

**Towards a Vision Zero Policy Theory: Examining  
Emerging Road Safety Initiatives in U.S. Cities**

A thesis submitted by

Nathaniel J. Fink

in partial fulfillment of the requirements for the degree of

Master of Arts

in

Urban and Environmental Policy and Planning

Tufts University

August 2016

Adviser: Justin Hollander

Reader: Mark Chase

## **Abstract**

In recent years, U.S. municipalities have adopted Vision Zero policies aimed at eliminating roadway fatalities and serious injuries. This comes at a time when many cities are promoting walking and cycling in order to achieve various transportation, environmental and public health goals. Vision Zero, which originated in Sweden in 1997, proposes a systematic approach to road safety in which transportation professionals share an equal burden of responsibility with road users for outcomes. This thesis presents a working theory of Vision Zero within the context of U.S. municipal level policy through a qualitative mixed-methods approach that included content analysis of Vision Zero action plans and interviews with municipal officials. Core principles, problem framing, and implementation strategies are explored in depth. The findings of this research are relevant for Vision Zero policy proponents within and outside of government and for transportation professionals involved with policy implementation.

## Acknowledgements

While writing a Master's thesis may be a solitary pursuit, it is one that nonetheless cannot be achieved alone. First, I'd like to thank my adviser Professor Justin Hollander for guiding me through the process and for helping me craft a rigorous qualitative research approach. Mark Chase, my reader, was an indispensable resource and mentor throughout my two years in graduate school. Nick Jackson, Michelle Danila and Beth Isler at Toole Design Group were each instrumental and helpful in guiding me towards a research topic. My interest in exploring this topic area was kindled through working at Toole Design Group. I thank Leah Shahum of the Vision Zero Network for providing guidance in shaping a research focus and for connecting me with Vision Zero professionals throughout the country. Each interviewee deserves thanks for taking time from their busy schedule to contribute to this research. Finally, I could not have done this without the support of my immediate family. They continuously encouraged me and were always curious about what I was up to. I credit my father, and the day-long bike rides around Boston we took when I was a child, for fostering my passion for sustainable transportation. Very special gratitude goes my fiancé and life partner David who kept me going towards the finish line.

## Table of Contents

1	Introduction.....	1
1.1	Research Context.....	8
1.2	Research Questions .....	10
2	Literature Review.....	11
2.1	Policy Principles.....	11
2.2	Policy Origins .....	13
2.3	A Departure from Tradition.....	15
2.4	Technical Implementation .....	19
2.5	Critical Perspectives.....	22
2.6	Vision Zero Goes Abroad.....	27
2.7	Vision Zero in the U.S.....	31
3	Methods .....	35
3.1	Content Analysis .....	36
3.2	Interviews.....	39
4	Results .....	41
4.1	Core Principles .....	42
4.2	Problem Framing.....	50
4.3	Implementation Strategies.....	59
5	Conclusion .....	73
5.1	Summary of Research Findings.....	73
5.2	Limitations .....	77
5.3	Future Research Potential .....	78
5.4	Implications for Practice .....	79
6	Bibliography .....	83

## List of Tables

Table 1: Comparison of death rates between U.S. Vision Zero cities and select nations .....	6
Table 2: Change in population and bicycle mode share in Vision Zero cities 2000-2010.....	8
Table 3: List of Vision Zero cities with action plans .....	37
Table 4: Core Principles theme frequency by action plan .....	42
Table 5: Who is Affected theme frequency by action plan.....	51
Table 6: Contributing Factors theme frequency by action plan .....	53
Table 7: Why it's Needed theme frequency by action plan .....	57
Table 8: Building Capacity theme frequency by action plan.....	61
Table 9: The "E's" theme frequency by action plan .....	67
Table 10: Users and Groups theme frequency by action plan.....	70

