is state-reported data on travel time, speeds, and crashes as report in the Highway Performance Monitoring System (HPMS). From these data items, TTI estimates primarily change in delay and fuel, and applies value of time and value of fuel to arrive at an overall estimate of economic cost.

General findings of the report have found that the annual delay per peak traveler, defined as "the extra time spent traveling at congested speeds rather than free-flow speeds divided by the number of persons making a trip during the peak period" [4], has steadily increased from 1982 to present day, going from 14 hours to 36 hours during that period [4]. Similarly, wasted fuel per peak traveler has risen over the same period from 9 gallons 24 gallons [4]. This rise can be attributed to congestion levels rising not just in a few metropolitan areas, but in practically all areas surveyed. This is shown by there currently being 23 urban areas with 40 or more hours of delay per peak traveler in 2007 compared to just one in 1982 [4].

All of these factors have led to the economic cost of congestion rising from $16.7 billion in 1982 (in 2007 dollars) to $87.2 billion in 2007 [4].

Although the historic trends of traffic congestion have been on the rise since 1982, trends over the last two years show that the rate at which congestion is increasing is slowing or, in some cases, declining. The reasons for this occurrence have been widely speculated, with many attributing the decline to the recent economic downturn. While exact reasons for the reduction in congestion are difficult to prove, later sections of this thesis will discuss different hypotheses that possibly explain this phenomenon.

Overall, it is difficult to overstate the negative effect that congestion has on the nation's economy. In 2007 estimates, congestion result in 2.8 billion gallons of wasted fuel and 4.2 billion hours of wasted time for commuters [4]. Because of the massive costs associated with congestion, congestion relief projects have long been an emphasis for transportation agencies around the country.

## 2.2 Economic Cost of Traffic Crashes

While many agencies are tasked with addressing transportation safety, each approaches the challenge of traffic crashes from a different perspective. For example, transportation officials are often tasked with identifying ways to improve the safety of the overall transportation system. In addition, they are responsible for restoring the system to adequate operation following an incident. By comparison, a police department focuses on enforcing laws and regulations to ensure that users of the transportation system are not put in harm's way by reckless actions or reckless individuals. Lastly, public health officials focus on how to prevent injuries or how to treat injuries when they occur. Although different, each of these perspectives is critical to understanding the breadth of perspectives that can be brought to a discussion of traffic safety's impact on society.

Quantifying the economic cost that traffic crashes have on society has been addressed by a variety of fields over the past several decades. Transportation agencies and professionals have worked independently, and also with other concerned parties, such as public health officials or police departments, to put a dollar amount on traffic crashes. In 2000, the United States Department of Transportation produced a report that identified the societal cost of traffic crashes to communities in the United States. This report determined that, in 2000, the cost came to $230.6 billion [5], or an average of $820 per person. The report utilized a cost estimate for a fatality of $977,000, which is relatively low based on current estimates by the Federal Highway Administration (FHWA) [6]. Another report, produced by the American Automobile Association (AAA) in 2008, produced similar cost estimates, although this report focused on metropolitan areas addressed in the biennial *Urban Mobility Report* produced by the Texas Transportation Institute (TTI) [4]. The AAA report found that the cost of crashes the 85 metropolitan areas studied was, on average, $1,051 per person as compared to $430 per person for congestion [3].

The reports that have focused on the economic cost of crashes, particularly the AAA report that compared the cost of crashes directly to the cost of congestion, raise important issues relating to traffic safety. By providing the general public, as well as decision-makers, with information that frames the issue of traffic safety in monetary terms, safety-related improvements can be better placed in the context of other investment strategies that often relate to such things as economic development, congestion, environmental quality , etc.

## 2.3 Traffic Safety and the Built Environment

Much of the emphasis on improving traffic safety is placed on spot improvements to a particular intersection or stretch of road. New research, however, is focusing on how the built environment may affect the occurrence of traffic crashes. The basic thought is that the physical layout and characteristics of a roadway may have a strong relationship to driver behavior, vehicle speed, and the interaction between vehicles and pedestrians, all of which are factors that can influence the occurrence and severity of crashes. The following section discusses how a compact built environment may have a positive impact on the safety of the transportation system.

### 2.3.1 Compact Built Environment

Recent trends in transportation planning have focused on a more compact built environment. Much of this emphasis has focused on the environmental benefits that this design provides by reducing the amount of vehicle miles traveled (VMT) and the emissions that result from personal vehicle use. Areas that are considered compact generally emphasize mixed-use land-use plans, multiple transportation options for residents, including pedestrian, bicycle, and transit options, and roadway cross sections that cater to all users, not just vehicles.

Some recent studies have examined whether the built environment [7] or vehicle technology [8] can have a greater impact on long-range benefits in combating climate change. However, a recent study found that a compact built environment can also have a positive impact on the safety of the transportation system, not just reducing the emissions from the transportation system [9]. In particular, the relationship between VMT and how it relates to safety has been an important one in safety planning. Intuitively, if drivers spend less time on the road, judged by either miles driven or hours driven, the less likely they are to be in a traffic crash. This is the simple factor of exposure, meaning that the less a person is exposed to something, the less likely it is to affect them.

While the potential for a reduction in VMT is a motivating factor for compact land use advocates, other benefits of a compact built environment are being realized. For one, compact built environments have been observed to reduce the overall speed of traffic flows because of a reduced width of travel lanes and the overall design of the roadway cross-section. In 2008, over 50 percent of fatal accidents in the United States occurred on roadways with a posted speed limit of 55 mph or greater while 11 percent occurred on roadways with a posted speed limit of 30 mph or less [10]. By contrast, roughly 22 percent of all crashes were estimated to have occurred on roadways with a posted speed limit of 55 mph or higher while 25 percent of all crashes occurred on roadways with a posted speed limit of 30 mph or lower [10]. These figures show that crashes that occur on high speed roadways are more likely to be fatal, suggesting that these facilities put users at a greater risk. As such, creating a built environment that encourages vehicles to travel at a slower speed can have a positive impact on the safety of a facility [7].

### 2.4 Trends in Crash Occurrences

For the last several decades, traffic fatalities have held relatively constant at around 40,000 per year in the United States [11]. However, in recent years, that number has begun to decline. The most recent reporting year available, 2008, showed a decline to nearly 36,000 fatalities [10]. Furthermore, early estimates for 2009 fatalities are even lower, with an estimate of 33,963 fatalities [12].

While fatalities only represent a small fraction of all crash occurrences, the data associated with these types of crashes is very reliable because of the extremely high reporting percentage that occurs for fatality crashes. As such, fatality data represents a good indicator of how crash occurrences and rates are changing over time.

Figure 1 below shows how the occurrence and rate of traffic crash-related fatalities in the US have changed over the past several years. As can be seen, both have experienced a decline since 2005.

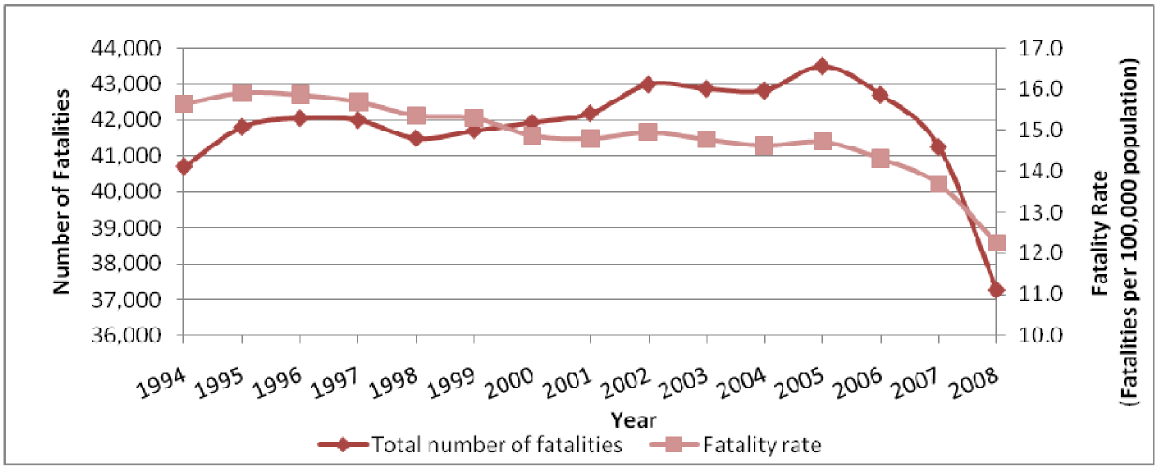



**Figure 1: Trend of the Occurrence of Fatalities and the Fatality Rate in the U.S.**

Source: http://www-fars.nhtsa.dot.gov

### 2.4.1 Causes of Declines in Crash Occurrences

From 2005 to 2008, the total number of fatality accidents in the United States declined from 39,189 to 34,017, a decrease of 13.2% [13]. As mentioned previously, this reduction is symbolic of a downward trend in traffic crashes being observed in the United States. While many hypotheses exist for why this reduction is occurring, little research has been done that unequivocally explains this phenomenon.

A common explanation is the economic downturn that has been evidenced by a declining national VMT figure. This downturn has led many to believe that auto users have altered their driving habits to reduce the overall cost of owning and operating a vehicle. This includes driving slower to improve fuel economy, buying vehicles with a higher average mile per gallon (MPG) rating, and reducing the overall number of miles driven.

In addition to a significant drop in the total number of traffic fatalities in the United States, other interesting trends have emerged that could help explain the phenomenon. First, fatalities on rural principle arterials have dropped by 22.4 percent between 2005 and 2008, from 2,674 to 2,075 [13]. Interestingly, this could be explained by the economy because vacationers could be choosing to stay closer to home, reducing the amount of long-distance travel that would likely utilize these types of facilities. Second, the number of fatal accidents that occurred in construction zones declined by 30.2 percent, from 949 in 2005 to 662 in 2008 [13]. This phenomenon could be explained by a reduction in the number of roadway construction projects that occurred due to the economic climate. Interestingly, however, the number of fatalities involving motorcycles increased from 4,492 to 5,129, an increase of 14.2 percent, over the same period [13]. This could be explained by individuals looking to reduce the amount of money spent on fuel by buying a motorcycle that has a high MPG rating. However, the level of motorcycle use had been increasing in the United States over the past 10 years, especially for middle aged men. Some believe it is this new, relatively inexperienced, motorcycle driver that has resulted in higher motorcycle-related fatalities, they tend not to survive such crashes as compared to similar aged drivers in automobiles [13].

While many explanations exists for why the number of fatal accidents are declining, in reality it is hard to find just one reason that accounts for all the variables involved. Likely, the reduction in crashes is a product of many different factors, including, but not limited to, the recent economic downturn, improved vehicle technology, and driver behavior adjustments.

### 2.4.2 VMT's Role in Fatality Reductions

The rate at which fatalities occur has been declining steadily for a significant period of time [10], steadily dropping from 25.89 fatalities per 100,000 population in 1966 to 12.25 fatalities per 100,000 population in 2008. Similarly, the fatality rate per 100 million vehicle miles traveled drop from 5.50 to 1.25 over the same time period. Most believe that this long term decline in fatalities with increasing VMT is due to the improved survivability of crash victims given new vehicle technology and safety equipment such as air bags and seat belts. However the recent severe drop in the number of fatalities is most likely the result of limited exposure, meaning people are beginning to drive less than in previous periods. Figure 2 below shows how the total estimated VMT for the United States has changed over time.

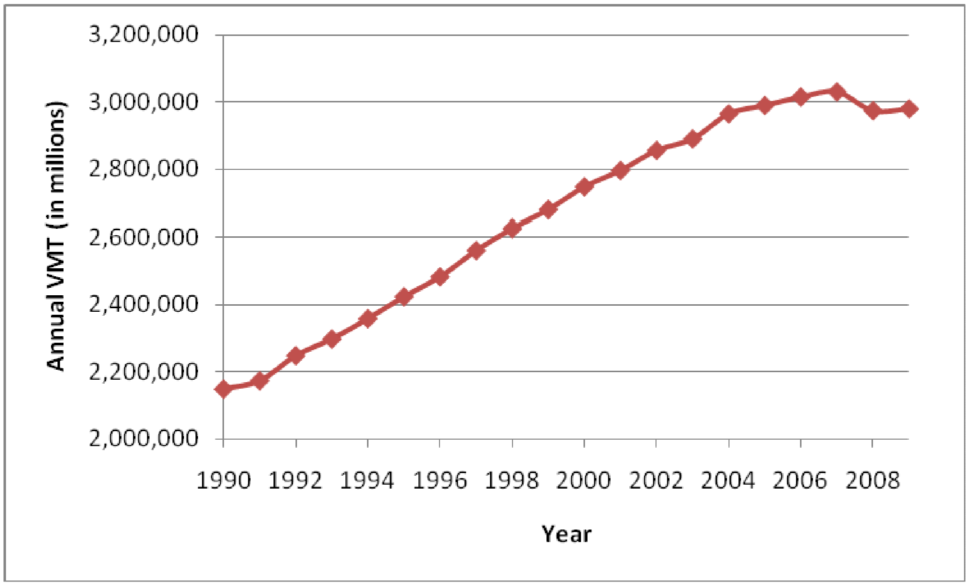



**Figure 2: Trend of Annual VMT in the U.S.**

Source: http://www.fhwa.dot.gov/policyinformation/travel/tvt/history/

As is shown, 2008 reported the first significant decline in VMT ever recorded in the United States outside of war years. This occurrence, when paired with the consistent decline in the fatality rate described early, may be a main reason underlying the large reduction in the gross number of fatalities being observed recently. However, the early estimate for the occurrence of fatalities in 2009 shows another significant decline in the gross number of fatalities while the VMT estimate slightly increases [12].

In general, VMT reduction is likely a significant factor involved in the reduction of traffic fatalities, however it would be difficult to prove that as a fact because of all the variables involved.

### 2.4.3 International Traffic Crash Trends

Outside of the United States, the occurrence of traffic-related fatalities is also trending downward. The 52 member countries of the International Transportation Forum

(ITF), excluding India, reported a combined total of less than 150,000 traffic related deaths occurring in 2008 for the first time ever [14]. This represents a decline of 8.9 percent from 2007 data. In addition, preliminary data for 2009 is showing another significant drop in fatalities of near 10 percent.

While the economic downturn being experienced in the United States has also affected countries around the world, identifying a cause for this trend would be extremely challenging. Each individual country likely has unique factors that affect the occurrence of fatalities within its borders.

# CHAPTER 3
# DATA COLLECTION

This chapter outlines the data collection efforts for this study. The goal of this effort was to acquire the data necessary to compare the economic cost of crashes to the economic cost of congestion. The data related to the congestion costs was based on information provided by the 2009 *Urban Mobility Report*, which uses 2007 congestion data. However, the data needed to calculate the cost of crashes had to be collected. The required data to calculate this cost was the occurrence of fatalities and injuries related to traffic crashes for the areas analyzed. In general, acquiring the traffic fatality data was relatively easy, but acquiring the traffic injury data was more challenging. This is primarily due to the manner in which the different kind of data is stored--fatality data is stored in a national database and injury data is often stored at the state level. As such, different levels of confidence are associated with the consistency of reporting methods for the different types of data.

Data was collected for the 2008 reporting year in most cases. However, when that information was not available, the most recent reporting year available was collected instead. Data other than 2008 was noted in the database when used.

## 3.1 Scope of Data Collection Effort

This study analyzed 85 metropolitan areas included in the *Urban Mobility Report*. Table 1 shows the areas analyzed.

| Table 1: Metropolitan Areas Analyzed | | |
|---|---|---|
| Akron, OH | Detroit-Warren-Livonia, MI | Philadelphia-Camden-Wilmington, PA-NJ-DE-MD |
| Albany-Schenectady-Troy, NY | El Paso, TX | Phoenix-Mesa-Scottsdale, AZ |
| Albuquerque, NM | Eugene-Springfield, OR | Pittsburgh, PA |
| Allentown-Bethlehem-Easton, PA-NJ | Fresno, CA | Portland-Vancouver-Beaverton, OR-WA |
| Anchorage, AK | Grand Rapids-Wyoming, MI | Providence-New Bedford-Fall River, RI-MA |
| Atlanta-Sandy Springs-Marietta, GA | Hartford-West Hartford-East Hartford, CT | Raleigh-Cary, Durham, NC |
| Austin-Round Rock, TX | Honolulu, HI | Richmond, VA |
| Bakersfield, CA | Houston-Baytown-Sugar Land, TX | Riverside-San Bernardino-Ontario, CA |
| Baltimore-Towson, MD | Indianapolis, IN | Rochester, NY |
| Beaumont-Port Arthur, TX | Jacksonville, FL | Sacramento-Arden-Arcade-Roseville, CA |
| Birmingham-Hoover, AL | Kansas City, MO-KS | Salem, OR |
| Boston-Cambridge-Quincy, MA-NH | Laredo, TX | Salt Lake City, UT |
| Boulder, CO | Las Vegas-Paradise, NV | San Antonio, TX |
| Bridgeport-Stamford-Norwalk, CT | Little Rock-North Little Rock, AR | San Diego-Carlsbad-San Marcos, CA |
| Brownsville-Harlingen, TX | Los Angeles-Long Beach-Santa Ana, CA | San Francisco-Oakland-Fremont, CA |
| Buffalo-Cheektowaga-Tonawanda, NY | Louisville, KY-IN | San Jose-Sunnyvale-Santa Clara, CA |
| Cape Coral-Fort Myers, FL | Memphis, TN-MS-AR | Sarasota-Bradenton-Venice, FL |
| Charleston-North Charleston, SC | Miami-Fort Lauderdale-Miami Beach, FL | Seattle-Tacoma-Bellevue, WA |
| Charlotte-Gastonia-Concord, NC-SC | Milwaukee-Waukesha-West Allis, WI | Spokane, WA |
| Chicago-Naperville-Joliet, IL-IN-WI | Minneapolis-St. Paul-Bloomington, MN-WI | Springfield, MA |
| Cincinnati-Middletown, OH-KY-IN | Nashville-Davidson-Murfreesboro, TN | St. Louis, MO-IL |
| Cleveland-Elyria-Mentor, OH | New Haven-Milford, CT | Tampa-St. Petersburg-Clearwater, FL |
| Colorado Springs, CO | New Orleans-Metairie-Kenner, LA | Toledo, OH |
| Columbia, SC | New York-Newark-Edison, NY-NJ-PA | Tucson, AZ |
| Columbus, OH | Oklahoma City, OK | Tulsa, OK |
| Corpus Christi, TX | Omaha-Council Bluffs, NE-IA | Virginia Beach-Norfolk-Newport News, VA-NC |
| Dallas-Fort Worth-Arlington, TX | Orlando, FL | Washington-Arlington-Alexandria, DC-VA-MD-WV |
| Dayton, OH | Oxnard-Thousand Oaks-Ventura, CA | |
| Denver-Aurora, CO | Pensacola-Ferry Pass-Brent, FL | |

### 3.2 Metropolitan Area Boundaries

The congestion data for the *Urban Mobility Report* is based on Urbanized Area (UA) boundaries. These boundaries are defined by the U.S. Census Bureau and based on population density [15]. These boundaries are irregular and do not necessarily follow other established political boundaries, such as county lines. By contrast, aggregated traffic crash data is usually kept, at best, at the county level. This disparity causes a problem when trying to compare the economic costs developed for congestion and crashes. The method used to account for this discrepancy will be addressed in Chapter 4.

This research used the Metropolitan Statistical Area (MSA), which is defined by county boundaries, as the basis for linking crash statistics to metropolitan areas. This definition fits well with the how traffic crash data is kept which is, as noted previously, at the county level. In addition, the MSA boundary was used by the AAA report to calculate the cost of crashes, allowing for comparisons between the results of that report and this research effort.

### 3.3 Fatality Data

The National Highway Traffic Safety Administration (NHTSA) maintains a database of every reported road-related fatality in the U.S. This database, called the Fatality Analysis Reporting System (FARS), can be queried based on a variety of variables related to the crash, including year, travel mode, and, most importantly for this research, location. Because of this feature, collecting fatality data for the 85 metropolitan areas was as simple as setting up a query search for the relevant information.

Fatality data from each state was queried at the county level. These queries resulted in a raw data set for each state. These data sets were then imported into

Microsoft Excel and aggregated based on the defined MSAs for each metropolitan area. In many cases, the MSAs crossed state lines, requiring information from two or more queries of the FARS database. MSA definitions for each metropolitan area can be found in Appendix A.

From this collection effort, fatality data for all 85 metropolitan areas for the 2008 reporting year was compiled. The raw data can be seen in Table 2.

