OREGON TRANSPORTATION SAFETY ACTION PLAN

Chapter 4 – Safety Challenges and Opportunities

prepared for

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THE HUMAN IMPACT OF CRASHES

The loss of a family member or friend to a sudden and unexpected crash is devastating. Over 30,000 motor vehicle crash victims and their families experience this every year in the United States, including over 400 in Oregon in 2015.

The impacts of a motor vehicle fatality are far-reaching. Not only is the crash victim's life cut short, but spouses, children, parents, extended families, friends, and coworkers are each impacted in ways that are difficult to measure: the loss of a child is an unimaginable burden for most parents that they will carry for the remainder of their life; the premature death of a parent leaves a permanent void in a child's life; a spouse or friend lost in a crash can never be replaced. These experiences can fundamentally change the quality of a person's life.

Fortunately, Oregon has made great progress in reducing crash fatalities and associated impacts over the past ten years; however, individuals and families are also significantly impacted by debilitating injuries. In 2013, more than 1,400 people suffered incapacitating injuries in motor vehicle crashes in Oregon. Outcomes from these crashes can range from a short-term inconvenience (e.g., broken arm, concussion) to a life-altering injury (e.g., paralysis, loss of a limb). Life-altering injuries can further lead to depression and other health problems which again impact not only the victim, but friends, families, and coworkers as well.

Crashes and resulting injuries have historically been considered by many as an inevitable consequence of mobility. However, more recently this idea has been challenged as countries, states, and cities across the world seek to eliminate traffic fatalities entirely. The idea may be difficult to grasp initially, but when people are asked how many traffic fatalities are acceptable for their friends and family, the universal response is: 'zero'.

A change in culture is needed to shift the philosophy from one where crashes, fatalities, and injuries are seen as a consequence of mobility to one where these events are viewed as a failure of society. To accomplish this, everyone must not only be responsible for ensuring their own safety, but must go a step further by protecting the lives of others through responsible decision-making.

As long as drivers engage in risky behaviors such as driving under the influence of alcohol or drugs, speeding, not wearing seat belts, or texting while driving fatalities and injuries will continue to occur on our roads. Furthermore, unless we design our roads for the speeds that are appropriate to the land use and geographic context and the types of users expected, crashes will continue as before. A multidisciplinary approach is required, with dedicated and sustained effort from government agencies representing the 4 Es of Safety (Engineering, Enforcement, Education, and Emergency Response) as well as the public.

THE ECONOMIC COST OF CRASHES

While it is difficult to quantify the emotional costs of crashes, it is possible to estimate the purely financial impacts of lost lives, injuries, and property damage attributable to crashes involving motor vehicles. Economists often use two approaches to quantify the costs of crashes: economic costs and comprehensive costs. Economic costs can generally be described as those costs which are measurable, while comprehensive costs include the economic costs as well as lost quality of life.

Consistent with the 2011 Transportation Safety Action Plan (TSAP), crash costs developed by the National Safety Council (NSC) are used in this chapter to estimate the statewide economic cost of crashes. Understanding the economic cost of crashes will help Oregon's policy makers and the public compare the scale of the traffic safety problem to other societal concerns.

The NSC defines the economic cost of crashes as 'a measure of the dollars spent and income not received due to accidents, injuries, and fatalities.' This includes costs associated with lost wages and productivity, travel delay, medical expenses and emergency response, administrative costs, damage to motor vehicles and property, and additional costs borne by employers as a result of fatalities or injuries.

NSC economic crash costs are as follows:

Comprehensive crash costs attempt to account for lost quality of life in addition to the economic costs described in this chapter. NHTSA and FHWA estimate the comprehensive cost of a motor vehicle fatality at over $9 million per fatality.[1] Using more conservative (lower) NSC estimates ($4.6 million per fatality), the total comprehensive crash cost for Oregon over the 2009-2013 timeframe was $15.6 billion, or around $785 per year for each Oregon resident, compared to roughly $300 per year in economic costs.