# 1 Introduction

Over the past several years, U.S. municipalities have been at the forefront of adopting ambitious Vision Zero road safety initiatives aimed at eliminating roadway fatalities and serious injuries. While safety has increased year-over-year for motor vehicle occupants in the United States, vulnerable road users such as pedestrians and cyclists continue to make up a disproportionate share of fatalities and injuries (USDOT 2014). This comes at a time when the benefits of walking and biking for transportation have become increasingly accepted strategies to reduce congestion, improve public health, decrease greenhouse gas emissions, and use transportation resources more efficiently (Hinde and Dixon 2005; Lovegrove and Litman 2007; Adkins et al. 2012). Yet, perceived lack of safety remains a major barrier for many people to bicycle for transportation (Dill and McNeil 2013). Improving road safety through Vision Zero policies is a potential strategy to address many of the deficiencies of the road transportation system.

Viewed from an epidemiological perspective, traffic fatalities and serious injuries are considered predictable and preventable (Richter et al. 2006). On a global scale, the World Health Organization has identified traffic fatalities as a leading cause of preventable death worldwide (Toroyan 2015), and many nations including the U.S. have established quantified road safety targets (Wong and Sze 2009; Federal Highway Administration 2016). Approximately 32,000 people die on U.S roads every year (NHTSA 2016).

Depending on the year and method of measuring, traffic fatalities might rank between the eleventh and thirteenth leading cause of death in the U.S. Of these fatalities, roughly 17 percent are pedestrians or cyclists; between 2009–2012, fatalities for both of these modes increased (USDOT 2014). The fatality rate for these modes is disproportionate considering that walking and cycling trips comprise only 3.4 percent of journeys to work in the U.S. (McKenzie 2014).

In addition to fatalities and serious injuries, the road system produces numerous negative environmental, public health, and economic externalities. Twenty-six percent of annual greenhouse gas emissions in the U.S.—6,870 million metric tons of CO<sup>2</sup>—come from the transportation system (EPA 2016). At the local level, exposure to fine particulate matter from automobile exhaust has been shown to increase incidence of respiratory and cardiac diseases (Patton et al. 2014). These effects are most noticeable near high-volume, high speed roadways, many of which are located in low-income and/or minority communities (Brugge et al. 2015). Reliance on private cars and concomitant land use decisions discourage active forms of transportation and contribute to obesity and related health problems as a result of a sedentary lifestyle (Hinde and Dixon 2005).

Economic and societal impacts of the road transportation are numerous and substantial. Travel delays above a certain threshold inhibit job growth in U.S. metropolitan areas (Sweet 2014). Congestion reduces the benefits of centralization of services that cities offer, and increases costs for

goods delivery (Weisbrod et al. 2001). The total economic losses associated with roadway crashes in the U.S.—including the associated costs of fatalities, injuries, and property damage—amounted to \$242 billion in 2010; these costs are manifested by lost productivity, medical and emergency response costs, the legal system, insurance, time spent in congestion as a result of collisions, and property damage (Blincoe et al. 2015). Further, the total societal harm from motor vehicle crashes is estimated at \$826 billion for 2010; this figure includes loss of quality-of-life and productivity for crash survivors and relatives of those lost to traffic violence (Blincoe et al. 2015).

Road safety, environmental impacts, public health indicators, and adverse economic effects are all externalities of the road transportation system. Yet, the public and policymakers generally regard each of these as separate issues. Policies aimed at mitigating the effects of any of these externalities are often considered in isolation (Lovegrove and Litman 2007). This might be a reflection of the segmentation of regulatory control over various components of the transportation system; additionally, major societal questions regarding sustainability might be beyond the scope of a single agency and require larger public debate and buy-in (Toleman and Rose 2008). For road safety, interventions have historically been aimed at changing individual road user behavior without considering systemic factors that influence behaviors (Zein and Navin 2003).

In spite of this, a well-designed transportation policy could theoretically address many of the road system's externalities while

preserving economic growth and mobility (Toleman and Rose 2008). Given that road safety, greenhouse gas emissions, local air quality, and economic loss from congestion are all positively linked to vehicle miles traveled, managing demand by providing viable and safe alternative forms of transportation would seem to be an effective mitigation strategy (Lovegrove and Litman 2007; Ferreira, Diao, and Xu 2013; Sweet 2014; Brugge et al. 2015).