### 3.4 Injury Data

Unlike fatality data, no national database exists for injury data. As such, the data collection effort was more difficult for road-related injuries. In all cases, an effort was made to obtain crash data for the 2008 reporting year, however, that was not always possible. For the following states, 2007 data was the most recent available:

- Arkansas
- Maryland
- New Mexico
- New York
- North Carolina
- South Carolina
- Tennessee
- Utah

In the case of Colorado, 2005 was the most recent reporting year available. Also, injury crash data was not available for Hawaii, Rhode Island, and Washington, DC. A detailed account of the data collection efforts is outlined in a following section. Injury data for the metropolitan dataset is shown in Table 2.

| Table 2: Crash Statistics by Metropolitan Area, 2008 | | |
|---|---|---|
| **Metropolitan Area** | **Total No. Fatalities** | **Total No. Injuries** |
| Akron, OH | 48 | 6,861 |
| Albany-Schenectady-Troy, NY | 57 | 7,856[5] |
| Albuquerque, NM | 96 | 9,742[4] |
| Allentown-Bethlehem-Easton, PA-NJ | 86 | 6,605 |
| Anchorage, AK | 33 | 1,998 |
| Atlanta-Sandy Springs-Marietta, GA | 604 | 63,027 |
| Austin-Round Rock, TX | 198 | 16,383 |
| Bakersfield, CA | 115 | 5,338 |
| Baltimore-Towson, MD | 243 | 25,402[3] |
| Beaumont-Port Arthur, TX | 99 | 5,051 |
| Birmingham-Hoover, AL | 195 | 7,428 |
| Boston-Cambridge-Quincy, MA-NH | 226 | 14,696 |
| Boulder, CO | 23 | 2,589[2] |
| Bridgeport-Stamford-Norwalk, CT | 46 | 9,501 |
| Brownsville-Harlingen, TX | 38 | 4,116 |
| Buffalo-Cheektowaga-Tonawanda, NY | 84 | 12,094[5] |
| Cape Coral-Fort Myers, FL | 77 | 4,551 |
| Charleston-North Charleston, SC | 125 | 7,593[7] |
| Charlotte-Gastonia-Concord, NC-SC | 176 | 24,050[6,7] |
| Chicago-Naperville-Joliet, IL-IN-WI | 595 | 70,472 |
| Cincinnati-Middletown, OH-KY-IN | 192 | 19,216 |
| Cleveland-Elyria-Mentor, OH | 170 | 19,032 |
| Colorado Springs, CO | 49 | 5,847[2] |
| Columbia, SC | 133 | 8,096[7] |
| Columbus, OH | 173 | 18,278 |
| Corpus Christi, TX | 40 | 4,872 |
| Dallas-Fort Worth-Arlington, TX | 546 | 53,965 |
| Dayton, OH | 74 | 7,714 |
| Denver-Aurora, CO | 203 | 21,069[2] |
| Detroit-Warren-Livonia, MI | 298 | 32,954 |

| Table 2: Crash Statistics by Metropolitan Area, 2008 | | |
|---|---|---|
| Metropolitan Area | Total No. Fatalities | Total No. Injuries |
| El Paso, TX | 63 | 6,599 |
| Eugene-Springfield, OR | 33 | 2,155 |
| Fresno, CA | 138 | 5,200 |
| Grand Rapids-Wyoming, MI | 79 | 5,700 |
| Hartford-West Hartford-East Hartford, CT | 86 | 12,564 |
| Honolulu, HI | 43 | - |
| Houston-Baytown-Sugar Land, TX | 603 | 55,053 |
| Indianapolis, IN | 178 | 12,448 |
| Jacksonville, FL | 207 | 14,447 |
| Kansas City, MO-KS | 225 | 16,477 |
| Laredo, TX | 27 | 2,335 |
| Las Vegas-Paradise, NV | 201 | 23,150 |
| Little Rock-North Little Rock, AR | 122 | 13,007[1] |
| Los Angeles-Long Beach-Santa Ana, CA | 874 | 93,784 |
| Louisville, KY-IN | 165 | 11,510 |
| Memphis, TN-MS-AR | 193 | 16,116[1,8] |
| Miami-Fort Lauderdale-Miami Beach, FL | 694 | 61,661 |
| Milwaukee-Waukesha-West Allis, WI | 86 | 14,292 |
| Minneapolis-St. Paul-Bloomington, MN-WI | 193 | 20,747 |
| Nashville-Davidson-Murfreesboro, TN | 230 | 19,083[7] |
| New Haven-Milford, CT | 76 | 9,826 |
| New Orleans-Metairie-Kenner, LA | 145 | 18,459 |
| New York-Newark-Edison, NY-NJ-PA | 992 | 195,813[5] |
| Oklahoma City, OK | 154 | 13,355 |
| Omaha-Council Bluffs, NE-IA | 67 | 7,960 |
| Orlando, FL | 328 | 21,969 |
| Oxnard-Thousand Oaks-Ventura, CA | 76 | 5,280 |
| Pensacola-Ferry Pass-Brent, FL | 78 | 5,831 |
| Philadelphia-Camden-Wilmington, PA-NJ-DE-MD | 456 | 47,857[3] |
| Phoenix-Mesa-Scottsdale, AZ | 449 | 37,185 |
| Pittsburgh, PA | 242 | 14,747 |
| Portland-Vancouver-Beaverton, OR-WA | 127 | 15,152 |

| Table 2: Crash Statistics by Metropolitan Area, 2008 | | |
|---|---|---|
| **Metropolitan Area** | **Total No. Fatalities** | **Total No. Injuries** |
| Providence-New Bedford-Fall River, RI-MA | 108 | - |
| Raleigh-Cary, Durham, NC | 123 | 12,481[6] |
| Richmond, VA | 150 | 12,490 |
| Riverside-San Bernardino-Ontario, CA | 546 | 25,136 |
| Rochester, NY | 70 | 9,350[5] |
| Sacramento-Arden-Arcade-Roseville, CA | 169 | 15,254 |
| Salem, OR | 39 | 3,002 |
| Salt Lake City, UT | 91 | 12,166[8] |
| San Antonio, TX | 221 | 25,453 |
| San Diego-Carlsbad-San Marcos, CA | 263 | 19,051 |
| San Francisco-Oakland-Fremont, CA | 225 | 23,552 |
| San Jose-Sunnyvale-Santa Clara, CA | 106 | 9,368 |
| Sarasota-Bradenton-Venice, FL | 96 | 5,763 |
| Seattle-Tacoma-Bellevue, WA | 200 | 23,555 |
| Spokane, WA | 22 | 3,050 |
| Springfield, MA | 44 | 2,328 |
| St. Louis, MO-IL | 308 | 23,056 |
| Tampa-St. Petersburg-Clearwater, FL | 421 | 36,312 |
| Toledo, OH | 70 | 7,603 |
| Tucson, AZ | 137 | 9,317 |
| Tulsa, OK | 143 | 10,688 |
| Virginia Beach-Norfolk-Newport News, VA-NC | 153 | 14,515[6] |
| Washington-Arlington-Alexandria, DC-VA-MD-WV | 392 | 38,032[3,9] |

Notes: "-" indicates that data is not available
[1]2007 injury data used for Arkansas counties
[2]2006 injury data used for Colorado counties
[3]2007 injury data used for Maryland counties
[4]2007 injury data used for New Mexico counties
[5]2007 injury data used for New York counties
[6]2007 injury data used for North Carolina counties
[7]2007 injury data used for South Carolina counties
[8]2007 injury data used for Tennessee counties
[9]Does not include data for Jefferson County, WV and Washington, DC city limits

### 3.4.1 Crash Data Reports

In most cases, crash injury data is stored at the state level, usually with the state Department of Transportation. In addition, most states produce an annual report on the occurrence of traffic crashes within the state. The scope, format, and availability of these reports vary widely between states. In many cases, these reports were available online. However, not all crash data reports contained complete injury data at the county level. For example, some crash reports included the number of injury crashes that occurred at the county level, but did not contain the number of persons injured. For the purposes of this research, the number of persons injured is required. As such, further inquiries about crash data were needed for several states.

### 3.4.2 Phone or Email Efforts

When crash data reports were either not available, not current (i.e., for a year prior to 2008), or did not contain the required information, an effort was made to contact a technical resource in the respective state. In some cases, this contact person was able to provide an updated crash data report or provide the requested information directly. In other cases, crash data for a year prior to 2008 was provided because later years had not yet been summarized.

The injury crash data used for this research came from a variety of sources, not just state DOTs. For example, in some states this data was found by speaking with the Governor's Office of Transportation Safety, the State Police, or a local university, to name a few. In general, it was found that while the majority of states store crash data with the state DOT, this is far from a uniform practice. Because of this, obtaining injury crash data for all 85 metropolitan areas became a daunting task that took several months and countless phone calls and emails. The sources of the crash data used for each state can be found in Appendix C.

In the end, injury crash data was found for 83 of the 85 metropolitan areas considered. Crash data was not successfully obtained for Providence, RI and Honolulu, HI. In the case of Providence, RI, the Rhode Island DOT was unable to release the crash data without extensive review by their legal department. In the case of Honolulu, HI, successful contact with the appropriate agency officials was not accomplished in time for this thesis. Also, an incomplete injury data set for the Washington DC MSA was compiled with data missing from Jackson County, WV and Washington DC. However, injury data for the other 20 counties in the Washington DC MSA was found. As such, Washington DC was included in the study. However, all relevant analysis will note this incomplete data set.

### 3.5 Property Damage Only Data

Like injury crash data, no national database exists that summarizes property damage only (PDO) data. As such, the data collection effort to obtain PDO crash information for the 85 metropolitan areas would be substantial. Due to assumed limitations in the PDO data and the relatively low economic costs associated with these types of crashes, PDO crash data was not collected or included in this research.

### 3.6 Confidence in Data

No standard methods exist for collecting and reporting traffic crash data. As a result, the consistency that exists in data collection methods between different states or jurisdictions is unknown. The potential differences or discrepancies are outlined below.

First, crash data is only as good as the agencies or individuals charged with producing that data. This means that individual police officers that respond to a traffic crash and produce a crash report is solely responsible for the quality of data related to that crash. Any omissions, errors, or oversight by the reporting officer amounts to an incomplete data set.

Second, traffic crash reporting is an inexact science as best. For example, an officer will likely report a crash as an injury crash if obvious signs of injury are present at the scene. However, if a person involved in the crash develops signs of an injury related to the crash in the days or weeks following the crash, the crash record might not be updated to reflect that. Furthermore, the severity of an injury is somewhat of a judgment call, particularly for officers who are not trained extensively in that area. These examples and others highlight some of the areas where crash statistics can be flawed.

Third, the accuracy of crash statistics faces the problem of crashes going unreported. It is estimated that roughly 50 percent of PDO crashes and 21 percent of injury crashes go unreported. [5]. These estimates represent a significant gap in the data set. Based on 2008 national crash data, that means that roughly 400,000 injury crashes and 4 million PDO crashes went unreported [10]. However, a high level of confidence can be had in the accuracy of reporting related to fatality crash occurrence. This is due to the significance of the event when a fatality occurs. These crashes generally result in an in-depth investigation and review. As such, it can be assumed that few fatality crashes go unreported.

Lastly, state reporting methods for what constitutes an injury crash is another area where discrepancies can arise. In general, states classify injuries as incapacitating, non-incapacitating, or possible injury. When reporting aggregated injury numbers, however, some states may include possible injuries in the total number of injuries whereas others do not. By leaving these out, a state could artificially reduce the number of injuries that appear to occur within its borders. Further investigation into the reporting methods of each state would need to be conducted to verify the consistency related to this issue.

In general, crash data is widely known to have significant limitations and flaws. For that reason, this research attempts to outline those limitations when applicable and take a conservative approach on reporting the occurrence of crashes for different jurisdictions.

# CHAPTER 4
# METHODOLOGY

This chapter outlines the methodology used for this research. Specifically, the methods used to calculate the economic cost of traffic crashes will be discussed. In addition, the methods used to compare the economic cost of traffic crashes to the economic cost of traffic congestion will be outlined.

## 4.1 Gross Calculation Method

To calculate the economic cost of traffic crashes, two factors will be considered, the number of fatalities and the number of injuries that occur as a result of traffic crashes in a given MSA. As noted previously, the occurrence of PDO crashes has been excluded from this study because of the low confidence in the completeness of the data set and the relatively low economic costs associated with these crashes. In addition, by excluding crashes of this type, the overall cost estimate can be assumed to be more conservative, meaning the actual cost of crashes is higher than the value being reported.

A simple equation is used to estimate the gross economic cost of traffic crashes. This equation is shown below. The Value of a Statistical Life (VSL) and the cost of injury estimate are described later in this chapter.

$$\text{Cost of crashes} = \text{Total number of fatalities} \times VSL + \text{Total Number of injuries} \times \text{Cost of injury estimate}$$

## 4.2 Value of a Statistical Life

Periodically, the FHWA develops guidance for an appropriate estimate for the VSL. The VSL is a figure used to estimate the economic costs to society when a person is killed as a result of a traffic crash. This estimate is a generalized number that attempts to take into account a variety of factors including medical costs, repair costs, nonrecurring congestion, and lost productivity, to name a few. A guidance memorandum from the FHWA describes the VSL as, "the value of improvements in safety that result in a reduction by one in the expected number of fatalities." [6]

### 4.2.1 History of VSL

In January 1993, the FHWA adopted the guidance memorandum, "Treatment of Value of Life and Injuries in Preparing Economic Evaluations" [16]. This document outlined the procedures that should be used to estimate the economic cost of traffic crashes. At the time, the VSL was estimated to be $2.5 million. This meant that any time a person was killed as a result of a traffic crash, the economic cost to society of that event was assumed to be $2.5 million. In subsequent years, the FHWA has periodically issued updates to this estimate based on the implicit gross domestic product (GDP) price deflator. Table 3 shows how the VSL estimate changed over time.

**Table 3: VSL Estimate Over Time**

| Year | Value |
|---|---|
| 1993 | $2.5 million[1] |
| 2002 | $3.0 million[1] |
| 2006 | $3.25 million[2] |

Source: [1]"Treatment of the Economic Value of a Statistical Life in Departmental Analyses Report," 2008.
[2]Cambridge Systematics and M.D. Meyer, "Crashes vs Congestion – What's the Cost to Society?," 2008.

However, the updating method used by the FHWA to adjust the 1993 value was found to be underestimating the VSL for two major reasons. First, the implicit GDP price deflator was found not to be an accurate way to adjust for the change in cost over time [6], resulting in a downward bias trend. Second, the previous estimate did not account for the rising income of US households and that as people grow richer, they become more willing to pay for safety. As such, the change in the VSL estimate could very well differ between income classes more or less than it does for the country as a whole [6], making simplified adjustments less meaningful.

### 4.2.2 Updated VSL Estimate

In 2008, rather than simply increasing the 1993 estimate incrementally, the FHWA revisited the issue of the VSL. Upon review, it was determined that a new estimate should be made based on recent research. In particular, the review considered five independent studies that had been completed between 2000 and 2004. Each of these studies developed an estimate for what the appropriate VSL estimate should be. Table 4 shows these studies and the VSL values that each developed.

**Table 4: VSL Estimates**

| Study | Year Completed | VSL Estimate |
|---|---|---|
| Mrozek and Taylor [17] | 2000 | $2.6 million |
| Miller [18] | 2000 | $5.2 million |
| Viscusi [19] | 2004 | $6.1 million |
| Kochi et al. [20] | 2003 | $6.6 million |
| Viscusi and Aldy [21] | 2003 | $8.5 million |

Note: Values from each study have been adjusted to 2007 dollars.

Source: "Treatment of the Economic Value of a Statistical Life in Departmental Analyses Report," 2008.

As can be seen by the values shown, little consensus existed as to an appropriate estimate for the VSL value. To determine a value for FHWA studies, the agency simply took the average of the five studies, resulting in a VSL estimate of $5.8 million, although the corresponding guidance did recommend that analyses do a sensitivity analysis with both a higher and lower value.

## 4.3 Estimating the Value of Preventing an Injury

While several studies have been conducted to estimate an appropriate VSL, few, if any, have been conducted recently that focus on the value of preventing an injury related to a traffic crash. This is likely for several reasons. First, injuries demand less attention than fatalities because they are assumed to be a less significant event. Because of the rarity of fatalities and the extreme consequences of their occurrence, the effects of those crashes seem to be studied more. Second, it is extremely difficult to estimate the economic costs associated with injury crashes because of the wide range of injuries that could occur. An injury could range from a minor bruise to a life threatening event. As such, capturing the economic costs of these events in one, or even several, generalized estimates is extremely difficult. Lastly, as mentioned previously, the likelihood that an injury crash is reported is roughly 80 percent, leaving the researcher with the task of accounting for the uncertainty that exists in the available data sets.

### 4.3.1 Abbreviated Injury Scale

In the original 1993 FHWA study, an injury scale, called the Abbreviated Injury Scale (AIS), was adopted that based the costs associated with different types of injuries on a percentage of the assumed VSL estimate. This scale can be seen in Table 5.

| Table 5: Relative Disutility Factors by Injury Severity Level | | |
|---|---|---|
| **AIS Level** | **Severity** | **Fraction of VSL** |
| AIS 1 | Minor | 0.0020 |
| AIS 2 | Moderate | 0.0155 |
| AIS 3 | Serious | 0.0575 |
| AIS 4 | Severe | 0.1875 |
| AIS 5 | Critical | 0.7625 |
| AIS 6 | Fatal | 1.0000 |
| Source: "Treatment of the Economic Value of a Statistical Life in Departmental Analyses Report," 2008. | | |

Because of the lack of data to update these values, the FHWA has issued guidance that this scale should be applied to the updated VSL estimate when considering the costs associated with injuries.

The estimates presented in this scale present several challenges. Most notably, as part of this research, no states were found that kept injury data at this level of detail. Rather, most states, at best, keep injury data in three categories, incapacitating injury, non-incapacitating injury, and possible injury. While these categories do an adequate job of summarizing the types of injuries that occur within a given jurisdiction, they do not fall easily into the AIS scale outlined above. Because of this, estimating the costs associated with injuries becomes a challenging task.

This challenge is further exacerbated by the limited data that exists for injury crashes. While some states maintain a crash database that classifies crashes into three categories, many only publish the occurrence of uncategorized injuries. This reality creates the need for a singular generalized estimate for injuries. The procedure used to develop this estimate can be found in the following section.

### 4.3.2 Cost of Injury Estimating Procedure

Due to the lack of detailed crash data, a procedure was developed to create a generalized estimate for the costs associated with the occurrence of injuries related to traffic crashes.

First, the estimates for the occurrence of injuries based on the AIS scale needed to be developed. This was done by observing the occurrence of incapacitating, non-incapacitating, and possible injury crashes in several states. The findings of this analysis are displayed in Table 6.

**Table 6: Injury Severity Analysis**

| State | Injury Type | | |
|---|---|---|---|
| | **Incapacitating** | **Non-Incapacitating** | **Possible Injury** |
| Arizona | 5,330<br>(10%) | 19,672<br>(35%) | 31,007<br>(55%) |
| Florida | 23,758<br>(12%) | 64,883<br>(32%) | 111,016<br>(56%) |
| Kentucky | 4,620<br>(12%) | 13,351<br>(36%) | 19,520<br>(52%) |
| Massachusetts | 3,983<br>(8%) | 18,806<br>(40%) | 24,703<br>(52%) |
| **Average** | **10%** | **36%** | **54%** |

Source: 2008 state crash reports

As can be seen by table above, the split between incapacitating, non-incapacitating, and possible injury crashes was found to be very similar between the four states observed. Specifically, the average occurrence of incapacitating injuries was found to be 10 percent, the average occurrence of non-incapacitating injuries was found to be

36 percent, and the average occurrence of possible injuries was found to be 54 percent. These estimates are using 2008 statewide crash data.

Now that the average occurrence of these crashes has been estimated, the same needs to be done for the AIS scale. As stated before, crash data could not be located that is kept at the level of detail contained in the AIS scaled structure. However, assumptions were made to apply the data found in Table 6 to estimate the occurrence of each AIS severity level. Those assumptions can be found in Table 7 below.

**Table 7: Relative Disutility Factors by Injury Severity Level**

| Injury Type | AIS Level | Severity | Fraction of VSL[1] | Subdivision Weight[2] | Economic Costs |
|---|---|---|---|---|---|
| Possible Injury | AIS 1 | Minor | 0.0020 | N/A | $11,600 |
| Non-Incapacitating | AIS 2 | Moderate | 0.0155 | N/A | $89,000 |
| Incapacitating | AIS 3 | Serious | 0.0575 | 0.73 | $718,792 |
| | AIS 4 | Severe | 0.1875 | 0.21 | |
| | AIS 5 | Critical | 0.7625 | 0.06 | |

Notes: VSL = $5,800,000

Source: [1]"Treatment of the Economic Value of a Statistical Life in Departmental Analyses Report," 2008.
[2] National Highway Traffic Safety Administration, *Early Estimates of Motor Vehicle Traffic Fatalities in 2009*, Washington, DC: 2010

As can be seen by the Table above, incapacitating injuries were assumed to describe AIS levels 3, 4, and 5. Because no current data could be found to describe the proportional occurrence of these three levels, data from the report *Economic Impact of Crashes* that was completed in 2000 by the National Highway Traffic Safety Administration (NHTSA) [5], was used. In that study, it was found that 125,903 reported and unreported injuries occurred at AIS level 3, 36,509 reported and unreported injuries occurred at AIS level 4, and 9,463 reported and unreported injuries occurred at AIS level 5. This data is based on occurrences in the U.S. during 2000.

The economic cost shown in Table 7 for each injury type is calculated by multiplying the assumed VSL by the Fraction of VSL value for each (the Fraction of VSL value comes from the original AIS scale). In the case of incapacitating injury, the resultant economic costs of the three AIS levels contained in that category are weighted by the occurrence of crashes found in the *Economic Impact of Crashes* discussed earlier. The economic costs assumed from this process is $11,600 for possible injury crashes, $89,000 for non-incapacitating crashes, and $718,792 for incapacitating crashes.

These values are then weighted based on the state level data discussed earlier. This procedure can be seen in Table 8 below.

**Table 8: Relative Disutility Factors by Injury Severity Level**

| Injury Type | Economic Costs | Weight Factor[1] | Aggregated Cost of Injury |
|---|---|---|---|
| Possible Injury | $11,600 | 0.538 | $114,036 |
| Non-Incapacitating | $89,000 | 0.357 | |
| Incapacitating | $718,792 | 0.105 | |

Notes: [1]Weight factor is based on observed injury split of 2008 data for four states (AZ, FL, KY, .MA)

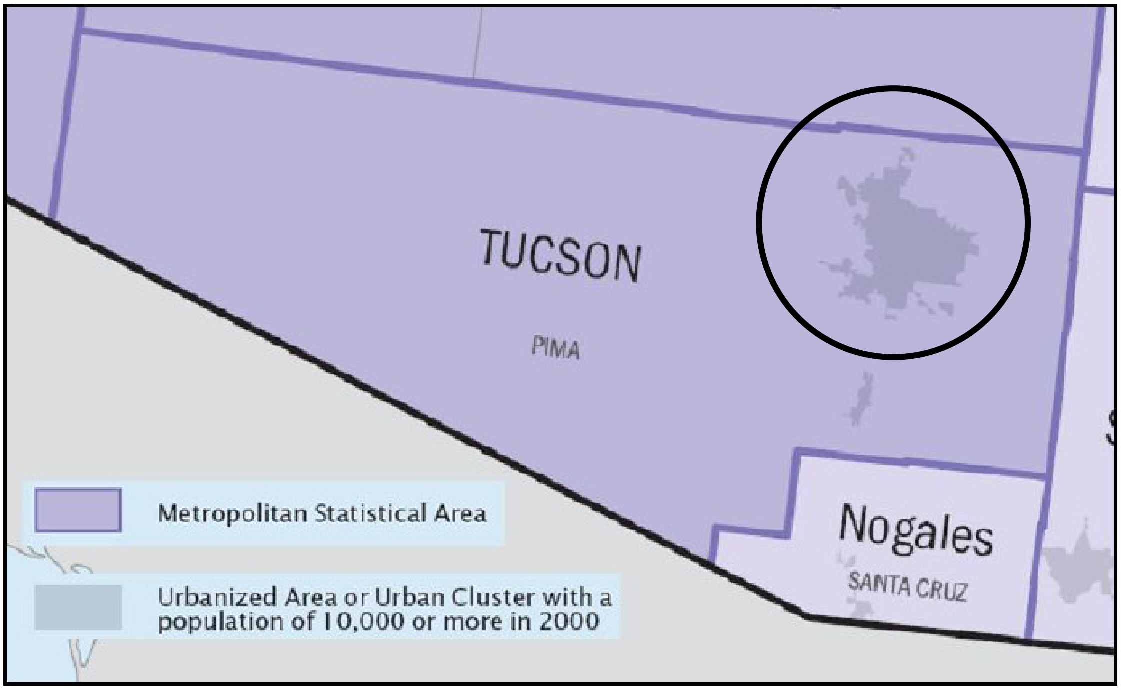
As can be seen in Table 8, the assumed total aggregated cost of an injury is $114,036. This value, as described above, accounts for the variation in injury severity. This value will be applied the total number of injuries that were found to occur in each MSA area.