Table 1. National Safety Council Economic Crash Costs (U.S. Average)[1]

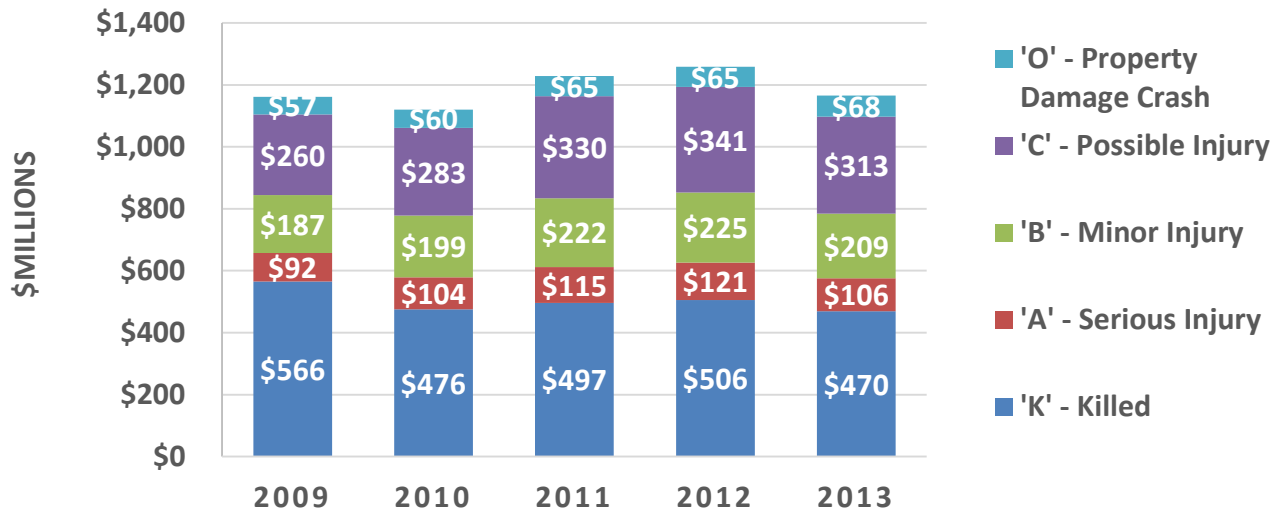
Injury Severity	Cost (2013 dollars)
K – Killed	$1,500,000 per Person
A – Disabling Injury	$74,900 per Person
B – Evident Injury	$24,000 per Person
C – Possible Injury	$13,600 per Person
O – No Injury	$2,600 per Crash

Source: National Safety Council. Estimating the Costs of Unintentional Injuries, 2013.

[1] 'K' crashes as used by the NSC and in this technical memo are equivalent to 'F' (fatal) crashes in the TSAP document. Similarly, 'A' crashes are equivalent to 'serious injury' or 'incapacitating injury' crashes in the TSAP document or elsewhere.

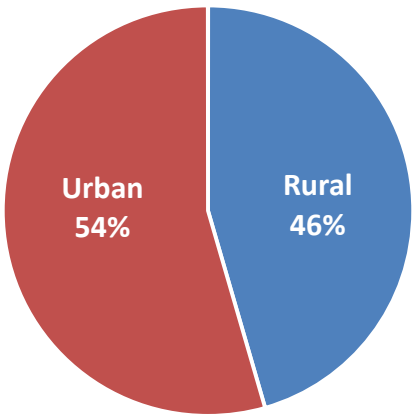
Based on these estimates, the economic cost of crashes in Oregon in 2013 was $1,166,000,000, or close to 1.2 billion dollars.[2] Figure 1 provides a breakdown of economic crash costs by year and severity level from 2009-2013. The total economic crash cost to Oregon over the five year period was close to six billion dollars ($5.9B), or roughly $300 per Oregon resident per year.

Figure 1. Oregon Economic Crash Costs by Year, 2009-2013 (Millions)



Crashes in rural areas tend to be more severe than those in urban areas. As a result, despite having significantly fewer crashes, rural areas account for 46 percent of the total economic crash cost burden in Oregon ($2.7B from 2009 to 2013 compared to $3.2B in urban areas; Figure 2).

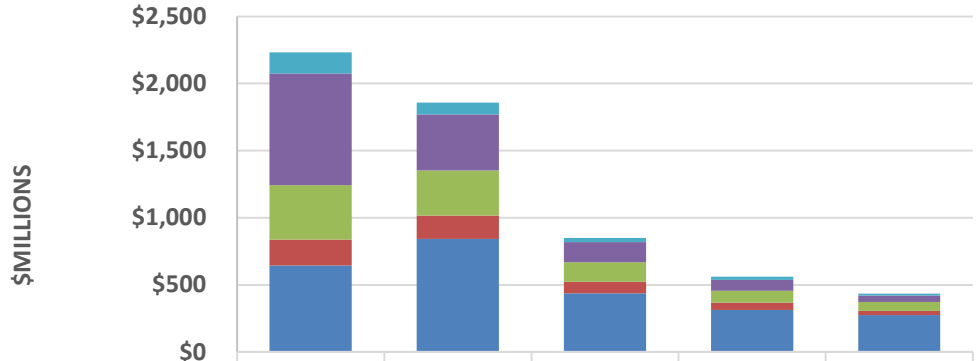
Figure 2. Oregon Economic Crash Costs by Rural/Urban Geography, 2009-2013 (Millions)