In 1997, Sweden adopted an ambitious and innovative road safety policy called Vision Zero which set a long-term goal to eliminate all fatalities and serious injuries within the road transportation system (Elvik 1999; Rosencrantz, Edvardsson, and Hansson 2007; Johansson 2009; Belin, Tillgren, and Vedung 2012; C. McAndrews 2013). Vision Zero treats road safety as a public health issue and uses a systems-based approach that integrates roadway design, education and enforcement efforts. Vision Zero has been recognized as an influential policy internationally (Peden et al. 2004; May, Tranter, and Warn 2011). Closely related policies emerged in the Netherlands and Norway around the same time (Elvebakk and Steiro 2009; Weijermars and Wegman 2011).

An important concept in Vision Zero is that system designers are ultimately responsible for road safety. Users are expected to follow the rules, but system designers have the responsibility and obligation to change the road environment when a safety problem is identified (Fahlquist 2006; Johansson 2009; C. McAndrews 2013). This contrasts with the traditional



approach to road safety in which outcomes are primarily attributed to individual road user behaviors (Fahlquist 2006; Larsson, Dekker, and Tingvall 2010). After nearly two decades of implementation, Vision Zero is regarded internationally as a model for bringing about a systematic, interdisciplinary approach to road safety (Peden et al. 2004).

Compared with other developed nations, the U.S. ranks significantly worse when it comes to road safety, even as safety for motor vehicle occupants has continued to increase over previous decades (Dula and Geller 2007; Luoma and Sivak 2014; Sung et al. 2016). And yet, there is a sense of complacency among the U.S. public regarding traffic fatalities and risk (Dula and Geller 2007). Numerous explanations have been proposed for this, including lack of awareness regarding the risks of participating in the road transportation system and a general acceptance of mortality as an unfortunate byproduct of mobility (Smith and Martin 2007; May, Tranter, and Warn 2008). Part of the challenge facing road safety advocates in the U.S. is building public awareness of the public health threat posed by the roadway system (C. McAndrews 2013). In other realms of transportation, such as aviation and railroads, such a high fatality rate would be considered unacceptable (Johansson 2009; Elvebakk and Steiro 2009; Belin, Tillgren, and Vedung 2012).

Location	Deaths per 100,000	Total # deaths
Select countries <sup>a</sup>		
United States	10.6	34,064
Canada	6	2,114
Australia	5.4	1,252
Germany	4.3	3,540
Netherlands	3.4	574
United Kingdom	2.9	1,827
Sweden	2.8	272
U.S. Vision Zero Cities <sup>b c</sup>		
Sacramento, CA	14.4	69
San Antonio, TX	12.3	164
Austin, TX	8.3	64
San José, CA	8.1	71
Los Angeles, CA	7.7	293
Portland, OR	6.2	36
New York, NY	5.9	330
Washington, D.C.	5.9	37
San Diego, CA	5.6	77
Seattle, WA	5.2	34
Denver, CO	5	78
San Francisco, CA	4	37

<sup>a</sup>National level data via the World Health Organization (Toroyan 2015).

<sup>b</sup>Data for U.S. cities via the U.S. Centers for Disease Control and Prevention (CDC 2012).

<sup>c</sup>Several Vision Zero cities not shown because of missing data

*Table 1: Comparison of death rates between U.S. Vision Zero cities and select nations*

Incidence of fatalities measured per 100,000 individuals is an indicator commonly used by public health professionals to represent risk, which provides a basis for comparison between different jurisdictions and geographic scales (Vereeck and Vrolix 2007). As shown in Table 1, the incidence of road fatalities in the U.S is notably higher than comparable developed countries including those with similar land use patterns and automobile use such as Canada and Australia. For U.S. Vision Zero cities,

there is a wide range of fatality incidence, from a low of 4 per 100,000 in San Francisco, CA to a high of 14.4 per 100,000 in Sacramento, CA. This wide variation suggests that local conditions are a major factor in road safety.