### 4.4 Comparing the Cost of Crashes to the Cost of Congestion

As noted earlier, the cost of crashes cannot be directly compared to the cost of traffic congestion because of inconsistent boundaries for each calculation. That issue, and the method developed for accounting for that issue, is described in the following sections.

#### 4.4.1 Inconsistent Boundary Issue

The study that calculates the cost of congestion for different metropolitan areas does so based on an Urbanized Area (UA) boundary. The UA boundary is an area defined by the United States Census Bureau that does not necessarily follow any other predefined boundaries. This research effort, which is looking at the cost of crashes for different metropolitan areas, does so based on the Metropolitan Statistical Area (MSA) boundary for each area. This boundary was chosen because these areas are defined based on county boundaries. This is useful because crash data can be consistently found aggregated on the county level. Given that this boundary is different from the UA boundary described above, a process needed to be created so that data from the two studies could be compared. Figure 3 below shows the UA versus MSA boundary discrepancy issue visually for the Tucson, AZ area. This example was previously used in the AAA report [3].




Source: U.S. Bureau of the Census, 2008.

**Figure 3: MSA vs UA for Tucson, AZ**

In the figure above, the black circle highlights the shaded area that represents the UA boundary for the Tucson area. However, the MSA area for Tucson is defined by Pima County, whose boundary is shown to be much broader [3]

### 4.4.2 Normalizing Economic Estimates

To account for the boundary discrepancies that were described above, a normalization procedure was developed to make the results of the two studies comparable. This is done by dividing the total estimated economic cost for congestion and crashes by the appropriate population estimate for each boundary area. This will produce a cost per person estimate for each that can be compared against the other for relative magnitude.

# CHAPTER 5
# ANALYSIS AND RESULTS

This chapter describes the analysis and subsequent results of this research. Specifically, the cost of crashes for the different metropolitan areas analyzed for this study will be presented as well as generalized cost estimates based on population size categories and other metrics. In addition, the cost of congestion for each of the analyzed areas will be presented for comparison purposes.

## 5.1 Cost of Crashes by Metropolitan Area Size

Tables 9 to 12 show the total cost of crashes for each metropolitan area organized by metropolitan area size. The population size categories are as follows:

- Small – Less than 500,000
- Medium – 500,000 to 1,000,000
- Large – 1,000,000 to 3,000,000
- Very Large – Greater than 3,000,000

The metropolitan areas have been placed into the same size categories as they were for the original AAA study for comparison purposes. The original category placements in that study were based upon the estimated UA boundary population used in the *Urban Mobility Report* that year. Given that MSA's define a larger area and populations have likely grown in the different metropolitan areas since the previous study, a metropolitan area's current population listed below may fall outside of the above criteria.

| Table 9: Small Metropolitan Areas Cost of Crashes Estimates | | | |
|---|---|---|---|
| Metropolitan Area | Population[1] | Cost of Crashes Estimate | Cost per Person |
| Anchorage, AK | 364,701 | $419,243,928 | $1,150 |
| Bakersfield, CA | 800,458 | $1,275,724,168 | $1,594 |
| Beaumont-Port Arthur, TX | 378,255 | $1,150,195,836 | $3,041 |
| Boulder, CO | 293,161 | $428,639,204 | $1,462 |
| Brownsville-Harlingen, TX | 392,736 | $689,772,176 | $1,756 |
| Cape Coral-Fort Myers, FL | 593,136 | $965,577,836 | $1,628 |
| Charleston-North Charleston, SC | 644,506 | $1,590,875,348 | $2,468 |
| Colorado Springs, CO | 617,714 | $950,968,492 | $1,539 |
| Columbia, SC | 728,063 | $1,694,635,456 | $2,328 |
| Corpus Christi, TX | 415,376 | $787,583,392 | $1,896 |
| Eugene-Springfield, OR | 346,560 | $437,147,580 | $1,261 |
| Laredo, TX | 236,941 | $422,874,060 | $1,785 |
| Little Rock-North Little Rock, AR | 675,069 | $2,190,866,252 | $3,245 |
| Pensacola-Ferry Pass-Brent, FL | 452,992 | $1,117,343,916 | $2,467 |
| Salem, OR | 391,680 | $568,536,072 | $1,452 |
| Spokane, WA | 462,677 | $475,409,800 | $1,028 |
| Notes: [1]2008 estimate based on MSA boundary | | | |

| Table 10: Medium Metropolitan Areas Cost of Crashes Estimates | | | |
|---|---|---|---|
| **Metropolitan Area** | **Population[1]** | **Cost of Crashes Estimate** | **Cost per Person** |
| Akron, OH | 698,553 | $1,060,800,996 | $1,519 |
| Albany-Schenectady-Troy, NY | 853,919 | $1,226,466,816 | $1,436 |
| Albuquerque, NM | 845,913 | $1,667,738,712 | $1,972 |
| Allentown-Bethlehem-Easton, PA-NJ | 808,210 | $1,252,007,780 | $1,549 |
| Austin-Round Rock, TX | 1,652,602 | $3,016,651,788 | $1,825 |
| Birmingham-Hoover, AL | 1,117,608 | $1,978,059,408 | $1,770 |
| Bridgeport-Stamford-Norwalk, CT | 895,030 | $1,350,256,036 | $1,509 |
| Charlotte-Gastonia-Concord, NC-SC | 1,701,799 | $3,763,365,800 | $2,211 |
| Dayton, OH | 836,544 | $1,308,873,704 | $1,565 |
| El Paso, TX | 742,062 | $1,117,923,564 | $1,507 |
| Fresno, CA | 909,153 | $1,393,387,200 | $1,533 |
| Grand Rapids-Wyoming, MI | 776,833 | $1,108,205,200 | $1,427 |
| Hartford-West Hartford-East Hartford, CT | 1,190,512 | $1,931,548,304 | $1,622 |
| Honolulu, HI[2] | - | - | - |
| Jacksonville, FL | 1,313,228 | $2,848,078,092 | $2,169 |
| Louisville, KY-IN | 1,244,696 | $2,269,554,360 | $1,823 |
| Nashville-Davidson-Murfreesboro, TN | 1,550,733 | $3,510,148,988 | $2,264 |
| New Haven-Milford, CT | 846,101 | $1,561,317,736 | $1,845 |
| Oklahoma City, OK | 1,206,142 | $2,416,150,780 | $2,003 |
| Omaha-Council Bluffs, NE-IA | 837,925 | $1,296,326,560 | $1,547 |
| Oxnard-Thousand Oaks-Ventura, CA | 797,740 | $1,042,910,080 | $1,307 |
| Raleigh-Cary, Durham, NC | 1,088,765 | $2,136,683,316 | $1,962 |
| Richmond, VA | 1,225,626 | $2,294,309,640 | $1,872 |

| Table 10: Medium Metropolitan Areas Cost of Crashes Estimates | | | |
|---|---|---|---|
| **Metropolitan Area** | **Population[1]** | **Cost of Crashes Estimate** | **Cost per Person** |
| Rochester, NY | 1,034,090 | $1,472,236,600 | $1,424 |
| Salt Lake City, UT | 1,115,692 | $1,915,161,976 | $1,717 |
| Sarasota-Bradenton-Venice, FL | 687,823 | $1,213,989,468 | $1,765 |
| Springfield, MA | 687,558 | $520,675,808 | $757 |
| Toledo, OH | 649,104 | $1,273,015,708 | $1,961 |
| Tucson, AZ | 1,012,018 | $1,857,073,412 | $1,835 |
| Tulsa, OK | 916,079 | $2,045,936,048 | $2,233 |
| Notes: [1]2008 estimate based on MSA boundary<br>[2]Data not available for Honolulu, HI | | | |

| Table 11: Large Metropolitan Areas Cost of Crashes Estimates | | | |
|---|---|---|---|
| Metropolitan Area | Population[1] | Cost of Crashes Estimate | Cost per Person |
| Baltimore-Towson, MD | 2,667,117 | $4,306,142,472 | $1,615 |
| Buffalo-Cheektowaga-Tonawanda, NY | 1,124,309 | $1,866,351,384 | $1,660 |
| Cincinnati-Middletown, OH-KY-IN | 2,155,137 | $3,304,915,776 | $1,534 |
| Cleveland-Elyria-Mentor, OH | 2,088,291 | $3,156,333,152 | $1,511 |
| Columbus, OH | 1,773,120 | $3,087,750,008 | $1,741 |
| Denver-Aurora, CO | 2,506,626 | $3,580,024,484 | $1,428 |
| Indianapolis, IN | 1,715,459 | $2,451,920,128 | $1,429 |
| Kansas City, MO-KS | 2,002,047 | $3,183,971,172 | $1,590 |
| Las Vegas-Paradise, NV | 1,865,746 | $3,805,733,400 | $2,040 |
| Memphis, TN-MS-AR | 1,285,732 | $2,957,204,176 | $2,300 |
| Milwaukee-Waukesha-West Allis, WI | 1,549,308 | $2,128,602,512 | $1,374 |
| Minneapolis-St. Paul-Bloomington, MN-WI | 3,229,878 | $3,485,304,892 | $1,079 |
| New Orleans-Metairie-Kenner, LA | 1,134,029 | $2,945,990,524 | $2,598 |
| Orlando, FL | 2,054,574 | $4,407,656,884 | $2,145 |
| Pittsburgh, PA | 2,351,192 | $3,085,288,892 | $1,312 |
| Portland-Vancouver-Beaverton, OR-WA | 2,207,462 | $2,464,473,472 | $1,116 |
| Providence-New Bedford-Fall River, RI-MA[2] | - | - | - |
| Riverside-San Bernardino-Ontario, CA | 4,115,871 | $6,033,208,896 | $1,466 |
| Sacramento-Arden-Arcade-Roseville, CA | 2,109,832 | $2,719,705,144 | $1,289 |
| San Antonio, TX | 2,031,445 | $4,184,358,308 | $2,060 |
| San Diego-Carlsbad-San Marcos, CA | 3,001,072 | $3,697,899,836 | $1,232 |
| San Jose-Sunnyvale-Santa Clara, CA | 1,819,198 | $1,683,089,248 | $925 |

| Table 11: Large Metropolitan Areas Cost of Crashes Estimates | | | |
|---|---|---|---|
| **Metropolitan Area** | **Population[1]** | **Cost of Crashes Estimate** | **Cost per Person** |
| St. Louis, MO-IL | 2,816,710 | $4,415,614,016 | $1,568 |
| Tampa-St. Petersburg-Clearwater, FL | 2,733,761 | $6,582,675,232 | $2,408 |
| Virginia Beach-Norfolk-Newport News, VA-NC | 1,658,292 | $2,542,632,540 | $1,533 |

Notes: [1]2008 estimate based on MSA boundary
[2]Data not available for Providence, RI

| Table 12: Very Large Metropolitan Areas Cost of Crashes Estimates | | | |
|---|---|---|---|
| **Metropolitan Area** | **Population[1]** | **Cost of Crashes Estimate** | **Cost per Person** |
| Atlanta-Sandy Springs-Marietta, GA | 5,376,285 | $10,690,546,972 | $1,988 |
| Boston-Cambridge-Quincy, MA-NH | 4,522,858 | $2,986,673,056 | $660 |
| Chicago-Naperville-Joliet, IL-IN-WI | 9,569,624 | $11,487,344,992 | $1,200 |
| Dallas-Fort Worth-Arlington, TX | 6,300,006 | $9,320,752,740 | $1,479 |
| Detroit-Warren-Livonia, MI | 4,425,110 | $5,486,342,344 | $1,240 |
| Houston-Baytown-Sugar Land, TX | 5,728,143 | $9,775,423,908 | $1,707 |
| Los Angeles-Long Beach-Santa Ana, CA | 12,872,808 | $15,763,952,224 | $1,225 |
| Miami-Fort Lauderdale-Miami Beach, FL | 5,414,772 | $11,056,773,796 | $2,042 |
| New York-Newark-Edison, NY-NJ-PA | 19,006,798 | $28,083,331,268 | $1,478 |
| Philadelphia-Camden-Wilmington, PA-NJ-DE-MD | 5,838,471 | $8,102,220,852 | $1,388 |
| Phoenix-Mesa-Scottsdale, AZ | 4,281,899 | $6,844,628,660 | $1,599 |
| San Francisco-Oakland-Fremont, CA | 4,274,531 | $3,990,775,872 | $934 |
| Seattle-Tacoma-Bellevue, WA | 3,344,813 | $3,846,117,980 | $1,150 |
| Washington-Arlington-Alexandria, DC-VA-MD-WV[2] | 5,358,130 | $6,610,617,152 | $1,234 |

Notes: [1]2008 estimate based on MSA boundary
[2]Washington, DC estimate is missing injury data from Jefferson County, WV and the Washington, DC city limits.

### 5.2 High and Low Cost of Crash Locations

The following tables present the metropolitan areas with the extreme values observed for a variety of different analysis approaches. The metropolitan areas are divided into four groups based on population size as described previously. The analysis is displayed in a way that is similar to the original AAA report.

Table 13 presents the extreme values observed for the cost of crashes per person for each metropolitan area studied.

**Table 13: High and Low Cost of Crash Locations**

| | Very Large | Cost[1] | Large | Cost | Medium | Cost | Small | Cost |
|---|---|---|---|---|---|---|---|---|
| High | Miami-Fort Lauderdale-Miami Beach, FL | $2,042 | New Orleans-Metairie-Kenner, LA | $2,598 | Nashville-Davidson-Murfreesboro, TN | $2,264 | Little Rock-North Little Rock, AR | $3,245 |
| Low | Boston-Cambridge-Quincy, MA-NH | $660 | San Jose-Sunnyvale-Santa Clara, CA | $925 | Springfield, MA | $757 | Spokane, WA | $1,028 |
| Average[2] | | $1,392 | | $1,579 | | $1,773 | | $1,946 |

Notes: [1]Cost of crashes per person
[2]Average for respective size category

Table 14 presents the extreme values observed for the cost of congestion per person for each metropolitan area studied. These values are based on information provided in the *2009 Urban Mobility Report*. As noted previously, these values are based on 2007 congestion data.

**Table 14: High and Low Cost of Congestion Locations**

| | Very Large | Cost[1] | Large | Cost | Medium | Cost | Small | Cost |
|---|---|---|---|---|---|---|---|---|
| High | Los Angeles-Long Beach-Santa Ana, CA | $807 | San Diego-Carlsbad-San Marcos, CA | $605 | Oxnard-Thousand Oaks-Ventura, CA | $605 | Charleston-North Charleston, SC | $431 |
| Low | Philadelphia-Camden-Wilmington, PA-NJ-DE-MD | $436 | Buffalo-Cheektowaga-Tonawanda, NY | $119 | Akron, OH | $102 | Brownsville-Harlingen, TX | $87 |
| Average[2] | | $575 | | $407 | | $322 | | $214 |

Notes: [1]Cost of congestion per person
[2]Average for respective size category

Source: *Urban Mobility Report, 2009*

Table 15 presents the extreme values observed for the ratio of the cost of crashes per person to the cost of congestion per person for each metropolitan area observed.

**Table 15: High and Low Crash to Congestion Locations**

| | Very Large | Ratio[1] | Large | Ratio | Medium | Ratio | Small | Ratio |
|---|---|---|---|---|---|---|---|---|
| High | Miami-Fort Lauderdale-Miami Beach, FL | 3.75 | Buffalo-Cheektowaga-Tonawanda, NY | 13.94 | Akron, OH | 14.94 | Beaumont-Port Arthur, TX | 24.43 |
| Low | Boston-Cambridge-Quincy, MA-NH | 1.39 | San Jose-Sunnyvale-Santa Clara, CA | 1.56 | Oxnard-Thousand Oaks-Ventura, CA | 2.16 | Cape Coral-Fort Myers, FL | 4.93 |
| Average[2] | | 2.42 | | 3.88 | | 5.51 | | 9.10 |

Notes: [1]Ratio = Cost of crashes per person / Cost of congestion per person
[2]Average for respective size category

Interestingly, the metropolitan area with the lowest cost of congestion for medium, large, and very large areas is also the metropolitan area with the highest ratio of the cost of crashes per person to the cost of congestion per person. This suggests that the high ratio values are being driven more by the low cost of congestion than the high cost of safety.

### 5.3 Cost of Crashes vs Cost of Congestion

The following graphs show the average cost of crashes per person compared to the average cost of congestion per person. The estimates are based on groups of metropolitan areas by different population size categories.

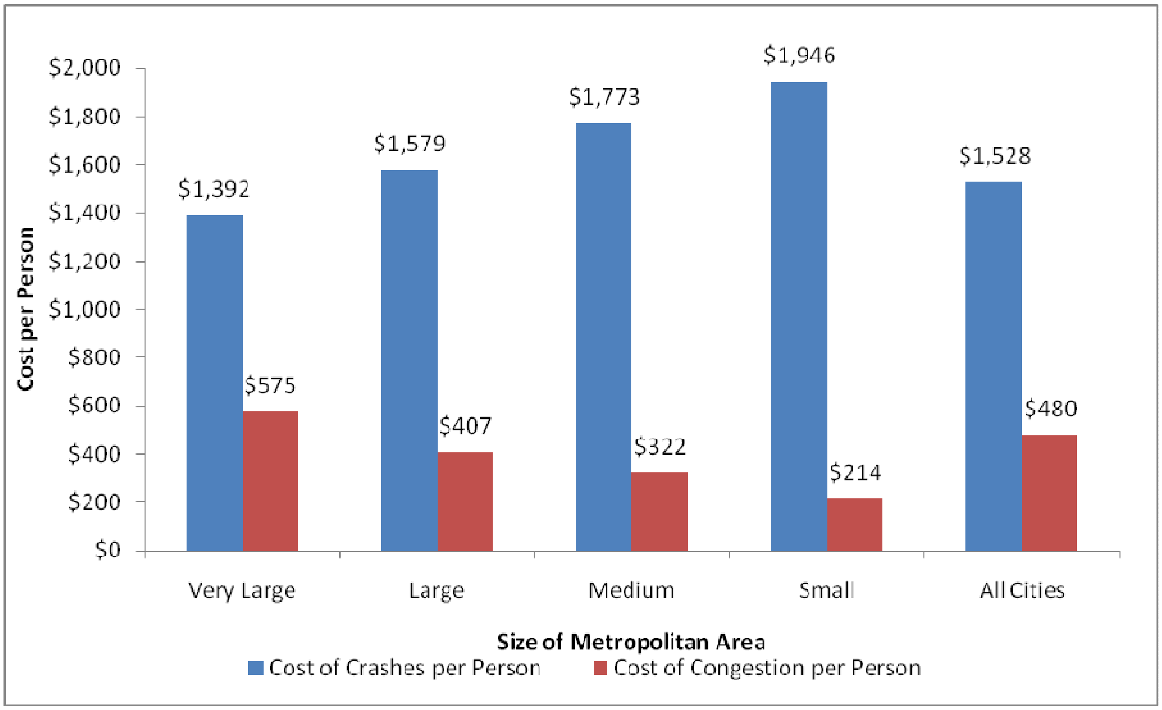



**Figure 4: Cost of Crash per person vs Cost of Crashes per person**

As can be seen in Figure 4, the average cost of crashes rises as the size of the metropolitan area increases. By contrast, the average cost of congestion decreases as the size of the metropolitan area increases. This inverse difference drives the ratio that can be seen in Figure 5 below. This figure displays how much, on average, the cost of crashes is greater than the cost of congestion for different metropolitan areas based on size categories. As can be seen, the ratio is relatively low for very large metropolitan areas and relatively high for small metropolitan areas.