[2] Crash cost estimates are obtained by multiplying the injury costs shown in Table 1 by the number of injuries for each severity level. For example, in 2013 there were 313 fatalities, each with an associated economic cost of $1.5 million. As a result the total economic cost of fatalities in 2013 was $470 billion (313 x $1,500,000 = $469,500,000).

Another way to evaluate the geographic distribution of crash costs is by ODOT region. Figure 3 shows the distribution of crash costs by injury severity across the five ODOT regions. The Portland Metro region (ODOT Region 1) experiences the highest overall burden, followed by the Willamette Valley region (ODOT Region 2). Region 1 has the greatest number of crashes by a significant margin, but Region 2 actually has a higher number of fatalities (561 in Region 2 from 2009 to 2013 compared to 430 in Region 1), which drives up the economic cost.

Figure 3. Economic Crash Costs by ODOT Region, 2009-2013 (Millions)



	1 - Portland Metro	2 - Willamette Valley, North and Mid- Coast	3 - Southern Oregon and South Coast	4 - Central Oregon	5 - Eastern Oregon
'O' - Property Damage Crash	$155	$88	$33	$24	$14
'C' - Possible Injury	$834	$417	$150	$80	$47
'B' - Minor Injury	$405	$336	$146	$88	$67
'A' - Serious Injury	$192	$175	$84	$54	$33
'K' - Killed	$645	$842	$438	$314	$275

Transportation Safety Challenges and Opportunities

The TSAP establishes the framework needed to save lives and reduce injuries within these changing social, demographic, technological, and policy contexts. Given the significant impact of crashes on Oregon's families, communities and economy, it is important to look broadly at the challenges and opportunities for reducing these impacts.

Challenges

Significance of Motor Vehicle Crashes Compared to Other Causes of Death and Injury Traffic

Injuries were responsible for 2,595 deaths in Oregon in 2013, making the category the third leading cause of death behind cancer (7,771 deaths) and heart disease (6,464 deaths). However,

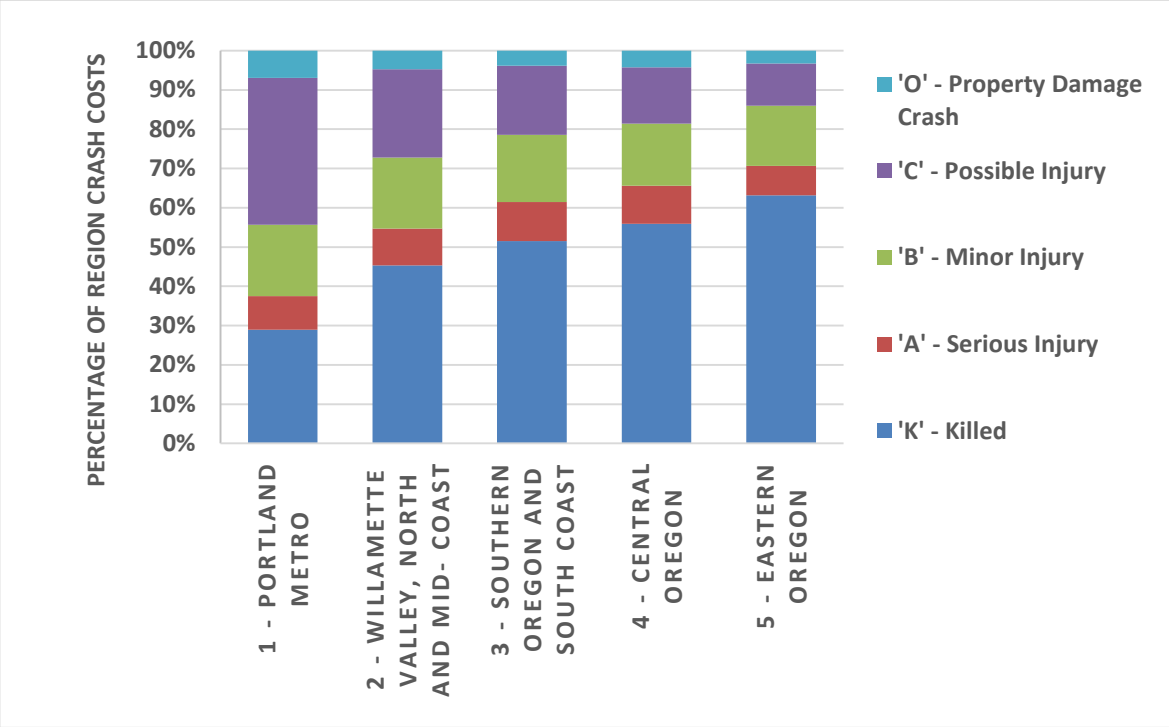
among the population 44 years or younger (excluding newborns), injuries have been the leading cause of death each year since 2000. As a result, more years of life are lost to injury than other causes of death in Oregon.