Policy makers at various jurisdictional levels in the U.S. have recently adopted new strategies to combat the epidemic of roadway fatalities and serious injuries. The U.S. Department of Transportation Federal Highway Administration (FHWA) adopted Towards Zero Deaths, a long-term strategy to eliminate of roadway deaths initiated in response to the United Nations' Decade of Action for Road Safety 2011-2020 (Birdsall 2016). Vision Zero policies have been adopted by 18 U.S. cities as of this writing. The advent of Vision Zero in U.S. cities comes at a time when many cities are experiencing economic and population growth after a long period of decline (see Table 2). Concurrently, many U.S. cities are seeing dramatic increases in the share of people cycling to work (Pucher, Buehler, and Seinen 2011; League of American Bicyclists 2015). There is also increased demand for living in walkable neighborhoods and for accessing jobs and services by public transit (Pollack, Bluestone, and Billingham 2010; Forsyth 2015).

City	2014 population <sup>a</sup>	Population change 2000-2014 <sup>a</sup>	Bicycle mode share 2014 <sup>b</sup>	Bicycle mode share change 2000-2014 <sup>b</sup>
New York, NY	8,491,079	6.0%	1.1%	132.7%
Los Angeles, CA	3,928,827	6.3%	1.3%	115.4%
San Antonio, TX	1,436,723	25.5%	0.3%	109.9%
San Diego, CA	1,381,083	12.9%	1.3%	86.3%
San José, CA	1,015,796	13.5%	1.1%	72.0%
Austin, TX	912,798	39.0%	1.3%	44.4%
San Francisco, CA	852,469	9.8%	4.4%	120.8%
Seattle, WA	668,337	18.6%	3.7%	96.6%
Denver, CO	663,862	19.7%	2.5%	161.7%
Washington, D.C.	658,893	15.2%	3.9%	234.0%
Boston, MA	656,051	11.4%	2.4%	148.1%
Portland, OR	619,446	17.1%	7.2%	306.6%
Sacramento, CA	485,193	19.2%	1.9%	41.4%
Anchorage, AK	301,010	15.6%	1.3%	153.4%
Fremont, CA	228,760	12.5%	0.3%	-
Fort Lauderdale, FL	176,018	15.5%	1.2%	-
Eugene, OR	160,552	16.4%	6.8%	-
Cambridge, MA	109,699	8.2%	7.4%	89.7%

<sup>a</sup>2014 population based on annual estimates released by the U.S. Census Bureau in 2015. Population change 2000-2014 was calculated with population data from the 2000 U.S. Census (U.S. Census Bureau 2015).

<sup>b</sup>Bicycle mode share and bicycle mode share change were calculated using U.S. Census American Community Survey data compiled by the League of American Bicyclists (League of American Bicyclists 2015).

*Table 2: Change in population and bicycle mode share in Vision Zero cities 2000-2010*

## 1.1 Research Context

Policymakers at all levels of government are interested in promoting active transportation modes for the numerous potential public health and environmental benefits they offer (Adkins et al. 2012). Proponents of alternative transportation modes, whether within or outside of government, may find that the safety message conveyed by Vision Zero could be the most compelling argument for improving infrastructure for pedestrians and cyclists. As the research presented here shows, this may be especially true

for projects that involve potentially tough political decisions, such as the reallocation of roadway space or increased travel times for motorists.

Considering the recent spate of Vision Zero policy adoption at the municipal level in the U.S., that nature and intention of these policies bears examination. This research explores the question of how cities are conceptualizing the Vision Zero policy approach using a qualitative mixed-methods research approach that includes content analysis of Vision Zero “action plans” and interviews with municipal officials involved with implementation. The original Swedish policy is used as a basis for comparative analysis. Rooted in a *grounded theory* methodology, the findings represent a working theory of what Vision Zero means within the context of U.S. municipal level policy.