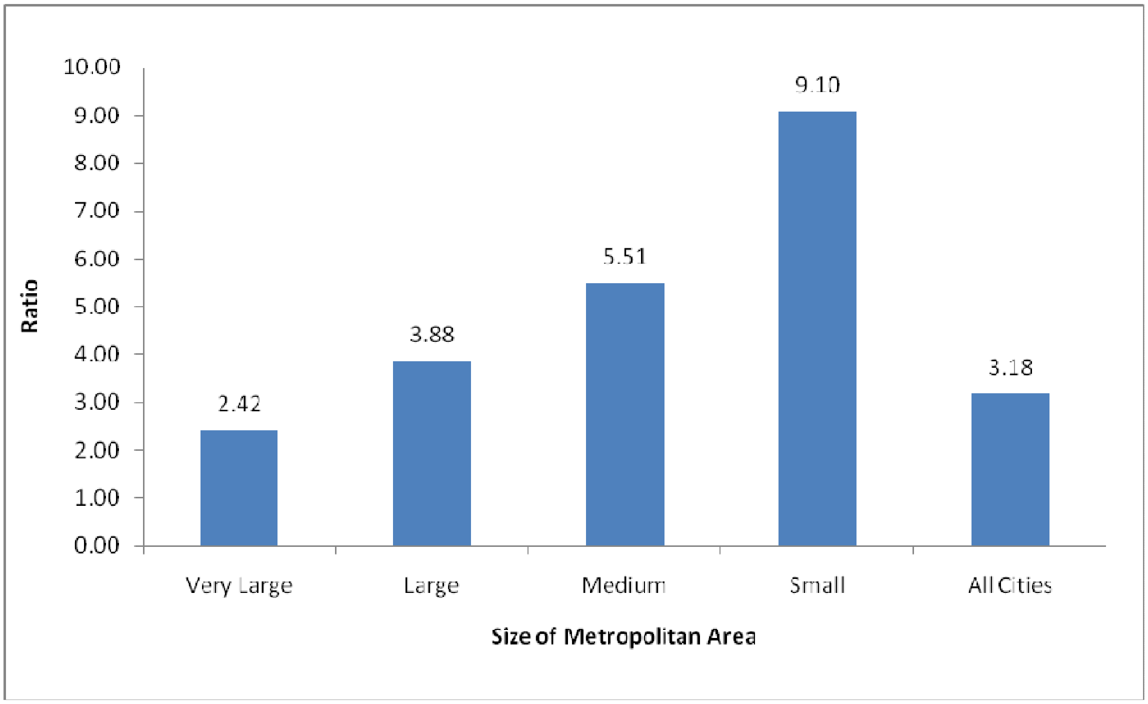



**Figure 5: Ratio of Cost of Crashes per person to Cost of Congestion per person**

These results raise the question as to why the cost of crashes declines when the population of an area increases and, by contrast, the cost of congestion increases as the population of an area increases. While an exact reason would be difficult to determine, several hypotheses are possible. These hypotheses are discussed in the following sections.

### 5.3.1 Trends in the Cost of Crashes

As mentioned, the cost of crashes has been observed to decline as the population of a metropolitan area increases. While this occurrence may seem puzzling, several factors could be driving this phenomenon.

First, a certain number of crashes might be inherent to a transportation system, meaning that even in areas with a small population, fatalities and injuries will occur to some extent. Because of the high economic costs attributed to even one fatality, the gross amount that crashes cost a metropolitan area, regardless of size, can rise very quickly. When this occurs in areas with a small population, the cost per person can rise quickly.

Second, as population rises, the occurrence of crashes is also likely to rise. However, it is possible at the occurrence of crashes does not rise at the same rate at population. If this is true, then the occurrence of crashes gets "diluted" as population increases. This could be what is happening in the results that are shown.

Lastly, as the size of a metropolitan area increases, congestion likely increases as well. As such, vehicles are likely traveling at a lower rate of speed, thus reducing the severity of crashes when they do occur. This phenomenon could be a factor in the reduced cost of crashes per person seen in areas with larger populations.

### 5.4 Cost of Fatalities vs Cost of Injuries

Given the high cost associated with a fatality compared to the relatively low cost associated with an injury, one would expect the total cost of fatalities to outweigh the total cost of injuries. However, the relatively high occurrence of injuries compared to the relatively low occurrence of fatalities causes this balance to shift. In reality, the findings of this research found that the cost of injuries outweigh the cost of fatalities at a rate of nearly 2 to 1. Figure 6 below shows the rate at which the cost of injuries outweighs the cost of fatalities for the different metropolitan area size categories. As can be seen, the cost of injuries exceeds the cost of fatalities for all size categories.

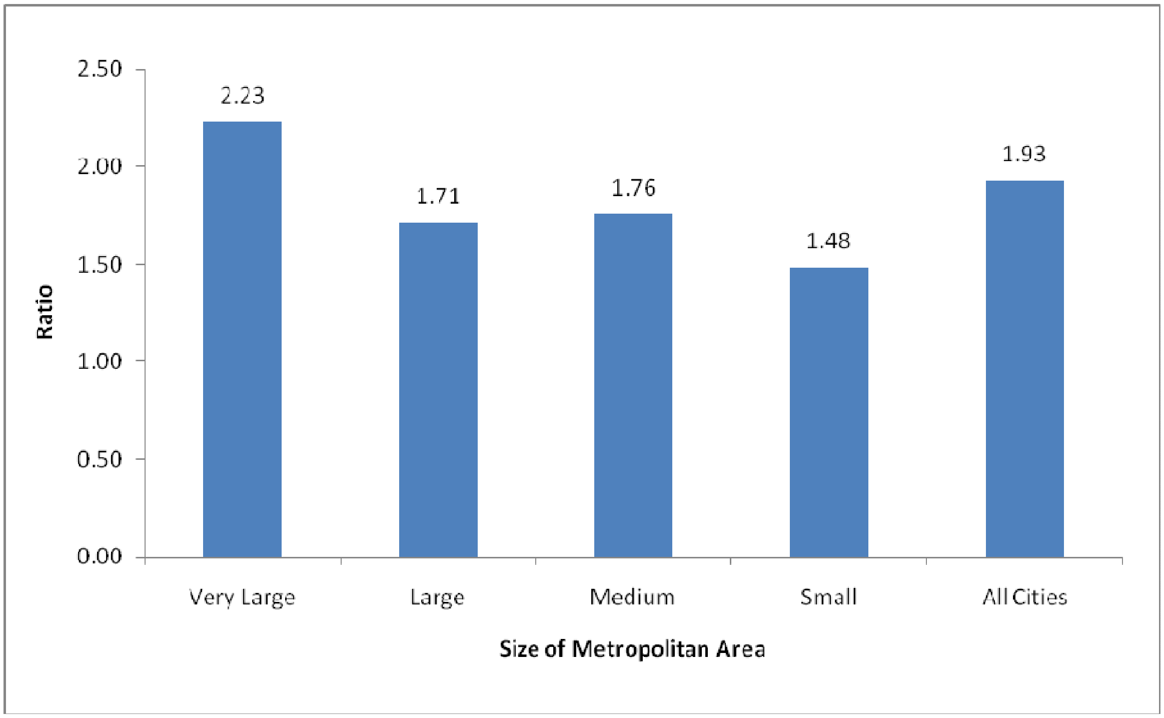



**Figure 6: Ratio of Cost of Injuries to Cost of Fatalities**

Tables 16 to 19 show the cost of injuries and fatalities for each of the metropolitan areas considered for this research effort as well as the ratio of the cost of injuries to the cost of fatalities. As can be seen, the cost of injuries exceeds the cost of fatalities in all but four of the metropolitan areas. The areas where the cost of fatalities are higher than the gross cost of injuries are Bakersfield, CA, Birmingham-Hoover, AL, Fresno, CA, Riverside-San Bernardino-Ontario, CA. Oddly, three out of four of these areas are located in Southern California.

| Table 16: Small Metropolitan Areas Cost of Crashes Estimates | | | |
|---|---|---|---|
| **Metropolitan Area** | **Cost of Injuries** | **Cost of Fatalities** | **Cost of Injuries / Cost of Fatalities** |
| Anchorage, AK | $227,843,928 | $191,400,000 | 1.19 |
| Bakersfield, CA | $608,724,168 | $667,000,000 | 0.91 |
| Beaumont-Port Arthur, TX | $575,995,836 | $574,200,000 | 1.00 |
| Boulder, CO | $295,239,204 | $133,400,000 | 2.21 |
| Brownsville-Harlingen, TX | $469,372,176 | $220,400,000 | 2.13 |
| Cape Coral-Fort Myers, FL | $518,977,836 | $446,600,000 | 1.16 |
| Charleston-North Charleston, SC | $865,875,348 | $725,000,000 | 1.19 |
| Colorado Springs, CO | $666,768,492 | $284,200,000 | 2.35 |
| Columbia, SC | $923,235,456 | $771,400,000 | 1.20 |
| Corpus Christi, TX | $555,583,392 | $232,000,000 | 2.39 |
| Eugene-Springfield, OR | $245,747,580 | $191,400,000 | 1.28 |
| Laredo, TX | $266,274,060 | $156,600,000 | 1.70 |
| Little Rock-North Little Rock, AR | $1,483,266,252 | $707,600,000 | 2.10 |
| Pensacola-Ferry Pass-Brent, FL | $664,943,916 | $452,400,000 | 1.47 |
| Salem, OR | $342,336,072 | $226,200,000 | 1.51 |
| Spokane, WA | $347,809,800 | $127,600,000 | 2.73 |

| Table 17: Medium Metropolitan Areas Cost of Crashes Estimates | | | |
|---|---|---|---|
| **Metropolitan Area** | **Cost of Injuries** | **Cost of Fatalities** | **Cost of Injuries / Cost of Fatalities** |
| Akron, OH | $782,400,996 | $278,400,000 | 2.81 |
| Albany-Schenectady-Troy, NY | $895,866,816 | $330,600,000 | 2.71 |
| Albuquerque, NM | $1,110,938,712 | $556,800,000 | 2.00 |
| Allentown-Bethlehem-Easton, PA-NJ | $753,207,780 | $498,800,000 | 1.51 |
| Austin-Round Rock, TX | $1,868,251,788 | $1,148,400,000 | 1.63 |
| Birmingham-Hoover, AL | $847,059,408 | $1,131,000,000 | 0.75 |
| Bridgeport-Stamford-Norwalk, CT | $1,083,456,036 | $266,800,000 | 4.06 |
| Charlotte-Gastonia-Concord, NC-SC | $2,742,565,800 | $1,020,800,000 | 2.69 |
| Dayton, OH | $879,673,704 | $429,200,000 | 2.05 |
| El Paso, TX | $752,523,564 | $365,400,000 | 2.06 |
| Fresno, CA | $592,987,200 | $800,400,000 | 0.74 |
| Grand Rapids-Wyoming, MI | $650,005,200 | $458,200,000 | 1.42 |
| Hartford-West Hartford-East Hartford, CT | $1,432,748,304 | $498,800,000 | 2.87 |
| Honolulu, HI[1] | - | - | - |
| Jacksonville, FL | $1,647,478,092 | $1,200,600,000 | 1.37 |
| Louisville, KY-IN | $1,312,554,360 | $957,000,000 | 1.37 |
| Nashville-Davidson-Murfreesboro, TN | $2,176,148,988 | $1,334,000,000 | 1.63 |
| New Haven-Milford, CT | $1,120,517,736 | $440,800,000 | 2.54 |
| Oklahoma City, OK | $1,522,950,780 | $893,200,000 | 1.71 |
| Omaha-Council Bluffs, NE-IA | $907,726,560 | $388,600,000 | 2.34 |
| Oxnard-Thousand Oaks-Ventura, CA | $602,110,080 | $440,800,000 | 1.37 |
| Raleigh-Cary, Durham, NC | $1,423,283,316 | $713,400,000 | 2.00 |

| Table 17: Medium Metropolitan Areas Cost of Crashes Estimates | | | |
|---|---|---|---|
| **Metropolitan Area** | **Cost of Injuries** | **Cost of Fatalities** | **Cost of Injuries / Cost of Fatalities** |
| Richmond, VA | $1,424,309,640 | $870,000,000 | 1.64 |
| Rochester, NY | $1,066,236,600 | $406,000,000 | 2.63 |
| Salt Lake City, UT | $1,387,361,976 | $527,800,000 | 2.63 |
| Sarasota-Bradenton-Venice, FL | $657,189,468 | $556,800,000 | 1.18 |
| Springfield, MA | $265,475,808 | $255,200,000 | 1.04 |
| Toledo, OH | $867,015,708 | $406,000,000 | 2.14 |
| Tucson, AZ | $1,062,473,412 | $794,600,000 | 1.34 |
| Tulsa, OK | $1,216,536,048 | $829,400,000 | 1.47 |
| Notes: [1]Data not available for Honolulu, HI | | | |

| Table 18: Large Metropolitan Areas Cost of Crashes Estimates | | | |
|---|---|---|---|
| **Metropolitan Area** | **Cost of Injuries** | **Cost of Fatalities** | **Cost of Injuries / Cost of Fatalities** |
| Baltimore-Towson, MD | $2,896,742,472 | $1,409,400,000 | 2.06 |
| Buffalo-Cheektowaga-Tonawanda, NY | $1,379,151,384 | $487,200,000 | 2.83 |
| Cincinnati-Middletown, OH-KY-IN | $2,191,315,776 | $1,113,600,000 | 1.97 |
| Cleveland-Elyria-Mentor, OH | $2,170,333,152 | $986,000,000 | 2.20 |
| Columbus, OH | $2,084,350,008 | $1,003,400,000 | 2.08 |
| Denver-Aurora, CO | $2,402,624,484 | $1,177,400,000 | 2.04 |
| Indianapolis, IN | $1,419,520,128 | $1,032,400,000 | 1.37 |
| Kansas City, MO-KS | $1,878,971,172 | $1,305,000,000 | 1.44 |
| Las Vegas-Paradise, NV | $2,639,933,400 | $1,165,800,000 | 2.26 |
| Memphis, TN-MS-AR | $1,837,804,176 | $1,119,400,000 | 1.64 |
| Milwaukee-Waukesha-West Allis, WI | $1,629,802,512 | $498,800,000 | 3.27 |
| Minneapolis-St. Paul-Bloomington, MN-WI | $2,365,904,892 | $1,119,400,000 | 2.11 |
| New Orleans-Metairie-Kenner, LA | $2,104,990,524 | $841,000,000 | 2.50 |
| Orlando, FL | $2,505,256,884 | $1,902,400,000 | 1.32 |
| Pittsburgh, PA | $1,681,688,892 | $1,403,600,000 | 1.20 |
| Portland-Vancouver-Beaverton, OR-WA | $1,727,873,472 | $736,600,000 | 2.35 |
| Providence-New Bedford-Fall River, RI-MA[1] | - | - | - |
| Riverside-San Bernardino-Ontario, CA | $2,866,408,896 | $3,166,800,000 | 0.91 |
| Sacramento-Arden-Arcade-Roseville, CA | $1,739,505,144 | $980,200,000 | 1.77 |
| San Antonio, TX | $2,902,558,308 | $1,281,800,000 | 2.26 |
| San Diego-Carlsbad-San Marcos, CA | $2,172,499,836 | $1,525,400,000 | 1.42 |

| Table 18: Large Metropolitan Areas Cost of Crashes Estimates | | | |
|---|---|---|---|
| **Metropolitan Area** | **Cost of Injuries** | **Cost of Fatalities** | **Cost of Injuries / Cost of Fatalities** |
| San Jose-Sunnyvale-Santa Clara, CA | $1,068,289,248 | $614,800,000 | 1.74 |
| St. Louis, MO-IL | $2,629,214,016 | $1,786,400,000 | 1.47 |
| Tampa-St. Petersburg-Clearwater, FL | $4,140,875,232 | $2,441,800,000 | 1.70 |
| Virginia Beach-Norfolk-Newport News, VA-NC | $1,655,232,540 | $887,400,000 | 1.87 |
| Notes: [1]Data not available for Providence, RI | | | |

| Table 19: Very Large Metropolitan Areas Cost of Crashes Estimates | | | |
|---|---|---|---|
| **Metropolitan Area** | **Population[1]** | **Cost of Crashes Estimate** | **Cost of Injuries / Cost of Fatalities** |
| Atlanta-Sandy Springs-Marietta, GA | $7,187,346,972 | $3,503,200,000 | 2.05 |
| Boston-Cambridge-Quincy, MA-NH | $1,675,873,056 | $1,310,800,000 | 1.28 |
| Chicago-Naperville-Joliet, IL-IN-WI | $8,036,344,992 | $3,451,000,000 | 2.33 |
| Dallas-Fort Worth-Arlington, TX | $6,153,952,740 | $3,166,800,000 | 1.94 |
| Detroit-Warren-Livonia, MI | $3,757,942,344 | $1,728,400,000 | 2.17 |
| Houston-Baytown-Sugar Land, TX | $6,278,023,908 | $3,497,400,000 | 1.80 |
| Los Angeles-Long Beach-Santa Ana, CA | $10,694,752,224 | $5,069,200,000 | 2.11 |
| Miami-Fort Lauderdale-Miami Beach, FL | $7,031,573,796 | $4,025,200,000 | 1.75 |
| New York-Newark-Edison, NY-NJ-PA | $22,329,731,268 | $5,753,600,000 | 3.88 |
| Philadelphia-Camden-Wilmington, PA-NJ-DE-MD | $5,457,420,852 | $2,644,800,000 | 2.06 |
| Phoenix-Mesa-Scottsdale, AZ | $4,240,428,660 | $2,604,200,000 | 1.63 |
| San Francisco-Oakland-Fremont, CA | $2,685,775,872 | $1,305,000,000 | 2.06 |
| Seattle-Tacoma-Bellevue, WA | $2,686,117,980 | $1,160,000,000 | 2.32 |
| Washington-Arlington-Alexandria, DC-VA-MD-WV[1] | $4,337,017,152 | $2,273,600,000 | 1.91 |
| Notes: [1]Does not include injury data for Jefferson County, WV and Washington, DC city limits | | | |

### 5.5 Updated Cost of Crash Estimates vs Previous Cost of Crash Estimates

The economic cost figures for this research, as has been noted, are based on an updated methodology and cost estimates provided by the FWHA. As such, it is difficult to compare how the cost estimates for different metropolitan areas, or the country as a whole, have changed since the publishing of the original report in 2008.

First, to assess the magnitude of how the changing economic estimates, such as the VSL, affect the overall cost estimates, the following graphs have been prepared. Figure 7 shows the cost of crashes per person for 2008 crash data, but based on the economic cost estimates for fatalities and injuries used in the previous study. The previous cost estimates have been adjusted based on estimated growth in the United States Gross Domestic Product (GDP). The cost of a fatality and injury, based on the GDP adjustment, were assumed to be $3.48 million and $73,146, respectively.

For comparison purposes, the cost of crashes per person for 2008 crash data based on the updated VSL estimates has also been included in this section in Figure 8. As can be seen by the two figures, the updated VSL has a significant effect on the resultant cost per person estimates. This is due to the assume VSL rising from $3.25 million in the previous study to $5.8 million for this study. In addition, the cost of injuries rose from $68,170 to $114,036 based on the updated VSL and methodology for estimating the cost of an injury discussed in the methodology section of this document.

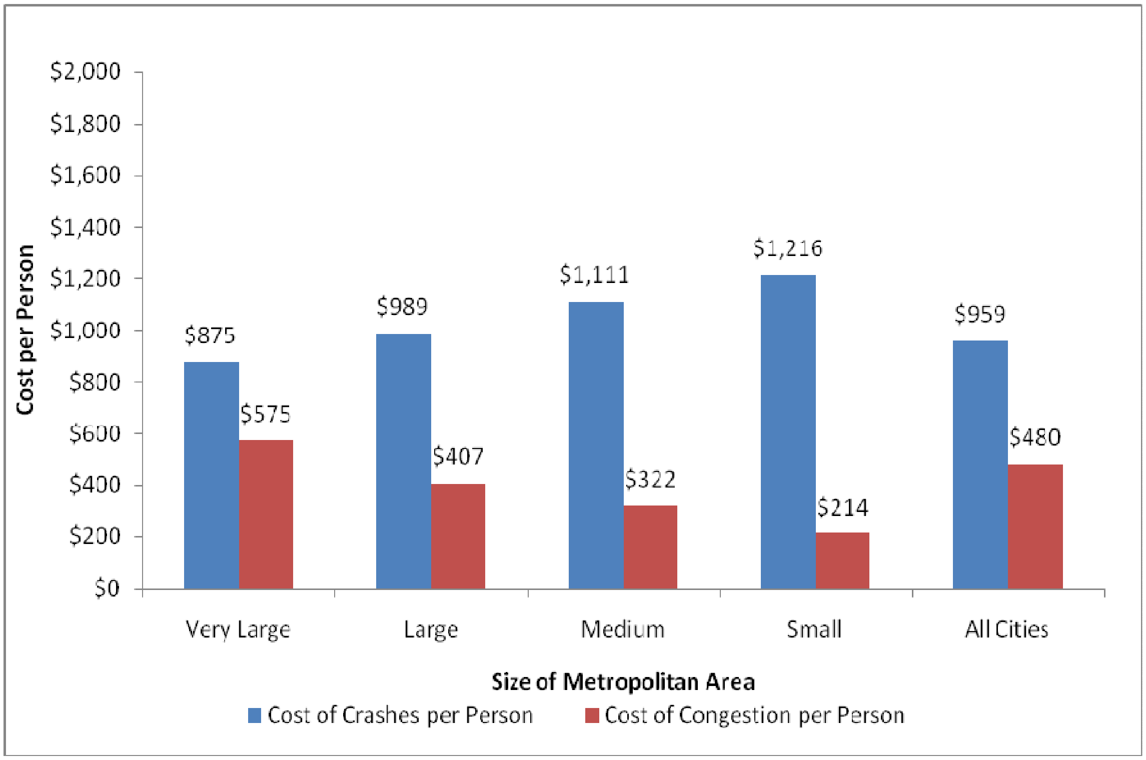



**Figure 7: Cost of Crashes per person vs Cost of Congestion per person (2005 cost estimates)**

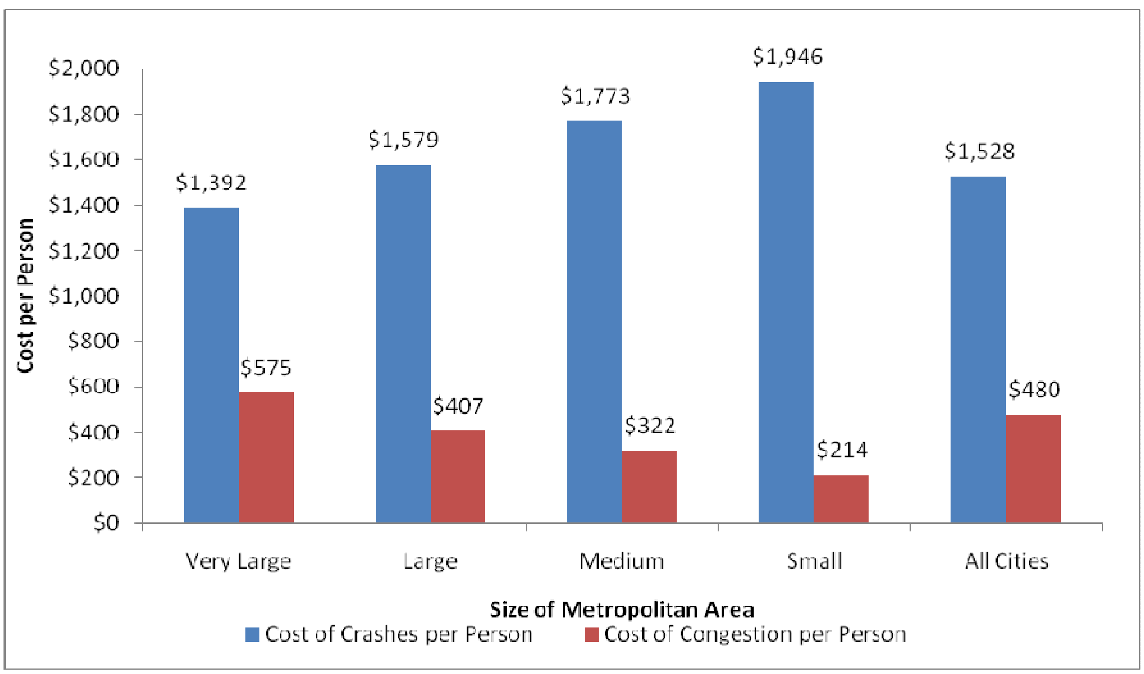



**Figure 8: Cost of Crashes per person vs Cost of Congestion per person (2008 cost estimates)**

Similarly, comparing the cost of crashes per person, based on both the previous cost estimates and the updated cost estimates, to the cost of congestion per person shows a drastic difference.