Within the injury category, motor vehicle crashes are the fourth leading cause of death, behind suicide, unintentional falls, and unintentional poisoning (e.g., alcohol poisoning or drug overdose). The Oregon Health Authority estimates that the number of motor vehicle fatalities per 100,000 Oregon residents fell from 13.4 per year in 2000 to 8.2 in 2013, a 39 percent decline. Hospitalization rates for motor vehicle related injuries also fell by around 30 percent during the same period. These trends are encouraging, especially relative to trends for other injury types. For example, mortality rates from both unintentional falls and poisoning more than doubled during that timeframe.

Equity (Geographic and Sociodemographic)

The burden of traffic crashes is not distributed evenly across society. As discussed above, rural areas experience a disproportionate share of fatalities and serious injuries, and associated costs. Figure 4 shows the distribution of crash costs by severity for each of ODOT's five regions. Fatalities make up a greater share of costs in regions that are more rural in character. For example, in Region 5 (Eastern Oregon), fatalities account for more than 60 percent of crash costs, while in Region 1 (Portland Metro), they are responsible for only 30 percent of costs.

Figure 4. Percentage of Regional Crash Costs by Severity



While only 19 percent of the Oregon population lives in rural areas, 67 percent of fatalities occur in these areas, along with almost half of severe injuries (48 percent).[3] Longer emergency response times and constrained medical resources are likely to explain much of the difference in severity between urban and rural areas, but other factors are also at play. For example, a higher percentage of fatalities in rural areas involved occupants failing to use seat belts (32 percent in rural areas compared to 22 percent in urban areas). Similarly, 71 percent of speed-related fatalities and serious injuries were on rural roadways.

Shifting Demographics

Oregon's population grew by over 5 percent from 2010 to over 4 million people in 2015, which was slightly faster than the U.S. overall. This growth translates into higher levels of travel and commercial activity, especially in metropolitan areas where most of the growth has occurred.[4]

Oregon is also experiencing an increase in the older driver population as baby boomers move into and through the retirement years. The portion of the population 65 years or older increased from 12.8 percent in 2000 to 13.9 percent in 2010 and 16 percent in 2014.[5] Although older drivers are safer in many respects than younger and middle age drivers, they have lower survival rates when involved in crashes, which could contribute to an increase in motor vehicle fatalities.

Competing Priorities in Urban Areas

There are several unique transportation challenges in urban areas. The mix of land uses, variety of travel purposes, and overall density of activity result in conflicts between user groups that are not easily resolved. Congestion is a natural outcome from this mix and density of activities in urban areas. It impacts travel users by imposing longer travel times, which results in higher levels of air pollution, increased travel costs, and frustration. One response to congestion is to increase the capacity of roads; however, while wider roads with higher capacity and travel speeds provide greater mobility, they must be carefully designed and operated to ensure the safety of all road users.

Technology Concerns

While technology has made and continues to make significant contributions to road safety, it is not always beneficial. For example, the proliferation of cell phones and other handheld devices

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[3] U.S. Census Bureau. Oregon: 2010, Population and Housing Units. 2010 Census of Population and Housing. August 2012. https://www.census.gov/prod/cen2010/cph-2-39.pdf

[4] Portland State University Population Research Center. Oregon Annual Population Report. 2014. http://www.pdx.edu/prc/sites/www.pdx.edu.prc/files/Oregon_Annual_Pop_Report_Tables_2014_v3.pdf

[5] U.S. Census Bureau. American Fact Finder.

has given rise to a distracted driving problem. Unfortunately, reliable statistics on the use of cell phones while driving and as a contributor to crashes and injuries are difficult to obtain, but available data and anecdotal evidence point to distraction as a significant traffic safety concern. A recent survey conducted by Southern Oregon University found that three out of four drivers engage in distracted driving. Furthermore, 83 percent of respondents felt that distracted driving is an important safety concern on Oregon's roads.[6] Research into the impact of various types of distraction on cognitive abilities confirms the risks associated with the use of technology while driving.[7]

Technological innovation can be expensive to implement and the benefits do not always outweigh the costs. For example, rigorous commercial vehicle driver training may in some cases be less expensive than implementing technology requirements that are potentially less effective. Equity is another concern stemming from the cost of technology. Advancements in technology are slower to reach lower income residents and those in rural areas, where a significant portion of fatalities and serious injuries occur.