Considering that Vision Zero policy adoption in U.S. cities is a novel development, scholarly research into the topic is in a somewhat nascent, though emergent, state. This thesis makes a unique contribution to the research by providing the first in-depth qualitative analysis of Vision Zero policy adoption in the U.S. The remainder of this thesis is structured as follows: a review of relevant scholarly literature regarding Vision Zero is presented; the research methods are discussed in detail; results of the research are presented and analyzed; and finally, a summary of research findings, limitations, considerations for future research, and implications for practice are provided.

## 1.2 Research Questions

How is the Vision Zero policy approach conceptualized at the municipal level in the U.S.?

### *Sub-Questions*

- How do municipal action plans and municipal officials define the core principals of Vision Zero?
  - In particular, what do they say about responsibility for traffic safety?
- How do municipal action plans and municipal officials frame the problem of road safety?
  - What are the contributing factors?
  - What justifications are provided for Vision Zero?
- What strategies will be used to implement Vision Zero?
- To what degree do municipal level Vision Zero policies in the U.S. reflect the original Swedish policy?

## **2 Literature Review**

This chapter begins by exploring what the scholarly literature has to say about the original Vision Zero policy as conceived, adopted and implemented in Sweden. By understanding the original policy and the circumstances surrounding its origin, it will be possible to provide a comparative basis for emerging municipal level Vision Zero policies in the U.S. Specific topic areas of the original policy considered include its core principles, origination, position in relation to traditional road safety approaches, technical implementation, and commentary regarding its intention and execution.

Vision Zero has been influential beyond Sweden (May, Tranter, and Warn 2008; May, Tranter, and Warn 2011). Prior to the recent interest among U.S. municipalities, similar road safety policies had already been adopted in several European countries. Some of the issues related to policy transfer will be explored. Finally, the chapter will conclude with a synopsis of the current state of Vision Zero adoption and implementation in U.S. municipalities.

### **2.1 Policy Principles**

As its most basic principle, Vision Zero proposes that the long-term goal of the road transportation system should be to eliminate fatalities and serious injuries (Elvik 1999; Rosencrantz, Edvardsson, and Hansson 2007; Johansson 2009; Belin, Tillgren, and Vedung 2012; C. McAndrews 2013).

Serious injuries are defined as injuries from which it is not possible to fully recover (Berg, Ifver, and Hasselberg 2016). At the root of the policy is the belief that it is ethically unacceptable for anyone to be killed within the roadway system (May, Tranter, and Warn 2008; Johansson 2009; C. McAndrews 2013). Vision Zero does not propose to eliminate crashes that result in property damage or minor personal injury; crashes are assumed to be inevitable, but the severity of crashes can be reduced through countermeasures (Elvik 1999; Rosencrantz, Edvardsson, and Hansson 2007; Johansson 2009).

Vision Zero has several important sub-principles. First, fatal crashes and serious injuries are preventable and not merely accidents. (C. McAndrews 2013; Sucha 2014). Therefore, the road transportation network should be viewed as a complex system in which a variety of factors influence safety outcomes (Larsson, Dekker, and Tingvall 2010).

Second, the operators and designers of the transportation system must share responsibility for the safety with the users of the system; traditionally, individual users were considered solely responsible for safety outcomes (Johansson 2009; C. McAndrews 2013). The policy takes an expansive definition of transportation system designers, which according to Fahlquist (2006) include “public and private organizations that are responsible for the design and maintenance of different parts of the road transport system such as roads, vehicles and transportation services as well as those responsible for different support systems for safe road traffic such



as rules and regulations, education, surveillance, rescue work, care and rehabilitation.” As a result, an emphasis is placed on interdepartmental and cross-disciplinary collaboration, as well as private sector involvement (C. McAndrews 2013).

Third, humans have inherent physical vulnerabilities and cognitive limitations and the road system must be designed to be forgiving of these fallibilities (Johansson 2009). The roadway system must be designed so that when crashes do occur, the force of kinetic energy released does not exceed what the human body can withstand.