Figure 9 below shows the ratio of the cost of crashes per person to the cost of congestion per person where the cost of crashes is based on the previous cost estimates adjusted for GDP. In addition, Figure 10 shows the same ratio, but based on the cost of updated costs estimates. Both figures use the same 2008 crash data. The cost of congestion data is same for both figures.

As can be seen, the ratio of the cost of crashes per person to the cost of congestion per person changes a significant amount based on what cost assumptions are used. However, in both cases, the cost of crashes per person still exceeds the cost of congestion per person by a significant margin. For example, even using the previous cost estimates, which are relatively low, the cost of crashes exceeds the cost of congestion by a rate of 2 to 1, on average, for all the metropolitan areas considered for this research effort.

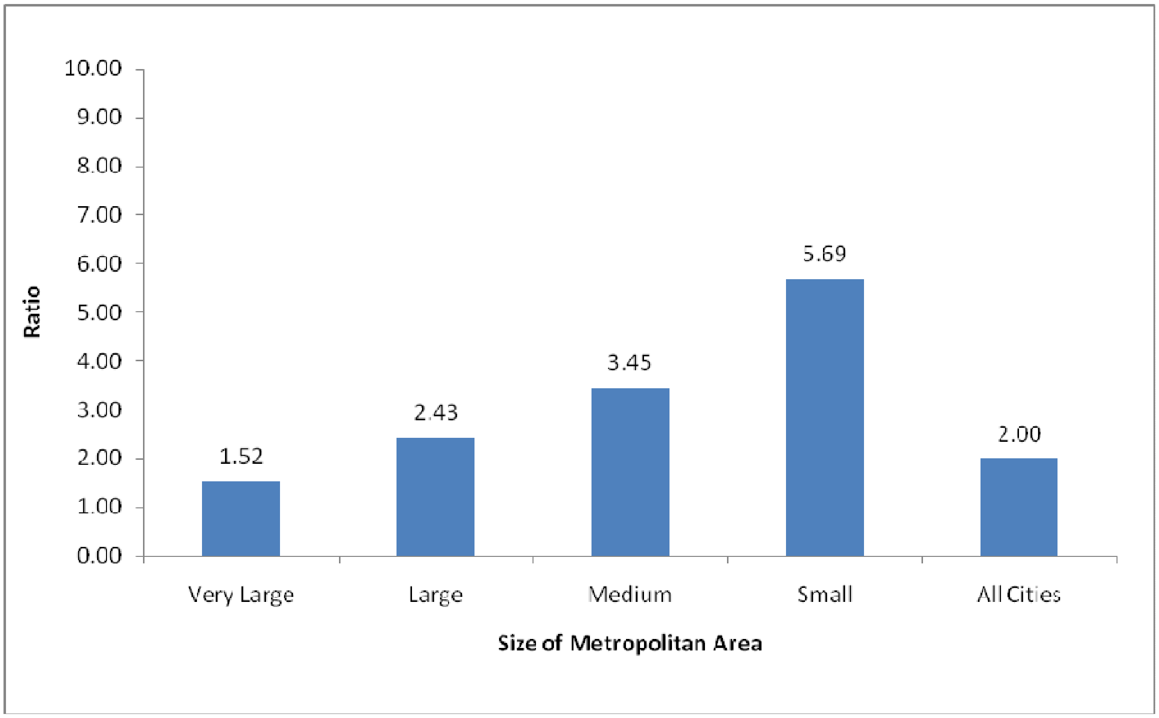



**Figure 9: Ratio of Cost of Crashes per person to Cost of Congestion per person (2005 cost estimates)**

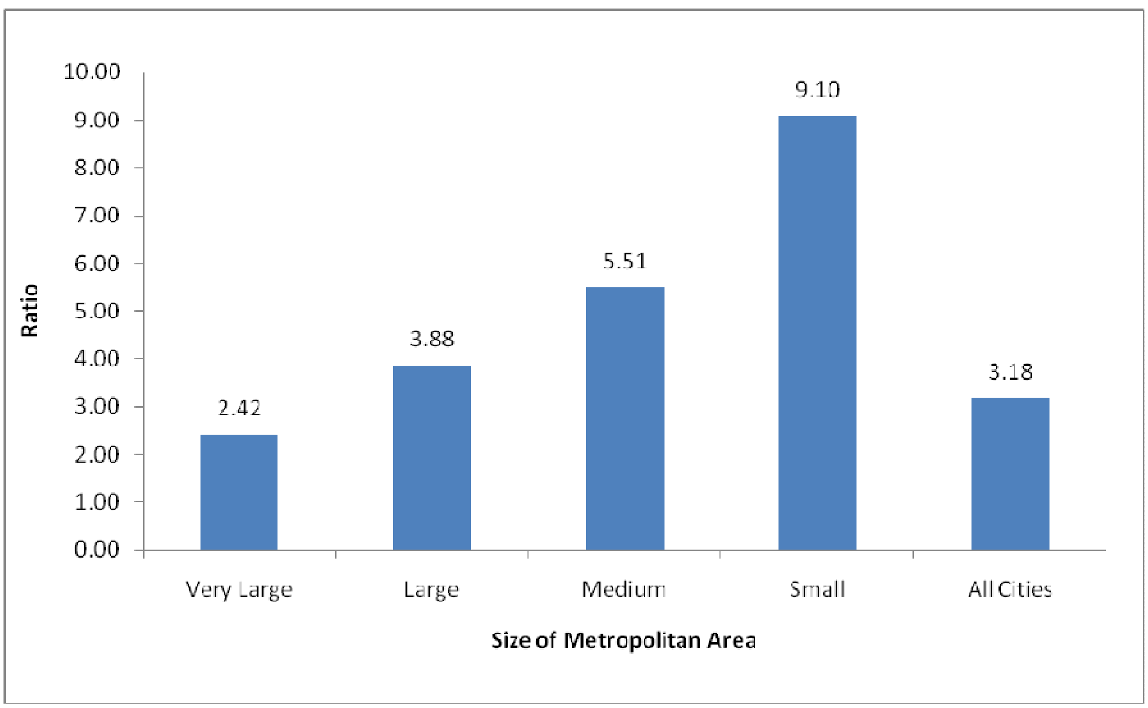



**Figure 10: Ratio of Cost of Crashes per person to Cost of Congestion per person (2008 cost estimates)**

### 5.6 2005 Data vs 2008 Data

In addition to the assumed value for the VSL and cost of an injury changing from the previous research to this research effort, the occurrence of crashes changed as well. Similarly, the cost of congestion, which is calculated biennially in the *Urban Mobility Report*, differs from the previous study. The trends that are occurring in these studies are likely affected by a variety of factors, making the exact reason for a given trend difficult, if not impossible, to pinpoint. However, understanding these trends is still important in putting the data presented in this research into the proper perspective.

Figure 11 shows how the cost of crashes per person and the cost of congestion per person changed, in percentage, from 2005 to 2008 for crashes and 2005 to 2007 for congestion. For the purpose of more comparable data, the cost estimates for 2005 and 2008 were both based on the previous estimates for the VSL and the cost of an injury. In the case of 2008 data, those assumptions were updated based on growth in GDP as outlined in previous sections.

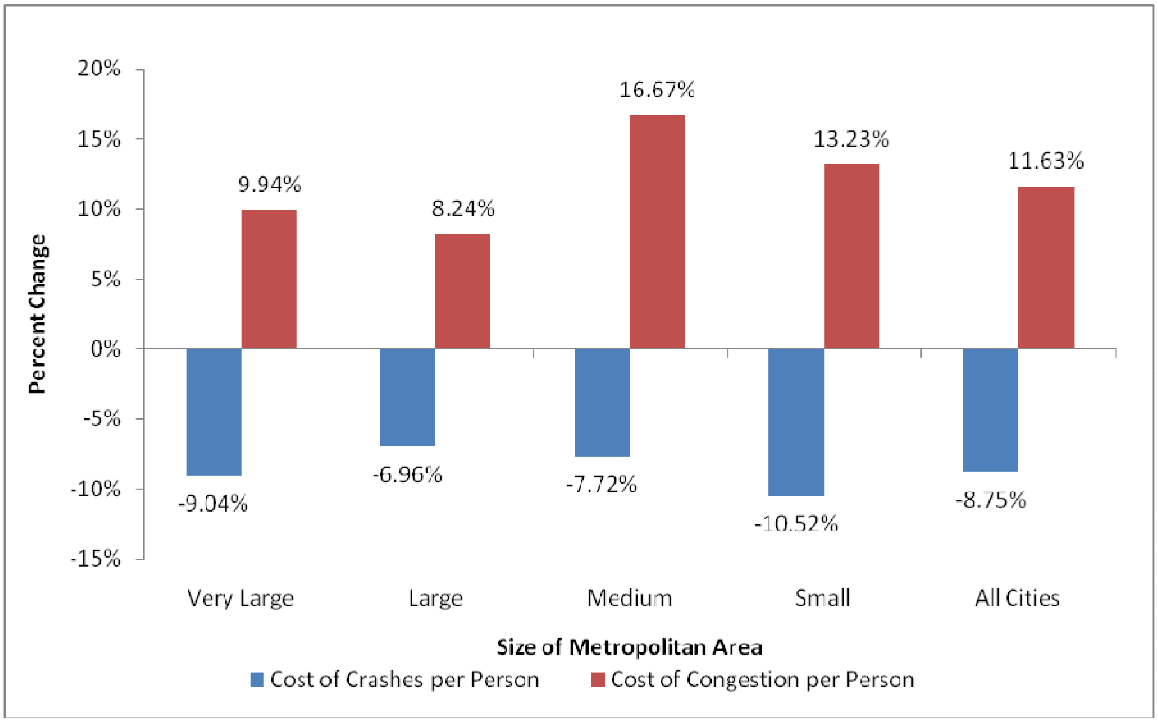



**Figure 11: Change of Cost of Crashes per person (2005-2008) and Cost of Congestion per person (2005-2007)**

As this figure shows, the cost of congestion per person is rising while the cost of crashes per person is declining. These trends have lead to the gap between the cost of crashes per person and the cost of congestion per person to shrink. Although, as noted earlier, the cost of crashes per person still significantly outweighs the cost of congestion per person.

For a more complete look at how the number of fatalities and injuries changed between 2005 and 2008 for the metropolitan areas considered, Table 20 shows data for both years as well as the percent change between the two. With few exceptions, the values generally decrease from 2005 to 2008 for both fatalities and injuries.

| Table 20: Change in Crash Data from 2005 to 2008 | | | | | | |
|---|---|---|---|---|---|---|
| Metropolitan Area | 2005 Data | | 2008 Data | | Change | |
| | Total No. Fatalities | Total No. Injuries | Total No. Fatalities | Total No. Injuries | Fatalities | Injuries |
| Akron, OH | 60 | 7,904 | 48 | 6,861 | -0.20 | -0.13 |
| Albany-Schenectady-Troy, NY | 63 | 8,933 | 57 | 7,856[4] | -0.10 | -0.12 |
| Albuquerque, NM | 129 | 11,575 | 96 | 9,742[3] | -0.26 | -0.16 |
| Allentown-Bethlehem-Easton, PA-NJ | 117 | 7,736 | 86 | 6,605 | -0.26 | -0.15 |
| Anchorage, AK | 38 | 4,274 | 33 | 1,998 | -0.13 | -0.53 |
| Atlanta-Sandy Springs-Marietta, GA | - | - | 604 | 63,027 | - | - |
| Austin-Round Rock, TX | - | - | 198 | 16,383 | - | - |
| Bakersfield, CA | 177 | 6,236 | 115 | 5,338 | -0.35 | -0.14 |
| Baltimore-Towson, MD | 229 | 26,578 | 243 | 25,402[2] | 0.06 | -0.04 |
| Beaumont-Port Arthur, TX | - | - | 99 | 5,051 | - | - |
| Birmingham-Hoover, AL | 170 | 9,616 | 195 | 7,428 | 0.15 | -0.23 |
| Boston-Cambridge-Quincy, MA-NH | - | - | 226 | 14,696 | - | - |
| Boulder, CO | 20 | 2,003 | 23 | 2,589[1] | 0.15 | 0.29 |
| Bridgeport-Stamford-Norwalk, CT | 56 | 10,877 | 46 | 9,501 | -0.18 | -0.13 |
| Brownsville-Harlingen, TX | - | - | 38 | 4,116 | - | - |
| Buffalo-Cheektowaga-Tonawanda, NY | 66 | 12,862 | 84 | 12,094[4] | 0.27 | -0.06 |
| Cape Coral-Fort Myers, FL | 150 | 5,686 | 77 | 4,551 | -0.49 | -0.20 |
| Charleston-North Charleston, SC | 123 | 7,686 | 125 | 7,593[6] | 0.02 | -0.01 |
| Charlotte-Gastonia-Concord, NC-SC | 185 | 23,727 | 176 | 24,050[5,6] | -0.05 | 0.01 |
| Chicago-Naperville-Joliet, IL-IN-WI | 794 | 85,089 | 595 | 70,472 | -0.25 | -0.17 |
| Cincinnati-Middletown, OH-KY-IN | 242 | 22,204 | 192 | 19,216 | -0.21 | -0.13 |

| Table 20: Change in Crash Data from 2005 to 2008 | | | | | | |
|---|---|---|---|---|---|---|
| **Metropolitan Area** | **2005 Data** | | **2008 Data** | | **Change** | |
| | **Total No. Fatalities** | **Total No. Injuries** | **Total No. Fatalities** | **Total No. Injuries** | **Fatalities** | **Injuries** |
| Cleveland-Elyria-Mentor, OH | 114 | 21,739 | 170 | 19,032 | 0.49 | -0.12 |
| Colorado Springs, CO | 52 | 3,900 | 49 | 5,847[1] | -0.06 | 0.50 |
| Columbia, SC | 154 | 8,538 | 133 | 8,096[6] | -0.14 | -0.05 |
| Columbus, OH | 193 | 21,339 | 173 | 18,278 | -0.10 | -0.14 |
| Corpus Christi, TX | - | - | 40 | 4,872 | - | - |
| Dallas-Fort Worth-Arlington, TX | - | - | 546 | 53,965 | - | - |
| Dayton, OH | 111 | 9,025 | 74 | 7,714 | -0.33 | -0.15 |
| Denver-Aurora, CO | 219 | 16,420 | 203 | 21,069[1] | -0.07 | 0.28 |
| Detroit-Warren-Livonia, MI | 364 | 39,821 | 298 | 32,954 | -0.18 | -0.17 |
| El Paso, TX | - | - | 63 | 6,599 | - | - |
| Eugene-Springfield, OR | 35 | 1,700 | 33 | 2,155 | -0.06 | 0.27 |
| Fresno, CA | 166 | 6,594 | 138 | 5,200 | -0.17 | -0.21 |
| Grand Rapids-Wyoming, MI | 80 | 7,205 | 79 | 5,700 | -0.01 | -0.21 |
| Hartford-West Hartford-East Hartford, CT | 95 | 13,883 | 86 | 12,564 | -0.09 | -0.10 |
| Honolulu, HI | 76 | 5,304 | 43 | - | -0.43 | - |
| Houston-Baytown-Sugar Land, TX | - | - | 603 | 55,053 | - | - |
| Indianapolis, IN | 195 | 14,577 | 178 | 12,448 | -0.09 | -0.15 |
| Jacksonville, FL | 254 | 15,369 | 207 | 14,447 | -0.19 | -0.06 |
| Kansas City, MO-KS | 245 | 19,396 | 225 | 16,477 | -0.08 | -0.15 |
| Laredo, TX | - | - | 27 | 2,335 | - | - |
| Las Vegas-Paradise, NV | 280 | 26,102 | 201 | 23,150 | -0.28 | -0.11 |
| Little Rock-North Little Rock, AR | 114 | 15,879 | 122 | 13,007 | 0.07 | -0.18 |
| Los Angeles-Long Beach-Santa Ana, CA | 950 | 109,610 | 874 | 93,784 | -0.08 | -0.14 |
| Louisville, KY-IN | 181 | 13,113 | 165 | 11,510 | -0.09 | -0.12 |
| Memphis, TN-MS-AR | 222 | 17,676 | 193 | 16,116[7] | -0.13 | -0.09 |

| Table 20: Change in Crash Data from 2005 to 2008 | | | | | | |
|---|---|---|---|---|---|---|
| Metropolitan Area | 2005 Data | | 2008 Data | | Change | |
| | Total No. Fatalities | Total No. Injuries | Total No. Fatalities | Total No. Injuries | Fatalities | Injuries |
| Miami-Fort Lauderdale-Miami Beach, FL | 794 | 76,653 | 694 | 61,661 | -0.13 | -0.20 |
| Milwaukee-Waukesha-West Allis, WI | 114 | 15,973 | 86 | 14,292 | -0.25 | -0.11 |
| Minneapolis-St. Paul-Bloomington, MN-WI | 227 | 24,084 | 193 | 20,747 | -0.15 | -0.14 |
| Nashville-Davidson-Murfreesboro, TN | 252 | 20,837 | 230 | 19,083[6] | -0.09 | -0.08 |
| New Haven-Milford, CT | 69 | 11,713 | 76 | 9,826 | 0.10 | -0.16 |
| New Orleans-Metairie-Kenner, LA | 160 | 20,873 | 145 | 18,459 | -0.09 | -0.12 |
| New York-Newark-Edison, NY-NJ-PA | 1,122 | 211,228 | 992 | 195,813[4] | -0.12 | -0.07 |
| Oklahoma City, OK | 153 | 14,533 | 154 | 13,355 | 0.01 | -0.08 |
| Omaha-Council Bluffs, NE-IA | 94 | 9,541 | 67 | 7,960 | -0.29 | -0.17 |
| Orlando, FL | 376 | 24,263 | 328 | 21,969 | -0.13 | -0.09 |
| Oxnard-Thousand Oaks-Ventura, CA | 71 | 6,266 | 76 | 5,280 | 0.07 | -0.16 |
| Pensacola-Ferry Pass-Brent, FL | 89 | 7,199 | 78 | 5,831 | -0.12 | -0.19 |
| Philadelphia-Camden-Wilmington, PA-NJ-DE-MD | 520 | 54,134 | 456 | 47,857[2] | -0.12 | -0.12 |
| Phoenix-Mesa-Scottsdale, AZ | 609 | 48,572 | 449 | 37,185 | -0.26 | -0.23 |
| Pittsburgh, PA | 261 | 16,187 | 242 | 14,747 | -0.07 | -0.09 |
| Portland-Vancouver-Beaverton, OR-WA | 174 | 17,566 | 127 | 15,152 | -0.27 | -0.14 |
| Providence-New Bedford-Fall River, RI-MA | 147 | 13,319 | 108 | - | -0.27 | - |
| Raleigh-Cary, Durham, NC | 176 | 17,979 | 123 | 12,481[5] | -0.30 | -0.31 |
| Richmond, VA | 158 | 12,822 | 150 | 12,490 | -0.05 | -0.03 |
| Riverside-San Bernardino-Ontario, CA | 758 | 32,895 | 546 | 25,136 | -0.28 | -0.24 |
| Rochester, NY | 98 | 10,217 | 70 | 9,350[4] | -0.29 | -0.08 |

| Table 20: Change in Crash Data from 2005 to 2008 | | | | | | |
|---|---|---|---|---|---|---|
| Metropolitan Area | 2005 Data | | 2008 Data | | Change | |
| | Total No. Fatalities | Total No. Injuries | Total No. Fatalities | Total No. Injuries | Fatalities | Injuries |
| Sacramento-Arden-Arcade-Roseville, CA | 250 | 19,239 | 169 | 15,254 | -0.32 | -0.21 |
| Salem, OR | 44 | 3,618 | 39 | 3,002 | -0.11 | -0.17 |
| Salt Lake City, UT | 82 | 13,502 | 91 | 12,166[7] | 0.11 | -0.10 |
| San Antonio, TX | - | - | 221 | 25,453 | - | - |
| San Diego-Carlsbad-San Marcos, CA | 308 | 23,248 | 263 | 19,051 | -0.15 | -0.18 |
| San Francisco-Oakland-Fremont, CA | 261 | 27,659 | 225 | 23,552 | -0.14 | -0.15 |
| San Jose-Sunnyvale-Santa Clara, CA | 118 | 10,882 | 106 | 9,368 | -0.10 | -0.14 |
| Sarasota-Bradenton-Venice, FL | 128 | 6,622 | 96 | 5,763 | -0.25 | -0.13 |
| Seattle-Tacoma-Bellevue, WA | 244 | 38,115 | 200 | 23,555 | -0.18 | -0.38 |
| Spokane, WA | 34 | 4,681 | 22 | 3,050 | -0.35 | -0.35 |
| Springfield, MA | - | - | 44 | 2,328 | - | - |
| St. Louis, MO-IL | 390 | 30,608 | 308 | 23,056 | -0.21 | -0.25 |
| Tampa-St. Petersburg-Clearwater, FL | 428 | 41,721 | 421 | 36,312 | -0.02 | -0.13 |
| Toledo, OH | 91 | 8,933 | 70 | 7,603 | -0.23 | -0.15 |
| Tucson, AZ | 137 | 11,265 | 137 | 9,317 | 0.00 | -0.17 |
| Tulsa, OK | 151 | 11,385 | 143 | 10,688 | -0.05 | -0.06 |
| Virginia Beach-Norfolk-Newport News, VA-NC | 138 | 17,007 | 153 | 14,515[5] | 0.11 | -0.15 |
| Washington-Arlington-Alexandria, DC-VA-MD-WV | 500 | 50,360 | 392 | 38,032[2] | -0.22 | -0.24 |

Notes: "-" indicates unavailable data. See respective reports for more details.