Opportunities

Mobility and System Efficiency Benefits of Reducing Crashes and Injuries

While mobility and safety are often thought of as competing goals, this is not always the case. Crashes are part of a broader category of congestion referred to as 'non-recurring congestion', which also includes congestion resulting from disabled vehicles, work zones, adverse weather, and special events.[8] Crashes impose costs on society through increased travel time, wasted fuel, and increased emissions. The vast majority of these costs are experienced on urban interstates and expressways. A single crash typically affects travel conditions from around 25 minutes to an hour and a half, depending on pre-crash traffic density, whether travel lanes are closed, and the severity of the crash.[9] Generally more severe crashes impose higher congestion costs. According to NHTSA, crashes resulted in $28 billion in congestion-related costs to the U.S. economy in

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[6] Angela Durant et al. Distracted Driving: an Epidemic, A Study of Distracted Driving Attitudes, Behaviors and Barriers Preventing Change. Southern Oregon University, Prepared for Oregon Department of Transportation. https://www.oregon.gov/ODOT/Documents/Distracted%20Driving%20An%20Epidemic.pdf

[7] AAA Foundation for Traffic Safety. Measuring Cognitive Distraction in the Automobile. 2013. https://www.aaafoundation.org/sites/default/files/MeasuringCognitiveDistractions.pdf

[8] FHWA. Office of Operations. Reducing Non-Recurring Congestion. 2015. http://ops.fhwa.dot.gov/program_areas/reduce-non-cong.htm

[9] National Highway Traffic Safety Administration. The Economic and Societal Impact of Motor Vehicle Crashes. 2010. http://www-nrd.nhtsa.dot.gov/pubs/812013.pdf

2010. Reducing crashes therefore is a significant opportunity to improve the economy through not only the reduction of injury costs, but also through reduced congestion costs.

The Role of Technology

Throughout history, technology has played a pivotal role in transportation safety. A few notable past examples are shown in Table 2.

Table 2. Examples of Significant Past Technological Innovations for Improved Safety

Application Area	Technological Innovation
Vehicle safety	• Reduced likelihood of getting in a crash (e.g., anti-lock brakes, traction control, anti-roll bars) • Improved crash injury outcomes (e.g., seat belts, air bags, child passenger seats, crumple zones)
Infrastructure	• Improved pavement technology to increase traction • More conspicuous signs and markings • Cable median barriers and guardrails
Law Enforcement	• Breathalyzers and other devices to detect impaired drivers • Ignition interlock devices to reduce repeat DUI offenses • Speed and red-light running cameras
Emergency Response	• Improved communications to reduce response time • Advanced equipment to sustain life following a severe crash
Problem Identification and Research	• Sophisticated methods and data to identify intersections and corridors with the greatest safety concern • Advanced research into crash causes and countermeasures • Integration of datasets across agencies and disciplines to better understand and address traffic safety issues •

Connected and Automated Vehicles

Technology continues to evolve and influence traffic safety. Perhaps the most significant safety-related technological change on the horizon is the introduction of connected vehicles to the road network. Connected vehicles have the potential to reduce the likelihood of crashes through the use of vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) applications. Examples of V2V and V2I applications include:

- V2V: forward collision warning, emergency electronic brake light, blind spot/lane change warning, do not pass warning, intersection movement assist, and left turn assist.
- V2I: curve speed warning, red light violation warning, spot weather information warning, reduced speed zone warning, stop sign gap assist, smart roadside, and transit pedestrian warning.