## **2.2 Policy Origins**

After a period of rapid motorization in developed countries that saw concurrent increases in road fatality rates, national governments began to establish quantified road safety targets starting in the early 1970s (Wong and Sze 2009). These typically consisted of a target number and a year by which the target should be attained. Although these efforts did yield some reductions in fatalities, they did not produce consistent results (Wong and Sze 2010; Belin, Tillgren, and Vedung 2012). Starting in the early 1990s, Sweden began developing a more ambitious policy towards roadway safety (C. McAndrews 2013). These developments would eventually lead to the adoption of Vision Zero in Sweden in 1997 (Belin, Tillgren, and Vedung 2012).

Johansson (2009) provides the political context for the rise of Vision Zero; in 1994 a new Minister for Transportation was elected who declared

road safety to be a major goal. This was followed by a convening of stakeholders to develop a new road safety program that would emphasize increased inter-agency cooperation. McAndrews (2013) interviewed Swedish transportation and planning professionals to trace the origins of the policy, and proposed that the idea emerged from a small, multi-disciplinary working group tasked with addressing child safety restraints. Participants in the group reported being able to find new approaches to the problem because of the diversity of professional backgrounds represented in the group, and to conceive of the problem within a larger framework of roadway safety rather than within the confines of professional practice. McAndrews (2013) does not clarify if this working group was convened by government, the private sector, non-government organizations, or a combination of these.

Johansson (2009) and Belin et al. (2012) trace the origins of Vision Zero to a deliberative planning effort within the Swedish Road Administration conducted for the expressed purpose of addressing road safety. According to McAndrews (2013), the working group took the idea of Vision Zero to the international safety community, found support from the World Bank and World Health Organization, and used that as leverage to gather political support among government ministers. McAndrews (2013) also notes that the policy did not originate from traffic engineers or public works officials, the professions most responsible with managing the road transportation system.

Vision Zero was proposed as a policy and debated publicly over the course of several years, culminating in its adoption by the Swedish parliament in October 1997 with support from all political parties (Belin, Tillgren, and Vedung 2012). The portrayal of the origins of Vision Zero on the official website of the Swedish Transport Administration largely corroborates the accounts found throughout the scholarly literature. In particular, the parliamentary process leading up to its adoption is highlighted as being very important: “The strong political will was of decisive importance in Vision Zero becoming a national long term goal for work on road safety, and thereafter an international example” (Swedish Transport Administration 2014).

### **2.3 A Departure from Tradition**

Vision Zero seeks to fundamentally reframe road safety in several important ways. Prior to its advent, there was a growing recognition that traditional approaches to road safety were not delivering effective or predictable results (Johansson 2009). Swedish policymakers intentionally framed Vision Zero as a departure from tradition (Belin, Tillgren, and Vedung 2012). Under the traditional approach, human error is assumed to be the primary cause of most crashes (Zein and Navin 2003; Fahlquist 2006; Johansson 2009; Larsson, Dekker, and Tingvall 2010). This notion is supported by a preponderance of studies over multiple decades which show that human error is the cause of 95% of road crashes (Zein and Navin 2003; Belin, Tillgren, and Vedung 2012).

However, these studies are rooted in the human error paradigm and do not consider the systemic and interrelated factors that lead to crashes (Johnston 2010). For example, many such studies are based on police crash data. Police officers are generally trained to report on the human behaviors that lead to a crash and assign responsibility to a specific party, rather than consider the systemic factors that may have led to a crash (Zein and Navin 2003). Johnston (2010) notes that the concept of latent conditions within a system having a causal relationship with safety outcomes has widely been accepted in industrial safety, but has not transferred to road safety.

Placing primary responsibility for crash causation on individual road users, as in the traditional approach, implies that the road system itself is without faults (Fahlquist 2006). Resulting countermeasures primarily target behaviors, often in the form of informational and educational campaigns, signage, enforcement, and legislation to determine fault in crashes (Larsson, Dekker, and Tingvall 2010). Previous road safety measures focused on adapting the individual user to the road environment through behavioral interventions, rather than adapting the road environment to the individual user through geometric design changes (Belin, Tillgren, and Vedung 2012). In addition to having a limited effect on road safety, this approach can lead to victim blaming, the inference being that a victim did not take appropriate measures to protect themselves (Johansson 2009; Larsson, Dekker, and Tingvall 2010; Belin, Tillgren, and Vedung 2012; C. McAndrews 2013).