Source: Cambridge Systematics and M.D. Meyer, "Crashes vs Congestion – What's the Cost to Society?," 2008.

# CHAPTER 6
# SAFETY IN PLANNING

The chapter summarizes key literature on the linkage between safety and long-range transportation planning. An analysis of a possible link between incorporating safety into transportation planning and the economic costs of traffic crashes developed for this research is also included.

## 6.1 Literature on Safety in Transportation Planning

This section outlines the literature on safety and transportation planning.

### 6.1.1 NCHRP Report on Transportation Planning and Safety

The National Cooperative Highway Research Program (NCHRP) recently published a report that focused on integrating transportation safety into long-range planning. The document, entitled *Incorporating Safety into Long-Range Transportation Planning,* examines long-range transportation planning documents. The report evaluates how different transportation agencies around the United States are incorporating safety into long-range transportation plans and what could be considered best practice. The report concludes that the safety of a transportation system is greatly influenced by the design and layout of that system [22]. As such, considering safety when creating the vision for the transportation system can have a positive effect on the future safety of the system. Specifically, inclusion of safety in the vision and goals of the document was identified as key ways in which safety should be addressed.

Improving safety has also been identified as a way to improve congestion problems that a particular metropolitan area might be facing. It has been estimated that 50 to 70 percent of urban congestion is related to traffic crash incidents [22]. Given these figures, it is easy to suggest that improving safety has the potential to positively impact the transportation system in more ways than simply reducing the occurrence of crashes. As such, improving safety becomes a way to "kill two birds with one stone," meaning that a safer transportation system can potentially improve the system in many ways.

Other ways, according to the report, that safety should be addressed by planning agencies include incorporating safety into system performance measures, incorporating safety into technical analysis, creating the ability to evaluate project alternatives in a way that considers safety, developing a safety plan and program that the agency can follow, and creating the ability to monitor the progress of the system related to safety over time. All of these elements provide ways for an agency to incorporate safety not just into the words that are included in the transportation plan, but also into the day to day operations of the workers. The document identifies that for safety to be adequately addressed by the agency, it needs to be thoroughly integrated into the agency as a whole.

#### 6.1.1.1 Best Practices Identified

First and foremost, interagency cooperation is essential to improving the safety of a community over the long-term. This includes cooperation among local, regional, and state agencies. In addition, a variety of agencies from each of those categories can and should have an active role in improving the overall safety of the transportation system including, but not limited to, the Governor's Office of Highway Safety, the Metropolitan Planning Organization (MPO), the State Department of Transportation (DOT), local DOTs, the FHWA, police agencies, and public health agencies.

Second, it is critical to have a solid data collection process in place related to the occurrence of traffic crashes and the built environment. Without this, the true scope of the problem might not be fully understood. For example, an incomplete data set might understate the occurrence of traffic crashes in a given area, potentially making the issue of transportation safety less prominent than it could be in the eyes of decision-makers. An incomplete data set could arise as a result of poor field reports by reporting officers at the scene of a crash, poor communication between public health officials relaying injury severity information to those responsible for maintaining crash records, or a flawed database related to the built environment, such as the connectivity of a pedestrian or bicycle network. In short, the issues related to transportation safety cannot be understood unless reliable data on the subject is obtained and maintained.

Third, specific goals for transportation safety, and performance measures to assess progress towards those goals, should be included in any long-range transportation plan. This not only brings the issue of transportation safety to the forefront of a planning document, it also provides concrete objectives for an agency, creating meaningful targets to strive for and accountability to ensure adequate effort is being put forth to obtain those goals. In addition, goals should be assigned to specific agencies or departments to champion so that there is no doubt as to who is responsible maintaining progress towards those goals.

It should be noted that while it is important to include safety in transportation planning documents, ensuring that adequate practices are implemented into the daily operations of the agency is equally, if not more, important. During the time of the research for this thesis, an NCHRP report was underway that is tasked with identifying what practices different agencies actually do related to improving transportation safety, not just what they put in a plan. This forthcoming report should be an interesting comparison to previous reports that look more at what is included in the planning documents and less what is done in the field.

### 6.1.2 Current Practices of Incorporating Safety into Long-range Planning

The document *Evaluation of Statewide Long-Range Transportation Plans* [23] looks at state long-range transportation plans (LRTP) for several different content areas and assesses how effective those plans are. One of the areas assessed was how well safety was incorporated into the plan. This study found that safety was identified as a goal in 31 of the 48 state plans surveyed. Of the 31 states that included safety as a goal, it was addressed at different levels of detail throughout each given plan. For example, in Tennessee, a state where safety is addressed very effectively at the state level, the state plan identifies performances measures to evaluate the state's progress towards achieving the safety related goals included in the plan. Similarly, Pennsylvania, another state on the leading edge of safety planning, has performance measures in place to assess its progress towards goals related to reducing the number of injury and fatality crashes that occur in the state. Overall, of the states that included safety in their planning documents, 87 percent addressed it as a broad goal while 29 percent addressed it in specific goals or objectives (these numbers don't add to 100 percent because some states addressed safety in both manners).

In addition to state LRTPs, the document also identifies that the transportation plan for the USDOT also has safety as a goal.

In summary, this document finds that target goals for safety and performance measures to gauge progress towards those goals are key to any state LRTP attempting to incorporate safety. In addition, for safety goals to be effective, this report finds that safety evaluation results need to be included in the prioritization process. Also, the report identifies the need for adequate data to evaluate the existing environment related to safety. This means having adequate and up-to-date crash information that the agency can use to identify problem areas. Lastly, the report identifies the benefit of having a commission or individual that will champion cause of safety within the agency.

Another paper, *Safety-Conscious Planning in Midsized Metropolitan Areas – Technical and Institutional Challenges* [24], was written to identify the challenges faced by midsized metropolitan areas that are attempting to incorporate safety into long-range planning. The reason for focusing on midsized areas as opposed to all areas is because of the special challenges faced as a result of the resources and manpower deficiencies that are often experienced by agencies of this size.

This paper focuses on safety conscious planning (SCP), a term that means incorporating safety into all aspects of planning. This practice has been gaining moment as of late as safety has become a more notable issue to the general public.

The main finding of this paper is that while safety is included in the majority of midsized metropolitan area planning documents, the level of effectiveness of implementing the planning document varies widely among the different jurisdictions. The main challenges faced by these agencies include a lack of adequate data, a shortage of staff to dedicate to safety related issues, and a lack of tools to effectively address safety in the decision making process.

In general terms, this paper identifies safety as an area that has not kept pace with other issues in terms of being included in long-range planning documents. This means that while other areas have had improvements in the tools available to better address long-range issues, safety has been somewhat lagging in this area.

This paper suggests better safety planning processes can result from an internal champion working to increase the awareness and focus on safety issues within an agency. In addition, including safety in the project selection process will help to ensure that safety benefits are considered when transportation improvement funds are allocated. This, however, will not be effective unless an adequate system is in place for quantifying the benefits or costs that would result from constructing, or not constructing, a safety improvement. The paper found that while a lot of agencies identify safety as a goal, few have found ways to adequately quantify safety. Lastly, having a state DOT that is an advocate for advanced safety practices can be very beneficial to improving the capabilities and practices of agencies within the state. This results from interagency information sharing and training sessions.

### 6.1.3 Transportation Safety Public Campaigns

A common way for agencies to try and reduce the occurrence of traffic crashes is through public campaigns. These campaigns, even though the tactics can vary, all focus on educating users of the transportation system as to ways in which safety can be improved or crashes reduced.

Several documents were found that focused on the effective implementation of these campaigns. The purpose of this section is to outline the findings of these documents.

6.1.3.1 Current Public Campaign Practices

The paper *Communicating Highway Safety - What Works* [25] is mainly focused on the effects of public campaigns whose purpose is to change driver behavior to benefit traffic safety. Specifically, this paper looks at the, "type of media components, types of collaboration, context or environment in which the campaign is intended to have impact, structure or procedural steps in which campaigns are organized, principles for what works in a campaign, and the desired level of effects of a campaign."

The main motivating element behind this paper is the fact that people's actions can affect traffic safety much more than improved technology. This is contrary to the belief that major future increases in reductions in injuries and fatalities will come from a better design of roads or vehicles. While it is true that improving those designs will help, modifying the driving styles of the public can be just as effective, if not more so, in improving the safety of the roadway system.

The results of this study found that we should have guarded optimism as to the ability of programs to influence driver behavior. This means that programs were found to have some influence, but minor or major challenges may be present in the implementation of these programs.

Some of examples of what was found to work in these programs are listed below:

- More effective campaigns carefully target or segment the audience that the campaign is intended to reach.
- Campaigns for preventive behavior are more effective if they emphasize the negative consequences of current behavior. Arousing fear (at least in the context

of highway safety) has been found to be highly to moderately successful as a campaign strategy.

- Campaigns are more effective if they emphasize current rewards rather than the avoidance of distant negative consequences.
- More effective campaigns set fairly modest, attainable goals in terms of behavioral change.
- More effective campaigns go in tandem with an aggressive enforcement strategy.
- More effective campaigns address the existing knowledge and beliefs of target audiences that are impeding adoption of desired behaviors.

These findings give some direction to agencies that are looking to include transportation safety improvement goals in their LRTP. First, money should be allocated to fund these types of programs. While large roadway safety improvement construction projects have the potential to improve safety in specific locations, these programs have the ability to influence driver behavior over a large region. Second, funding for enforcement should be considered part of the budget to improve safety. This study found that pairing enforcement with campaigns can be a very effective way to influence behavior. Lastly, goals focused on improving highway safety should be modest to enable short term "wins" to occur for the responsible agency. These wins will help lift morale and motivate future safety improvement projects.

### 6.1.4 General Findings

In general, the literature review found that agencies are, in most cases, including safety in some form in their LRTP. However, simply including the language in the planning documents does little to actually improve the safety of the transportation system by reducing traffic crash injuries and fatalities. The authors of these various documents found that the best way to encourage transportation safety projects is through various avenues. First, it is essential that a person or agency champion the cause of transportation safety. This will result in a constant voice advocating for the allocation of transportation improvement funds to safety related projects. Second, time and effort must be spent creating an accurate and complete data set of existing crash and safety data so that the current state of the transportation system in terms of safety is known. Third, relevant performance measures must be defined so that progress towards goals can be determined. Fourth, safety improvements or costs must be quantified so that safety benefits can be accurately included in the project selection process. The inclusion of safety in the project selection process was called out in several different documents as being critical to influencing the direction of improvement projects. Without the inclusion of safety in this process, safety will not be a driving force in determining how funds are spent.

### 6.2 Long-Range Transportation Plan Evaluations

For the purpose of evaluating the effect that long-range planning documents can have on the cost of crashes per person results discussed earlier, several plans were analyzed. The plans chosen for this analysis represent the five metropolitan areas with the highest and lowest cost of crashes per person of those in the “Large” population category, as explained previously. Table 21 displays these metropolitan areas and the corresponding cost of crashes per person for each.

| Table 21: Large Metropolitan Areas Cost of Crashes Estimates | | | | |
|---|---|---|---|---|
| | Metropolitan Area | Population[1] | Cost of Crashes Estimate | Cost per Person |
| Lowest Cost of Crashes per Person | | | | |
| 1 | San Jose-Sunnyvale-Santa Clara, CA | 1,819,198 | $1,683,089,248 | $925 |
| 2 | Minneapolis-St. Paul-Bloomington, MN-WI | 3,229,878 | $3,485,304,892 | $1,079 |
| 3 | Portland-Vancouver-Beaverton, OR-WA | 2,207,462 | $2,464,473,472 | $1,116 |
| 4 | San Diego-Carlsbad-San Marcos, CA | 3,001,072 | $3,697,899,836 | $1,232 |
| 5 | Sacramento-Arden-Arcade-Roseville, CA | 2,109,832 | $2,719,705,144 | $1,289 |
| Highest Cost of Crashes per Person | | | | |
| 20 | San Antonio, TX | 2,031,445 | $4,184,358,308 | $2,060 |
| 21 | Orlando, FL | 2,054,574 | $4,407,656,884 | $2,145 |
| 22 | Memphis, TN-MS-AR | 1,285,732 | $2,957,204,176 | $2,300 |
| 23 | Tampa-St. Petersburg-Clearwater, FL | 2,733,761 | $6,582,675,232 | $2,408 |
| 24 | New Orleans-Metairie-Kenner, LA | 1,134,029 | $2,945,990,524 | $2,598 |
| Notes: | [1]2008 estimate based on MSA boundary | | | |

For each of these metropolitan areas, the LRTP developed by the MPO was reviewed for the inclusion of safety related goals and practices. The MPO documents were chosen because those documents represent a regional focus, rather than a more localized focus of a plan developed by a city or county. Given that the cost estimates created for these research effort were based on MSA boundaries that encompasses a very broad area around the urban center of each of these metropolitan areas, the MPO plan seems the most reasonable to utilize.

These plans were evaluated based on criteria presented in NCHRP 546 [22]. In particular, the plans were surveyed for whether safety was included in the vision and goal of the plan, whether performance measures had been developed to assess progress towards safety goals, and whether the safety benefits of a project or policy were considered when allocating funds or debating policy alternatives, to name a few. Table 22 below presents a summarized version of the finds of this review. A complete review of each plan can be found in Appendix B.

| Table 22: Evaluation of Long-Range Transportation Plan Summary | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Low Cost of Crashes Locations | | | | | High Cost of Crashes Locations | | | | |
| | San Jose, CA | Minneapolis, MN | Portland, OR | Sand Diego, CA | Sacramento, CA | San Antonio, TX | Orlando, FL | Memphis, TN | Tampa, FL | New Orleans, LA |
| Safety in vision statement? | + | +/x | + | + | x | + | + | +/x | x | x |
| Safety included in goals? | + | x | + | +/x | +/x | + | + | + | + | +/x |
| Safety related performance measures? | + | x | + | x | x | x | + | x | +/x | x |
| Safety used in project identification? | + | x | + | x | x | + | + | + | + | x |
| Safety analysis tools used? | + | x | + | x | x | x | + | x | + | x |
| Safety evaluation criteria used to assess merits of different strategies or projects? | x | +/ x | + | x | x | +/x | + | x | + | x |
| Product of planning process includes safety-related actions? | + | x | + | x | x | x | + | + | x | x |
| Safety included in prioritization process? | x | x | + | x | +/x | + | + | + | + | x |
| Monitoring process in place? | + | x | + | x | x | x | + | x | +/x | x |
| Key safety stakeholders involved in the planning process? | + | + | + | x | + | + | + | + | + | x |
| + | 8 | 1 | 10 | 1 | 1 | 5 | 10 | 5 | 6 | 0 |
| +/x | 0 | 2 | 0 | 1 | 2 | 1 | 0 | 1 | 2 | 1 |
| x | 2 | 7 | 0 | 8 | 7 | 4 | 0 | 4 | 2 | 9 |

Notes: "+" indicates that the plan meets the respective criteria
"+/-" indicates that the plan partially meets the respective criteria
"-" indicates that the plan does not meet the respective criteria

As can been seen by the summary above, there does not seem to be a correlation between an metropolitan area having a low cost of crashes per person and also having a strong LRTP in terms of safety, or vice versa. In fact, three of the four worst plans in terms of how safety is included in the plan, Minneapolis, MN, San Diego, CA, and Sacramento, CA, are plans that are among the best in terms of the cost of crashes per person.

These results beg the question, “Why does it appear that the incorporation of safety into planning has such little effect on the cost of crashes experienced by the corresponding metropolitan area?” To answer this question, we must address the limitations of the analysis method used for this evaluation and also the limitations of the effect that transportation planning can have on safety.

### 6.2.1 Limitations of Evaluating LRTP

As noted, LRTPs are documents that address the long-range future of the transportation system for a given area. As such, they generally reflect the priorities and values of an agency by describing the visions and priorities for the region. However, these documents are not necessarily the only documents that are considered when policy or project decisions are made. In addition to LRTPs, agencies will often consider documents such as pedestrian plans, bicycle plans, state plans, local plans, and others. In short, the LRTP is one document among many that could be considered a policy document for a region.

In addition to a multitude of documents, an agency also must deal with a shifting political climate when decisions are made. For example, while a policy document might suggest a priority should be put on safety-related projects, the political forces in the area might want to focus on projects that would have a more immediate impact, such roadway resurfacing projects or capacity increasing projects. In such cases, when immediate impacts are desired, safety projects often lose out because the true benefits cannot be realized for sure until several years' worth of data is collected after the project has been completed.

Lastly, a review of LRTPs is limited by the lack of real world information that it provides. For example, while a LRTP plan may state that safety-related projects should be a priority of an agency, the actual actions of the agency might not reflect that. Similarly, while a LRTP might not explicitly call out that safety should be a priority for the area, individual departments or staff members might take it upon themselves to ensure that safety is adequately addressed in the operation of the agency. In general, while LRTPs might give us an idea of what is happening at an agency, they do not give us the complete picture of the actual environment as it relates to safety practices.

# CHAPTER 7
# CONCLUSIONS AND RECOMMENDATIONS

## 7.1 Summary

Although the cost of congestion is a more discussed phenomenon, this research has shown that the cost of traffic crashes exceeds the cost of congestion for 83 of the largest metropolitan areas in the U.S on a per person basis at a rate of over 3 to 1 based on the 2009 *Urban Mobility Report* and 2008 crash data. These findings are consistent with a previous report published by AAA that compared the cost of crashes to the cost of safety for 2005 data. In that report, the cost of crashes exceeded the cost of safety at a rate of over 2 to 1. The cost of crashes estimates for the two studies are based on different VSL and injury estimates due to the FHWA recently revisiting the assumed VSL used in department studies, raising the value from roughly $3.25 million in 2005 to $5.8 million for this study. However, even when considering the cost of crashes in 2008 based on the lower previous cost estimate, the cost of crashes still outweigh the cost of congestion by a significant margin.

While the result of the cost of crashes exceeding the cost of congestion continued for this research, interesting trends emerged for the two factors. Between 2005 and 2008, the cost of crashes was generally on the decline, declining an average of nearly 9 percent, while the cost of congestion was generally increasing, rising an average of over 11 percent. However, both factors have seen a decline in recent years, mostly likely due to the recent economic downturn experienced in the U.S. As noted, though, even with these inverse trends occurring, the cost of crashes still outweighs the cost of congestion.

## 7.2 Recommendations

Although recent trends in traffic related fatalities and injuries have shown a decline from historical averages, evidence suggests that those occurrences are more likely the result of outside factors, such as the recent economic downturn, rather than a shift in driver behavior or the overall safety of the transportation network. As such, significant effort needs to be taken to reduce the occurrence and severity of traffic crashes in the future. The following recommendations are aimed at identifying strategies that agencies can implement to combat traffic related fatalities and injuries in their region.

- **Encourage cooperation amongst partnering agencies to address regional safety issues.** Combating the overall safety of the region often is outside of the scope of a singular agency. Improvements will be seen when many agencies, such as local agencies, state agencies, regional agencies, and agencies that focus on variety of travel modes, work together for the common goal of improving safety and reducing crash related injuries and fatalities.
- **Include the safety benefits of a project or policy in the prioritization process.** By including safety in the project prioritization process, an agency is more likely to build projects that have a positive impact on the safety of the infrastructure system. In addition, securing consistent funding for safety improvements is a critical component of having a positive impact of the safety of the transportation system.
- **Develop and maintain a comprehensive data collection program for crash related statistics. This database should be as detailed as possible and preferably GIS-based.** Without adequate crash data, an agency is blind to the current safety of the transportation system. A complete crash database will allow an agency to identify

where safety concerns exist, what type of crashes are a problem, and potentially identify system wide approaches to combat those issues.

- **Work with local police agencies to produce consistent reporting methods for crashes.** Crash data is only as good as the information that is collected in the field. As such, effort should be taken to ensure that this information is as consistent and complete as possible. Agencies should work together to make data as comparable as possible across jurisdictional lines.
- **Encourage cooperation amongst health officials and police officials to accurately report the injury severity of crashes.** When a victim of a crash leaves the scene and is treated at a hospital, a possibility exists that the original crash report might not be updated to accurately record the severity of the injury that results from the crash. Communication between police and health officials should exist so that the final crash report is as accurate and complete as possible.
- **Incorporate transportation safety into the daily operations of the agency.** Improving transportation safety is not something that can occur overnight or with minimal effort by the governing jurisdiction. Positive results will come from a dedicated agency who works to include the potential safety benefits or costs of a particular project or policy into every decision.
- **Consider improving safety to be both a short-term and long-term issue.** While significant improvements in the safety of a transportation system will be the result of years of dedication to the issue, small steps towards or away from that goal are made each time an individual project is built. By making pro-safety decisions on specific projects, big or small, the overall safety of the network is increased.

- **Create a national database of injury crash data.** Injury case data is currently much more difficult to analyze because no national database exists like there is for fatality data. States should be required to report injury information at the county level to a national agency so that a more accurate picture of the trends related to injury information can be analyzed.

## 7.3 Future Research

To improve the confidence that can be had in analyses conducted like what was done for this thesis, further research should be done related to the economic costs associated with traffic crashes. In particular, little research on the economic impact of injuries has been conducted to date.

Much like the *Urban Mobility Report*, the economic cost of traffic crashes should be reported biennially. Having this information produced every other year will help ensure that safety stays in the conversation as to where transportation improvement dollars should be spent. Also, a more in-depth look at how the practices of an agency affect the occurrence of traffic crashes would be an interesting exercise. Similarly, a significant amount of research could be conducted related to the correlation between the occurrence of crashes and the existing environment, such as building density, congestion levels, transit ridership, and other factors that could affect the occurrence of crashes. Understanding these relationships could go a long way to helping agencies understand where resources should be invested to reduce crashes and, by doing so, save lives.