Automated vehicles are an extension of the connected vehicles concept where some or all of the driving function is handled by the vehicle itself. In the case of fully automated vehicles, human input would be limited to providing destination information only. In theory, such vehicles hold the potential to eliminate crashes altogether and would also bring about other beneficial outcomes, such as reduced congestion. However, there are numerous technical, legal, policy, and implementation challenges that must be resolved before connected and automated vehicles will significantly impact safety outcomes. Furthermore, the widespread implementation of these vehicles and associated infrastructure will not happen overnight. Rather, the technology will be gradually integrated into the fleet as new vehicles are purchased. Regulation may help to promote or require V2V and V2I in new car purchases, but even so the turnover in the fleet is such that it may be several decades before fully autonomous vehicles are widely implemented.[10]

Safety Analytics

The use of analytical tools and processes offers a more immediate application of technology to transportation safety. The increasing quality and quantity of safety-related data (e.g., crash, roadway inventory, and volume) is enabling new insights into the causes of crashes and possible measures to reduce their occurrence or severity. Advances in statistical modeling have enabled more reliable problem identification and application of safety countermeasures taking advantage of available data. Additionally, some agencies have begun to use prior crash history to forecast the likely occurrence of crashes and to proactively deploy law enforcement and emergency response resources accordingly.[11]

Shifting Transportation and Lifestyle Preferences

Like most states, Oregon's population has become increasingly focused in urban and suburban areas over the past few decades. The share of the population living in metropolitan areas increased from 77 percent in 2000 to 83 percent in 2014. This trend is likely to continue as the Portland region in particular attracts migrants from across the country.

Along with the overall trend toward living in urbanized areas, urban centers are also becoming denser. Increased density is being driven by a number of factors, including the preference among

[10] http://www.vtpi.org/avip.pdf

[11] http://www.timesfreepress.com/news/local/story/2014/aug/01/new-software-predicts-when-and/263323/

empty nesters and millennials for urban lifestyles, where a variety of amenities are within close proximity.

Transportation and land use patterns in urban areas tend to support the use of transit, bicycling, and walking, as well as relatively newer transportation forms such as car sharing and transportation network company services (e.g., Uber). Widespread use of smart phones and other mobile devices are playing a pivotal role in advancing new ways for people travel in the city.

All of these trends associated with greater urbanization impact safety outcomes. Crashes in urban areas tend to have better outcomes due to lower speeds and access to medical services. Per-capita miles traveled are also lower in urban areas, reducing exposure.[12]

The use of transit in urban areas likely contributes to improved safety. Transit is one of the safest modes of transportation[13] and it provides an alternative to driving for many commuters who would otherwise drive or who should not be operating a vehicle for health or other reasons. The role of transit in improving safety outcomes has not been fully explored in the literature, but research has demonstrated that cities with higher per capita transit use also have lower per capita fatality rates.[14]

Less is known about the relationship of the level of walking and bicycling to safety outcomes for these modes or for the broader public. A 'safety in numbers' theory has been proposed, suggesting that higher levels of walking and bicycling result in lower crash rates involving these modes. While data consistent with this theory has been presented from several countries, a consensus on this question has not been reached. For instance, data from Portland indicates that while bicycle traffic on Portland's bridges increased from 2,850 in 1991 to 18,794 in 2011 (a more than six fold increase) the number of bicycle crashes approximately only doubled, increasing from 155 to 297. However, during the same period bikeway facility miles increased by a factor of four (from 70 to 307 miles). It is possible that one or both of these factors played a role in reducing the crash rate, but it cannot be determined without a more rigorous study. Nonetheless, the evidence suggests that at the very least, higher levels of bicycling and walking do not result in a dramatic increase in crashes.

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[12] Federal Highway Administration. 2009 National Household Travel Survey: Summary of Travel Trends. 2011. http://nhts.ornl.gov/2009/pub/stt.pdf

[13] Bureau of Transportation Statistics. Distribution of Transportation Fatalities by Mode. http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/html/table_02_04.html

[14] Litman, T. A New Transit Safety Narrative. Journal of Public Transportation, Vol. 17, No. 4, 2014. http://www.nctr.usf.edu/wp-content/uploads/2014/12/JPT17.4_Litman.pdf

Another significant trend in urban areas is the emergence of the sharing economy. Car sharing and Transportation Network Companies (TNCs) such as Uber and Lyft are changing the relationship between the public and their vehicles. In particular, these innovations make it easier for people to live car-free and potentially result in fewer vehicle miles traveled and thus fewer crashes on our roadways. TNCs may also have a positive impact on risky behaviors such as impaired driving.[15]

[15] Greenwood, B. & S. Wattal. Show Me the Way to Go Home: An Empirical Investigation of Ride Sharing and Alcohol Related Motor Vehicle Homicide. Fox School of Business Research Paper No. 15-054. 2015. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2557612&download=yes