# APPENDIX A
# MSA AREA DEFINITIONS

| MSA Area | County | State |
| --- | --- | --- |
| Akron, OH | Portage County | Ohio |
| | Summit County | Ohio |
| Albany-Schenectady-Troy, NY | Albany County | New York |
| | Rensselaer County | New York |
| | Saratoga County | New York |
| | Schenectady County | New York |
| | Schoharie County | New York |
| Albuquerque, NM | Bernalillo County | New Mexico |
| | Sandoval County | New Mexico |
| | Torrance County | New Mexico |
| | Valencia County | New Mexico |
| Allentown-Bethlehem-Easton, PA-NJ | Warren County | New Jersey |
| | Carbon County | Pennsylvania |
| | Lehigh County | Pennsylvania |
| | Northampton County | Pennsylvania |
| Anchorage, AK | Anchorage Municipality | Alaska |
| | Matanuska-Susitna Borough | Alaska |
| Atlanta-Sandy Springs-Marietta, GA | Barrow County | Georgia |
| | Bartow County | Georgia |
| | Butts County | Georgia |
| | Carroll County | Georgia |
| | Cherokee County | Georgia |
| | Clayton County | Georgia |
| | Cobb County | Georgia |
| | Coweta County | Georgia |
| | Dawson County | Georgia |
| | DeKalb County | Georgia |
| | Douglas County | Georgia |
| | Fayette County | Georgia |
| | Forsyth County | Georgia |
| | Fulton County | Georgia |
| | Gwinnett County | Georgia |
| | Haralson County | Georgia |
| | Heard County | Georgia |
| | Henry County | Georgia |
| | Jasper County | Georgia |
| | Lamar County | Georgia |
| | Meriwether County | Georgia |
| | Newton County | Georgia |
| | Paulding County | Georgia |
| | Pickens County | Georgia |
| | Pike County | Georgia |
| | Rockdale County | Georgia |
| | Spalding County | Georgia |

| MSA Area | County | State |
|---|---|---|
| | Walton County | Georgia |
| Austin-Round Rock, TX | Bastrop County | Texas |
| | Caldwell County | Texas |
| | Hays County | Texas |
| | Travis County | Texas |
| | Williamson County | Texas |
| Bakersfield, CA | Kern County | California |
| Baltimore-Towson, MD | Anne Arundel County | Maryland |
| | Baltimore County | Maryland |
| | Carroll County | Maryland |
| | Harford County | Maryland |
| | Howard County | Maryland |
| | Queen Anne's County | Maryland |
| | Baltimore city | Maryland |
| Beaumont-Port Arthur, TX | Hardin County | Texas |
| | Jefferson County | Texas |
| | Orange County | Texas |
| Birmingham-Hoover, AL | Bibb County | Alabama |
| | Blount County | Alabama |
| | Chilton County | Alabama |
| | Jefferson County | Alabama |
| | St. Clair County | Alabama |
| | Shelby County | Alabama |
| | Walker County | Alabama |
| Boston-Cambridge-Quincy, MA-NH | Essex County | Massachusetts |
| | Middlesex County | Massachusetts |
| | Norfolk County | Massachusetts |
| | Plymouth County | Massachusetts |
| | Suffolk County | Massachusetts |
| | Rockingham County | New Hampshire |
| | Strafford County | New Hampshire |
| Boulder, CO | Boulder County | Colorado |
| Bridgeport-Stamford-Norwalk, CT | Fairfield County | Connecticut |
| Brownsville-Harlingen, TX | Cameron County | Texas |
| Buffalo-Cheektowaga-Tonawanda, NY | Erie County | New York |
| | Niagara County | New York |
| Cape Coral-Fort Myers, FL | Lee County | Florida |
| Charleston-North Charleston, SC | Berkeley County | South Carolina |
| | Charleston County | South Carolina |
| | Dorchester County | South Carolina |
| Charlotte-Gastonia-Concord, NC-SC | Anson County | North Carolina |
| | Cabarrus County | North Carolina |
| | Gaston County | North Carolina |
| | Mecklenburg County | North Carolina |
| | Union County | North Carolina |

| MSA Area | County | State |
|---|---|---|
| | York County | South Carolina |
| Chicago-Naperville-Joliet, IL-IN-WI | Cook County | Illinois |
| | DeKalb County | Illinois |
| | DuPage County | Illinois |
| | Grundy County | Illinois |
| | Kane County | Illinois |
| | Kendall County | Illinois |
| | Lake County | Illinois |
| | McHenry County | Illinois |
| | Will County | Illinois |
| | Jasper County | Indiana |
| | Lake County | Indiana |
| | Newton County | Indiana |
| | Porter County | Indiana |
| | Kenosha County | Wisconsin |
| Cincinnati-Middletown, OH-KY-IN | Dearborn County | Indiana |
| | Franklin County | Indiana |
| | Ohio County | Indiana |
| | Boone County | Kentucky |
| | Bracken County | Kentucky |
| | Campbell County | Kentucky |
| | Gallatin County | Kentucky |
| | Grant County | Kentucky |
| | Kenton County | Kentucky |
| | Pendleton County | Kentucky |
| | Brown County | Ohio |
| | Butler County | Ohio |
| | Clermont County | Ohio |
| | Hamilton County | Ohio |
| | Warren County | Ohio |
| Cleveland-Elyria-Mentor, OH | Cuyahoga County | Ohio |
| | Geauga County | Ohio |
| | Lake County | Ohio |
| | Lorain County | Ohio |
| | Medina County | Ohio |
| Colorado Springs, CO | El Paso County | Colorado |
| | Teller County | Colorado |
| Columbia, SC | Calhoun County | South Carolina |
| | Fairfield County | South Carolina |
| | Kershaw County | South Carolina |
| | Lexington County | South Carolina |
| | Richland County | South Carolina |
| | Saluda County | South Carolina |
| Columbus, OH | Delaware County | Ohio |
| | Fairfield County | Ohio |
| | Franklin County | Ohio |

| MSA Area | County | State |
| --- | --- | --- |
| | Licking County | Ohio |
| | Madison County | Ohio |
| | Morrow County | Ohio |
| | Pickaway County | Ohio |
| | Union County | Ohio |
| Corpus Christi, TX | Aransas County | Texas |
| | Nueces County | Texas |
| | San Patricio County | Texas |
| Dallas-Fort Worth-Arlington, TX | Collin County | Texas |
| | Dallas County | Texas |
| | Delta County | Texas |
| | Denton County | Texas |
| | Ellis County | Texas |
| | Hunt County | Texas |
| | Johnson County | Texas |
| | Kaufman County | Texas |
| | Parker County | Texas |
| | Rockwall County | Texas |
| | Tarrant County | Texas |
| | Wise County | Texas |
| Dayton, OH | Greene County | Ohio |
| | Miami County | Ohio |
| | Montgomery County | Ohio |
| | Preble County | Ohio |
| Denver-Aurora, CO | Adams County | Colorado |
| | Arapahoe County | Colorado |
| | Broomfield County | Colorado |
| | Clear Creek County | Colorado |
| | Denver County | Colorado |
| | Douglas County | Colorado |
| | Elbert County | Colorado |
| | Gilpin County | Colorado |
| | Jefferson County | Colorado |
| | Park County | Colorado |
| Detroit-Warren-Livonia, MI | Lapeer County | Michigan |
| | Livingston County | Michigan |
| | Macomb County | Michigan |
| | Oakland County | Michigan |
| | St. Clair County | Michigan |
| | Wayne County | Michigan |
| El Paso, TX | El Paso County | Texas |
| Eugene-Springfield, OR | Lane County | Oregon |
| Fresno, CA | Fresno County | California |
| Grand Rapids-Wyoming, MI | Barry County | Michigan |
| | Ionia County | Michigan |

| MSA Area | County | State |
|---|---|---|
| | Kent County | Michigan |
| | Newaygo County | Michigan |
| Hartford-West Hartford-East Hartford, CT | Hartford County | Connecticut |
| | Middlesex County | Connecticut |
| | Tolland County | Connecticut |
| Honolulu, HI | Honolulu County | Hawaii |
| Houston-Baytown-Sugar Land, TX | Austin County | Texas |
| | Brazoria County | Texas |
| | Chambers County | Texas |
| | Fort Bend County | Texas |
| | Galveston County | Texas |
| | Harris County | Texas |
| | Liberty County | Texas |
| | Montgomery County | Texas |
| | San Jacinto County | Texas |
| | Waller County | Texas |
| Indianapolis, IN | Boone County | Indiana |
| | Brown County | Indiana |
| | Hamilton County | Indiana |
| | Hancock County | Indiana |
| | Hendricks County | Indiana |
| | Johnson County | Indiana |
| | Marion County | Indiana |
| | Morgan County | Indiana |
| | Putnam County | Indiana |
| | Shelby County | Indiana |
| Jacksonville, FL | Baker County | Florida |
| | Clay County | Florida |
| | Duval County | Florida |
| | Nassau County | Florida |
| | St. Johns County | Florida |
| Kansas City, MO-KS | Franklin County | Kansas |
| | Johnson County | Kansas |
| | Leavenworth County | Kansas |
| | Linn County | Kansas |
| | Miami County | Kansas |
| | Wyandotte County | Kansas |
| | Bates County | Missouri |
| | Caldwell County | Missouri |
| | Cass County | Missouri |
| | Clay County | Missouri |
| | Clinton County | Missouri |
| | Jackson County | Missouri |
| | Lafayette County | Missouri |
| | Platte County | Missouri |
| | Ray County | Missouri |

| MSA Area | County | State |
| --- | --- | --- |
| Laredo, TX | Webb County | Texas |
| Las Vegas-Paradise, NV | Clark County | Nevada |
| Little Rock-North Little Rock, AR | Faulkner County | Arkansas |
| | Grant County | Arkansas |
| | Lonoke County | Arkansas |
| | Perry County | Arkansas |
| | Pulaski County | Arkansas |
| | Saline County | Arkansas |
| Los Angeles-Long Beach-Santa Ana, CA | Los Angeles County | California |
| | Orange County | California |
| Louisville, KY-IN | Clark County | Indiana |
| | Floyd County | Indiana |
| | Harrison County | Indiana |
| | Washington County | Indiana |
| | Bullitt County | Kentucky |
| | Henry County | Kentucky |
| | Jefferson County | Kentucky |
| | Meade County | Kentucky |
| | Nelson County | Kentucky |
| | Oldham County | Kentucky |
| | Shelby County | Kentucky |
| | Spencer County | Kentucky |
| | Trimble County | Kentucky |
| Memphis, TN-MS-AR | Crittenden County | Arkansas |
| | DeSoto County | Mississippi |
| | Marshall County | Mississippi |
| | Tate County | Mississippi |
| | Tunica County | Mississippi |
| | Fayette County | Tennessee |
| | Shelby County | Tennessee |
| | Tipton County | Tennessee |
| Miami-Fort Lauderdale-Miami Beach, FL | Broward County | Florida |
| | Miami-Dade County | Florida |
| | Palm Beach County | Florida |
| Milwaukee-Waukesha-West Allis, WI | Milwaukee County | Wisconsin |
| | Ozaukee County | Wisconsin |
| | Washington County | Wisconsin |
| | Waukesha County | Wisconsin |
| Minneapolis-St. Paul-Bloomington, MN-WI | Anoka County | Minnesota |
| | Carver County | Minnesota |
| | Chisago County | Minnesota |
| | Dakota County | Minnesota |
| | Hennepin County | Minnesota |
| | Isanti County | Minnesota |
| | Ramsey County | Minnesota |
| | Scott County | Minnesota |

| MSA Area | County | State |
| --- | --- | --- |
| | Sherburne County | Minnesota |
| | Washington County | Minnesota |
| | Wright County | Minnesota |
| | Pierce County | Wisconsin |
| | St. Croix County | Wisconsin |
| Nashville-Davidson-Murfreesboro, TN | Cannon County | Tennessee |
| | Cheatham County | Tennessee |
| | Davidson County | Tennessee |
| | Dickson County | Tennessee |
| | Hickman County | Tennessee |
| | Macon County | Tennessee |
| | Robertson County | Tennessee |
| | Rutherford County | Tennessee |
| | Smith County | Tennessee |
| | Sumner County | Tennessee |
| | Trousdale County | Tennessee |
| | Williamson County | Tennessee |
| | Wilson County | Tennessee |
| New Haven-Milford, CT | New Haven County | Connecticut |
| New Orleans-Metairie-Kenner, LA | Jefferson Parish | Louisiana |
| | Orleans Parish | Louisiana |
| | Plaquemines Parish | Louisiana |
| | St. Bernard Parish | Louisiana |
| | St. Charles Parish | Louisiana |
| | St. John the Baptist Parish | Louisiana |
| | St. Tammany Parish | Louisiana |
| New York-Newark-Edison, NY-NJ-PA | Bergen County | New Jersey |
| | Essex County | New Jersey |
| | Hudson County | New Jersey |
| | Hunterdon County | New Jersey |
| | Middlesex County | New Jersey |
| | Monmouth County | New Jersey |
| | Morris County | New Jersey |
| | Ocean County | New Jersey |
| | Passaic County | New Jersey |
| | Somerset County | New Jersey |
| | Sussex County | New Jersey |
| | Union County | New Jersey |
| | Bronx County | New York |
| | Kings County | New York |
| | Nassau County | New York |
| | New York County | New York |
| | Putnam County | New York |
| | Queens County | New York |
| | Richmond County | New York |
| | Rockland County | New York |

| MSA Area | County | State |
|---|---|---|
| | Suffolk County | New York |
| | Westchester County | New York |
| | Pike County | Pennsylvania |
| Oklahoma City, OK | Canadian County | Oklahoma |
| | Cleveland County | Oklahoma |
| | Grady County | Oklahoma |
| | Lincoln County | Oklahoma |
| | Logan County | Oklahoma |
| | McClain County | Oklahoma |
| | Oklahoma County | Oklahoma |
| Omaha-Council Bluffs, NE-IA | Harrison County | Iowa |
| | Mills County | Iowa |
| | Pottawattamie County | Iowa |
| | Cass County | Nebraska |
| | Douglas County | Nebraska |
| | Sarpy County | Nebraska |
| | Saunders County | Nebraska |
| | Washington County | Nebraska |
| Orlando, FL | Lake County | Florida |
| | Orange County | Florida |
| | Osceola County | Florida |
| | Seminole County | Florida |
| Oxnard-Thousand Oaks-Ventura, CA | Ventura County | California |
| Pensacola-Ferry Pass-Brent, FL | Escambia County | Florida |
| | Santa Rosa County | Florida |
| Philadelphia-Camden-Wilmington, PA-NJ-DE-MD | New Castle County | Delaware |
| | Cecil County | Maryland |
| | Burlington County | New Jersey |
| | Camden County | New Jersey |
| | Gloucester County | New Jersey |
| | Salem County | New Jersey |
| | Bucks County | Pennsylvania |
| | Chester County | Pennsylvania |
| | Delaware County | Pennsylvania |
| | Montgomery County | Pennsylvania |
| | Philadelphia County | Pennsylvania |
| Phoenix-Mesa-Scottsdale, AZ | Maricopa County | Arizona |
| | Pinal County | Arizona |
| Pittsburgh, PA | Allegheny County | Pennsylvania |
| | Armstrong County | Pennsylvania |
| | Beaver County | Pennsylvania |
| | Butler County | Pennsylvania |
| | Fayette County | Pennsylvania |
| | Washington County | Pennsylvania |
| | Westmoreland County | Pennsylvania |

| MSA Area | County | State |
|---|---|---|
| Portland-Vancouver-Beaverton, OR-WA | Clackamas County | Oregon |
| | Columbia County | Oregon |
| | Multnomah County | Oregon |
| | Washington County | Oregon |
| | Yamhill County | Oregon |
| | Clark County | Washington |
| | Skamania County | Washington |
| Providence-New Bedford-Fall River, RI-MA | Bristol County | Massachusetts |
| | Bristol County | Rhode Island |
| | Kent County | Rhode Island |
| | Newport County | Rhode Island |
| | Providence County | Rhode Island |
| | Washington County | Rhode Island |
| Raleigh-Cary, Durham, NC | Franklin County | North Carolina |
| | Johnston County | North Carolina |
| | Wake County | North Carolina |
| Richmond, VA | Amelia County | Virginia |
| | Caroline County | Virginia |
| | Charles City County | Virginia |
| | Chesterfield County | Virginia |
| | Cumberland County | Virginia |
| | Dinwiddie County | Virginia |
| | Goochland County | Virginia |
| | Hanover County | Virginia |
| | Henrico County | Virginia |
| | King and Queen County | Virginia |
| | King William County | Virginia |
| | Louisa County | Virginia |
| | New Kent County | Virginia |
| | Powhatan County | Virginia |
| | Prince George County | Virginia |
| | Sussex County | Virginia |
| | Colonial Heights city | Virginia |
| | Hopewell city | Virginia |
| | Petersburg city | Virginia |
| | Richmond city | Virginia |
| Riverside-San Bernardino-Ontario, CA | Riverside County | California |
| | San Bernardino County | California |
| Rochester, NY | Livingston County | New York |
| | Monroe County | New York |
| | Ontario County | New York |
| | Orleans County | New York |
| | Wayne County | New York |
| Sacramento-Arden-Arcade-Roseville, CA | El Dorado County | California |
| | Placer County | California |
| | Sacramento County | California |

| MSA Area | County | State |
|---|---|---|
| | Yolo County | California |
| Salem, OR | Marion County | Oregon |
| | Polk County | Oregon |
| Salt Lake City, UT | Salt Lake County | Utah |
| | Summit County | Utah |
| | Tooele County | Utah |
| San Antonio, TX | Atascosa County | Texas |
| | Bandera County | Texas |
| | Bexar County | Texas |
| | Comal County | Texas |
| | Guadalupe County | Texas |
| | Kendall County | Texas |
| | Medina County | Texas |
| | Wilson County | Texas |
| San Diego-Carlsbad-San Marcos, CA | San Diego County | California |
| San Francisco-Oakland-Fremont, CA | Alameda County | California |
| | Contra Costa County | California |
| | Marin County | California |
| | San Francisco County | California |
| | San Mateo County | California |
| San Jose-Sunnyvale-Santa Clara, CA | San Benito County | California |
| | Santa Clara County | California |
| Sarasota-Bradenton-Venice, FL | Manatee County | Florida |
| | Sarasota County | Florida |
| Seattle-Tacoma-Bellevue, WA | King County | Washington |
| | Pierce County | Washington |
| | Snohomish County | Washington |
| Spokane, WA | Spokane County | Washington |
| Springfield, MA | Franklin County | Massachusetts |
| | Hampden County | Massachusetts |
| | Hampshire County | Massachusetts |
| St. Louis, MO-IL | Bond County | Illinois |
| | Calhoun County | Illinois |
| | Clinton County | Illinois |
| | Jersey County | Illinois |
| | Macoupin County | Illinois |
| | Madison County | Illinois |
| | Monroe County | Illinois |
| | St. Clair County | Illinois |
| | Franklin County | Missouri |
| | Jefferson County | Missouri |
| | Lincoln County | Missouri |
| | St. Charles County | Missouri |
| | St. Louis County | Missouri |
| | Warren County | Missouri |

| MSA Area | County | State |
|---|---|---|
| | Washington County | Missouri |
| | St. Louis city | Missouri |
| Tampa-St. Petersburg-Clearwater, FL | Hernando County | Florida |
| | Hillsborough County | Florida |
| | Pasco County | Florida |
| | Pinellas County | Florida |
| Toledo, OH | Fulton County | Ohio |
| | Lucas County | Ohio |
| | Ottawa County | Ohio |
| | Wood County | Ohio |
| Tucson, AZ | Pima County | Arizona |
| Tulsa, OK | Creek County | Oklahoma |
| | Okmulgee County | Oklahoma |
| | Osage County | Oklahoma |
| | Pawnee County | Oklahoma |
| | Rogers County | Oklahoma |
| | Tulsa County | Oklahoma |
| | Wagoner County | Oklahoma |
| Virginia Beach-Norfolk-Newport News, VA-NC | Currituck County | North Carolina |
| | Gloucester County | Virginia |
| | Isle of Wight County | Virginia |
| | James City County | Virginia |
| | Mathews County | Virginia |
| | Surry County | Virginia |
| | York County | Virginia |
| | Chesapeake city | Virginia |
| | Hampton city | Virginia |
| | Newport News city | Virginia |
| | Norfolk city | Virginia |
| | Poquoson city | Virginia |
| | Portsmouth city | Virginia |
| | Suffolk city | Virginia |
| | Virginia Beach city | Virginia |
| | Williamsburg city | Virginia |
| Washington-Arlington-Alexandria, DC-VA-MD-WV | District of Columbia | District of Columbia |
| | Calvert County | Maryland |
| | Charles County | Maryland |
| | Frederick County | Maryland |
| | Montgomery County | Maryland |
| | Prince George's County | Maryland |
| | Arlington County | Virginia |
| | Clarke County | Virginia |
| | Fairfax County | Virginia |
| | Fauquier County | Virginia |
| | Loudoun County | Virginia |

| MSA Area | County | State |
|---|---|---|
| | Prince William County | Virginia |
| | Spotsylvania County | Virginia |
| | Stafford County | Virginia |
| | Warren County | Virginia |
| | Alexandria city | Virginia |
| | Fairfax city | Virginia |
| | Falls Church city | Virginia |
| | Fredericksburg city | Virginia |
| | Manassas city | Virginia |
| | Manassas Park city | Virginia |
| | Jefferson County | West Virginia |

# APPENDIX B
# LONG-RANGE TRANSPORTATION PLAN EVALUATIONS

| Evaluation of Long-Range Transportation Plan for Memphis | |
|---|---|
| **Does the vision statement for the planning process include safety?** | • The vision of the Memphis LRTP, "Healthy, vibrant communities that support accessibility and mobility for people and goods and foster economic vitality," does not include safety.<br>• A specific vision statement from the Tennessee Strategic Highway Safety Plan is identified in the plan.<br>• "All roadway users arrive safely at their destination." |
| **Are there at least one planning goal and at least two objectives related to safety?** | • "Promote efficient land use and development patterns to ensure safety, economic viability, and to meet existing and future transportation needs."<br>• "Increase the safety and security of the transportation system for motorized and non-motorized users.<br>• Improving travel safety is a "primary goal" of the LRTP.<br>• SHSP goal is to reduce the fatality rate by 10 percent by the end of CY 2008 based on CY 2002 data.<br>• A variety of planning goals related to safety are identified. |
| **Are safety-related performance measures part of the set being used by the agency?** | • None identified. |
| **Are safety-related data used in problem identification and for identifying potential solutions?** | • Data from the Tennessee Roadway Information Management System (TRIMS) is used to identify locations where high numbers of crashes occur based on crash rates.<br>• This data does not appear to be continually maintained. Rather, the plan indicates that the information was developed for the purpose of creating the LRTP.<br>• Intersections and facilities are evaluated based on whether or not their crash rates exceed the3-year statewide average accident rate. |
| **Are safety analysis tools used regularly to analyze the potential impacts of prospective strategies and actions?** | • None identified. |
| **Are evaluation criteria used for assessing the relative merits of different strategies and projects including safety-related issues?** | • Not able to evaluate. |
| **Do the products of the planning process include at least some actions that focus on transportation safety?** | • Several programs, such as "Click It or Ticket", have been created as a result of actions by the Tennessee Governor's Highway Safety Office. |

| Evaluation of Long-Range Transportation Plan for Memphis | |
|---|---|
| **To the extent that a prioritization scheme is used to develop a program of action for an agency, is safety one of the priority factors?** | • Locations that have been identified as having a higher than average crash rate, based on the 3-year statewide average crash rate, are identified. From that list, projects are created that are included in the Hazard Elimination Safety Program (HESP). No locations currently in this program are in the Memphis area. |
| **Is there a systematic monitoring process that collects data on the safety-related characteristics of transportation system performance, and feeds this information back into the planning and decision-making process?** | • None were identified. |
| **Are all of the key safety stakeholders involved in the planning process?** | • A goal exists to include stakeholders most affected by a transportation decision in the decision-making process.<br>• Stakeholders from a variety of backgrounds were identified t participate in the creation of the plan. |

| Evaluation of Long-Range Transportation Plan for Minneapolis | |
|---|---|
| **Does the vision statement for the planning process include safety?** | • Safety is included, but in a very limited fashion. |
| **Are there at least one planning goal and at least two objectives related to safety?** | • Safety is included as a byproduct of other goals, although a specific goal related to safety does not exist.<br>• Safety is mentioned throughout the document. However, it is not addressed explicitly in its own section. |
| **Are safety-related performance measures part of the set being used by the agency?** | • No safety related performance measures were identified. |
| **Are safety-related data used in problem identification and for identifying potential solutions?** | • No significant references to safety data were identified. |
| **Are safety analysis tools used regularly to analyze the potential impacts of prospective strategies and actions?** | • No mentions of safety analysis tools were found. |
| **Are evaluation criteria used for assessing the relative merits of different strategies and projects including safety-related issues?** | • Safety appears to be included in the project prioritization process, however it is unclear how the safety benefits of a project are weighted relative to other benefits. |
| **Do the products of the planning process include at least some actions that focus on transportation safety?** | • Safety is incorporated into a variety of different topics; however no specific actions items for safety were identified. |
| **To the extent that a prioritization scheme is used to develop a program of action for an agency, is safety one of the priority factors?** | • Safety is mentioned with a variety of topics, however not addressed as an individual priority. |
| **Is there a systematic monitoring process that collects data on the safety-related characteristics of transportation system performance, and feeds this information back into the planning and decision-making process?** | • None were found. |
| **Are all of the key safety stakeholders involved in the planning process?** | • Detailed public participation process outlined. |

| Evaluation of Long-Range Transportation Plan for New Orleans | |
|---|---|
| **Does the vision statement for the planning process include safety?** | • No specific vision was found. |
| **Are there at least one planning goal and at least two objectives related to safety?** | • Six goals are outlined in the plan, none of which address safety.<br>• Safety conscious planning is identified as a priority in the planning document. |
| **Are safety-related performance measures part of the set being used by the agency?** | • No specific performance measures of any kind were found. |
| **Are safety-related data used in problem identification and for identifying potential solutions?** | • No specific data information was found. |
| **Are safety analysis tools used regularly to analyze the potential impacts of prospective strategies and actions?** | • No references to analysis tools were found. |
| **Are evaluation criteria used for assessing the relative merits of different strategies and projects including safety-related issues?** | • None found. |
| **Do the products of the planning process include at least some actions that focus on transportation safety?** | • Cannot determine. |
| **To the extent that a prioritization scheme is used to develop a program of action for an agency, is safety one of the priority factors?** | • The prioritization process is not based on the technical merits of a project.<br>• Rather, a more nontechnical approach is taken to allocate funds. |
| **Is there a systematic monitoring process that collects data on the safety-related characteristics of transportation system performance, and feeds this information back into the planning and decision-making process?** | • Cannot determine. |
| **Are all of the key safety stakeholders involved in the planning process?** | • No public participation process could be identified. |

| Evaluation of Long-Range Transportation Plan for Orlando | |
|---|---|
| **Does the vision statement for the planning process include safety?** | • "A system that safely and efficiently moves people and goods…" |
| **Are there at least one planning goal and at least two objectives related to safety?** | • One specific safety goal with three objectives exist.<br>• Safety is incorporated into a variety of other goals as well.<br>• Safety is addressed extensively in the Congestion Management Plan. |
| **Are safety-related performance measures part of the set being used by the agency?** | • Two safety related performance measures exist.<br>• Lane miles of evacuation routes per thousand people.<br>• Crash rates (per million VMT).<br>• Incident severity is considered in the Congestion Management Plan. |
| **Are safety-related data used in problem identification and for identifying potential solutions?** | • Additional safety data needs are identified. |
| **Are safety analysis tools used regularly to analyze the potential impacts of prospective strategies and actions?** | • Safety is considered when addressing congestion issues (due to nonrecurring congestion).<br>• The need for safety studies to address nonrecurring congestion is addressed. |
| **Are evaluation criteria used for assessing the relative merits of different strategies and projects including safety-related issues?** | • The plan states that safety is used as a factor when prioritizing different projects.<br>• In addition, safety was considered during the creation of the Needs Plan and Cost Feasible Plan.<br>• Safety is included in prioritizing bicycle and pedestrian projects. |
| **Do the products of the planning process include at least some actions that focus on transportation safety?** | • Several programs and initiatives related to safety are included in the plan. |
| **To the extent that a prioritization scheme is used to develop a program of action for an agency, is safety one of the priority factors?** | • Safety has been established as a criterion for the project prioritization list. |
| **Is there a systematic monitoring process that collects data on the safety-related characteristics of transportation system performance, and feeds this information back into the planning and decision-making process?** | • A monitoring program is described that includes assessing the long-term impact of safety-related improvements.<br>• An understanding exists that the benefits of a safety improvement will likely take years to full realize. |

| Evaluation of Long-Range Transportation Plan for Orlando | |
|---|---|
| **Are all of the key safety stakeholders involved in the planning process?** | • A detailed public involvement plan was created for the development of the most recent plan.<br>• An effort to coordinate safety campaigns throughout the region has been identified. |

| Evaluation of Long-Range Transportation Plan for Portland, OR | |
|---|---|
| **Does the vision statement for the planning process include safety?** | • Vision for transportation system includes "provid(ing) safe and reliable travel choices."<br>• Reduce fatalities, serious injuries, and crashes per capita for al modes of travel. |
| **Are there at least one planning goal and at least two objectives related to safety?** | • Fund investments targeted to address known safety deficiencies and high-crash locations.<br>• Complete gaps in regional bicycle and pedestrian systems.<br>• Retrofit existing streets in downtowns and along main streets to include on-street parking, street trees, marked street crossings, and other designs to encourage traffic to follow posted speed limits.<br>• Construct intersection changes and ITS strategies, including signal timing and real-time traveler information on road conditions and hazards.<br>• Expand safety education, awareness, and multi-modal data collection efforts at all levels of government. |
| **Are safety-related performance measures part of the set being used by the agency?** | • Work is underway to develop safety performance measures to track on a regular basis safety related issues through the Congestion Management Process and possibly and eventual State of Safety in the Region report.<br>• The proposed State of Safety in the Region report would recommend actions at local, regional, and state levels.<br>• Table 2.3 – "By 2035, reduce the number of pedestrian, bicyclist, and motor vehicle occupant fatalities plus serious injuries each by 50% compared to 2005." |
| **Are safety-related data used in problem identification and for identifying potential solutions?** | • The plan identifies ODOT's Crash Analysis Unit as the main source of traffic crash data.<br>• ODOT's system is currently in the process of being improved to improve the usability of the data.<br>• The need to improve the crash reporting of crashes that involve less than $1,500 in damage is identified.<br>• Data needs for all modes of travel are identified. |
| **Are safety analysis tools used regularly to analyze the potential impacts of prospective strategies and actions?** | • Safety deficiencies are identified for different projects.<br>• Strategies needed to address the issues are indentified.<br>• High accident locations are identified. |
| **Are evaluation criteria used for assessing the relative merits of different strategies and projects including safety-related issues?** | • Performance measures are outlined to evaluate the overall effectiveness of the transportation system.<br>• The safety deficiencies of different proposed projects are identified and used to consider the merits of a project.<br>• No tools are used to predict safety conditions into the future. This issue is addressed through plan monitoring. |

| Evaluation of Long-Range Transportation Plan for Portland, OR | |
|---|---|
| **Do the products of the planning process include at least some actions that focus on transportation safety?** | • Project monitoring process includes an evaluation of how crash rates change over time. |
| **To the extent that a prioritization scheme is used to develop a program of action for an agency, is safety one of the priority factors?** | • Improving safety is one of six criteria used in evaluating projects for the Transportation System Management and Operations (TSMO) program.<br>• Projects to be emphasized were those that met one or more of seven different criteria, one of which was "make multi-modal travel safe and reliable."<br>• The goal is to link projects to investment priorities. |
| **Is there a systematic monitoring process that collects data on the safety-related characteristics of transportation system performance, and feeds this information back into the planning and decision-making process?** | • Data needs are identified, however it is unclear how, if at all, the analysis of this data is fed back into the planning and decision-making process.<br>• Performance evaluations of desired outcomes are monitored to ensure that progress is being made toward goals. This information is then used as feedback on the RTP policies and investment priorities.<br>• Performance measures serve as the link between RTP goals and plan implementation. |
| **Are all of the key safety stakeholders involved in the planning process?** | • Objective 10.1 states that "meaningful input opportunities for interested and affected stakeholders, including people who have traditionally been underrepresented, resource agencies, business, institutional and community stakeholders, and local, regional and state jurisdictions that own and operate the region's transportation system in plan development and review" should be provided. |

| Evaluation of Long-Range Transportation Plan for Sacramento | |
|---|---|
| **Does the vision statement for the planning process include safety?** | • The document lists six "guiding principles", none of which address safety. |
| **Are there at least one planning goal and at least two objectives related to safety?** | • Specific goals related to safety were not found.<br>• Safety is incorporated into other goals, although as somewhat of a secondary focus. |
| **Are safety-related performance measures part of the set being used by the agency?** | • Specific performance measures directed at safety could not be found. |
| **Are safety-related data used in problem identification and for identifying potential solutions?** | • No safety data references were found. |
| **Are safety analysis tools used regularly to analyze the potential impacts of prospective strategies and actions?** | • No safety analysis was found. |
| **Are evaluation criteria used for assessing the relative merits of different strategies and projects including safety-related issues?** | • Specific evaluation criteria for the safety merits of a project could not be found. |
| **Do the products of the planning process include at least some actions that focus on transportation safety?** | • No information was found. |
| **To the extent that a prioritization scheme is used to develop a program of action for an agency, is safety one of the priority factors?** | • Funding for safety projects is allocated within a program category that also include road maintenance and rehabilitation, maintaining Caltrans highways and freeways, and maintaining local roads and streets. As such, a specific dollar amount allocated to safety projects cannot be determined. |
| **Is there a systematic monitoring process that collects data on the safety-related characteristics of transportation system performance, and feeds this information back into the planning and decision-making process?** | • No information was found. |
| **Are all of the key safety stakeholders involved in the planning process?** | • An extensive public participation process was conducted throughout the development of the plan. |

| Evaluation of Long-Range Transportation Plan for<br>San Antonio | |
|---|---|
| **Does the vision statement for the planning process include safety?** | • Mission statement – "The San Antonio metropolitan area is served by an environmentally friendly transportation system where everyone is able to walk, ride, drive, or wheel in a safe, convenient, and affordable manner to their desired destinations."<br>• Goals include "…enhancing the safety of the traveling public…"<br>• Safety is identified as a goal specifically for each mode of travel. |
| **Are there at least one planning goal and at least two objectives related to safety?** | • In response to SAFETEA-LU requirements, the agencies outlines several actions that could be used to increase the safety of a variety of modes. |
| **Are safety-related performance measures part of the set being used by the agency?** | • No performance measures were identified. |
| **Are safety-related data used in problem identification and for identifying potential solutions?** | • The state Crash Records Information System (CRIS) is reviewed on a quarterly basis and safety related information is presented to stakeholders. |
| **Are safety analysis tools used regularly to analyze the potential impacts of prospective strategies and actions?** | • No safety analysis tools were identified. |
| **Are evaluation criteria used for assessing the relative merits of different strategies and projects including safety-related issues?** | • The current MTP proposes to "consider safety in the project selection process." |
| **Do the products of the planning process include at least some actions that focus on transportation safety?** | • None were identified. |
| **To the extent that a prioritization scheme is used to develop a program of action for an agency, is safety one of the priority factors?** | • Safety is identified as a funding category with specific funds allocated. |
| **Is there a systematic monitoring process that collects data on the safety-related characteristics of transportation system performance, and feeds this information back into the planning and decision-making process?** | • No monitoring system is identified. |

| Evaluation of Long-Range Transportation Plan for San Antonio | |
|---|---|
| **Are all of the key safety stakeholders involved in the planning process?** | • A public involvement process is outlined with the purpose of including the public early, continuously, and in a meaningful way for all transportation related projects. |

| Evaluation of Long-Range Transportation Plan for San Diego | |
|---|---|
| **Does the vision statement for the planning process include safety?** | • The vision statement briefly mentions "increas(ing) public safety" |
| **Are there at least one planning goal and at least two objectives related to safety?** | • One of the seven policy goals of the document is directed at improving the safety and reliability of the transportation system. However, the goal is more focused on reliability than safety.<br>• Safety is addressed more as a byproduct on non-recurring congestion. |
| **Are safety-related performance measures part of the set being used by the agency?** | • No safety related performance measures were identified. |
| **Are safety-related data used in problem identification and for identifying potential solutions?** | • None mentioned. |
| **Are safety analysis tools used regularly to analyze the potential impacts of prospective strategies and actions?** | • None mentioned. |
| **Are evaluation criteria used for assessing the relative merits of different strategies and projects including safety-related issues?** | • None mentioned. |
| **Do the products of the planning process include at least some actions that focus on transportation safety?** | • None mentioned. |
| **To the extent that a prioritization scheme is used to develop a program of action for an agency, is safety one of the priority factors?** | • None mentioned. |
| **Is there a systematic monitoring process that collects data on the safety-related characteristics of transportation system performance, and feeds this information back into the planning and decision-making process?** | • None mentioned. |
| **Are all of the key safety stakeholders involved in the planning process?** | • None mentioned. |

| Evaluation of Long-Range Transportation Plan for San Jose (San Francisco Bay Area) | |
|---|---|
| **Does the vision statement for the planning process include safety?** | • Vision includes a statement about creating a safe transportation system. |
| **Are there at least one planning goal and at least two objectives related to safety?** | • Improving safety is included as a goal.<br>• Reducing collisions and fatalities is included as an objective.<br>• Specific goals of reducing different crash types by a certain percentage by 2035. |
| **Are safety-related performance measures part of the set being used by the agency?** | • Occurrence of traffic fatalities and injuries. |
| **Are safety-related data used in problem identification and for identifying potential solutions?** | • ITS devices are used to located incidents on roadways.<br>• |
| **Are safety analysis tools used regularly to analyze the potential impacts of prospective strategies and actions?** | • Crash statistics are used to evaluate the trends that occur over time for the region. |
| **Are evaluation criteria used for assessing the relative merits of different strategies and projects including safety-related issues?** | • Not able to determine. |
| **Do the products of the planning process include at least some actions that focus on transportation safety?** | • Projects focused on safety improvements are referenced. |
| **To the extent that a prioritization scheme is used to develop a program of action for an agency, is safety one of the priority factors?** | • Not able to determine. |
| **Is there a systematic monitoring process that collects data on the safety-related characteristics of transportation system performance, and feeds this information back into the planning and decision-making process?** | • Plan includes several goals related to reducing different crash types by 2035.<br>• Achieving this goal requires monitoring of crash occurrences, although specific feedback considerations are not mentioned. |
| **Are all of the key safety stakeholders involved in the planning process?** | • Public outreach programs were in place for the development of the transportation plan. |

| Evaluation of Long-Range Transportation Plan for Tampa | |
|---|---|
| **Does the vision statement for the planning process include safety?** | • No vision statement located. |
| **Are there at least one planning goal and at least two objectives related to safety?** | • Goal V: Enhance the safety and security of the transportation system for both motorized and non-motorized users.”<br>• This goal is supplemented by several proposed policies to attain this goal. |
| **Are safety-related performance measures part of the set being used by the agency?** | • Performance measures are not addressed specifically. However, references to improvements in the number of fatalities and injuries due to traffic crashes are mentioned throughout. |
| **Are safety-related data used in problem identification and for identifying potential solutions?** | • Crash data is used to develop lists of high crash locations.<br>• Crash data is analyzed to compare crash rate trends in the Tampa area to the rates for the State of Florida and the national average.<br>• An analysis of the top locations based on a variety of factors, including the number of injuries, fatalities, bicycle crashes, and pedestrian crashes, are also done. |
| **Are safety analysis tools used regularly to analyze the potential impacts of prospective strategies and actions?** | • See box above. |
| **Are evaluation criteria used for assessing the relative merits of different strategies and projects including safety-related issues?** | • The safety benefits of a project are included in the project prioritization process.<br>• The safety benefits of a project are weighted the highest compared to other potential project benefits. |
| **Do the products of the planning process include at least some actions that focus on transportation safety?** | • None mentioned. |
| **To the extent that a prioritization scheme is used to develop a program of action for an agency, is safety one of the priority factors?** | • Safety is used in the project prioritization process.<br>• No other instances were found. |
| **Is there a systematic monitoring process that collects data on the safety-related characteristics of transportation system performance, and feeds this information back into the planning and decision-making process?** | • Extensive data collection is done, however no monitoring of specific programs was mentioned.<br>• Overall trends related to crash occurrences have been positive and thus it appears that there is an assumption that current programs are working. |

| Evaluation of Long-Range Transportation Plan for Tampa | |
|---|---|
| **Are all of the key safety stakeholders involved in the planning process?** | • An objective of the agency is to "support community education and involvement in transportation planning." |

# APPENDIX C
# DATA SOURCES

Fatality data was queried from the Fatality Accident Reporting System (FARS) database.

Injury Data Sources:

Alabama: 2008 Alabama Crash Facts Report

Alaska: 2007 Alaska Traffic Crashes Report

Arizona: Arizona Motor Vehicle Crash Facts 2008 Report

Arkansas: Arkansas 2007 Traffic Crash Statistics Report (not revised)

California: California Highway Patrol Data Request

Colorado: Provided by Colorado DOT representative

Connecticut: Provided by Connecticut DOT representative

Washington, DC: Could not locate

Florida: Traffic Crash Statistics Report 2008

Georgia: Provided by Georgia Governor's Office of Highway Safety representative

Hawaii: Could not locate

Illinois: Illinois Crash Facts and Statistics Annual Report 2008

Indiana: Indiana Crash Facts 2008

Iowa: Iowa DOT website - http://www.iowadot.gov/crashanalysis/county.htm

Kansas: 2008 Kansas Traffic Accident Facts Book

Kentucky: Kentucky Traffic Collision Facts 2008 Report

Louisiana: Louisiana Traffic Records Data Report 2008

Maryland: University of Maryland website - http://medschool.umaryland.edu/nscfortrauma/traffic_book2007_county_list.asp

Massachusetts: Provided by Massachusetts DOT representative

Michigan: Michigan Office of Highway Safety Planning website - http://www.michigantrafficcrashfacts.org/doc/2008/quick_2.pdf

Minnesota: Minnesota Office of Traffic Safety 2008 Crash Facts

Mississippi: Provided by Mississippi DOT representative

Missouri: Provided by Missouri State Highway Patrol representative

Nebraska: State of Nebraska 2008 Traffic Crash Facts Annual Report

Nevada: Data provided by Nevada DOT representative

New Hampshire: Provided by New Hampshire DOT representative

New Jersey: Raw data set provided by New Jersey DOT website - http://www.state.nj.us/transportation/refdata/accident/rawdata01-03.shtm

New Mexico: 2007 New Mexico Traffic Crash Information Report

New York: New York State Traffic Safety Data Report, February 2009

North Carolina: North Carolina DOT website - http://www.ncdot.org/doh/preconstruct/traffic/safety/data/profiles.html

Ohio: Ohio Traffic Crash Facts Report 2008

Oklahoma: 2008 Oklahoma Crash Facts Report

Oregon: Oregon DOT website - http://www.oregon.gov/ODOT/TD/TDATA/car/CAR_Publications.shtml

Pennsylvania: Provided by Pennsylvania DOT representative

Rhode Island: Could not locate

South Carolina: South Carolina 2007 Traffic Crash Collision Fact Book Report

Tennessee: Tennessee Department of Safety website - http://tennessee.gov/safety/stats/CrashData/default.html

Texas: Texas DOT website - http://www.txdot.gov/txdot_library/drivers_vehicles/publications/crash_statistics/default.htm

Utah: 2007 Utah Crash Summary Report

Virginia: 2008 Virginia Traffic Crash Facts Report

Washington: 2008 Washington State Collision Data Summary Report

Washington, DC: Could not locate

West Virginia: Could not locate

Wisconsin: Provided by Wisconsin Bureau of Transportation Safety representative

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