Swedish policymakers were deliberate in their framing of Vision Zero as a rejection of the traditional road safety paradigm. Belin, Tillgren, and Vedung (2012) conducted a content analysis of Swedish government documents published around the time of adoption (c. 1996-1997), finding the policy to be self-described as a departure from the government's then-current approach to road safety. The government further acknowledged that the previous delegation of responsibility to the individual road user was unfair and one-sided. Vision Zero proposes that responsibility should be shared between road users and system designers, but that system designers are ultimately responsible for the safe design and operation of the system. Road users are expected to abide by the rules to ensure their own safety, but system designers are responsible for creating a system in which the consequence of a mistake does not result in death or serious injury (Belin, Tillgren, and Vedung 2012).

Fahlquist (2006) considers the tension between the traditional approach and Vision Zero in how responsibility for traffic fatalities is assigned. She distinguishes "causal responsibility" and "blame responsibility" as separate categories; the former considers that there are many interrelated factors that result in a crash occurring, while the latter assigns blame to one individual or factor following normative perspectives. In other words, people might rush to conclude that a particular factor is the *only* factor to blame for a crash, thereby overlooking other important contributing factors. Fahlquist argues that Vision Zero constitutes a third category, "forward-looking

responsibility,” because road system designers are held accountable for reducing the possibility of crashes occurring in the future. Whereas traditionally, the individual was the only party held responsible, Vision Zero acknowledges the power that system designers have to change the environment that contributed to the crash and assigns them responsibility to take action (Fahlquist 2006).

The traditional approach to road safety also focuses narrowly on economic growth and mobility as the primary goals of the road system while generally sidestepping safety (Johansson 2009). Johansson (2009) notes that road agencies tend to conceive of crashes primarily on economic grounds (e.g., economic loss due to property damage, emergency response, or congestion due to crashes). Resulting countermeasures thereby focus on reducing the overall number of crashes rather than making the road safer from a public health perspective. This may create perverse incentives that ultimately reduce the safety of the roadway system. For example, roadway design manuals have historically encouraged wider, straighter roads on the premise that they allow drivers more space to take evasive action. However, roads designed this way have been shown to encourage drivers to speed, which in turn increases the likelihood of serious crashes (Richter et al. 2006). Vision Zero provides a clear directive to move away from a total crash reduction strategy towards one focused on public health. (Johansson 2009; Belin, Tillgren, and Vedung 2012; Swedish Transport Administration 2015).

## 2.4 Technical Implementation

Following adoption by the Swedish parliament in 1997, road safety professionals began the work of implementing Vision Zero. Aside from the process of building stakeholder and professional buy-in, there was also significant technical component to implementation. Given the fundamental premise that the roadway environment must be designed so that the human tolerance for kinetic force is not exceeded, it followed that engineering guidelines should emphasize minimizing impact speeds and decreasing exposure for vulnerable road users. Guidelines were developed based on empirical research regarding on crash survival for various road users under various conditions (Johansson 2009). Johansson (2009) summarizes the basic engineering principles behind Vision Zero in Sweden:

- Vulnerable road users (pedestrians and cyclists) should not be exposed to motor vehicles traveling faster than 18 mi/h (30 km/h). Where physical separation is not possible, motor vehicle speeds should be reduced to 18 mi/h (30 km/h) through traffic calming measures such as speed bumps and narrow travel lanes.
- Motor vehicle occupants should not be exposed to other motor vehicles traveling in excess of 31 mi/h (50 km/h) at 90 degree intersections. Engineers should adjust the roadway geometry, if possible, to less than 90 degrees, or reduce the speeds.

- Motor vehicle occupants should not be exposed to other motor vehicles traveling in the opposite direction at speeds exceeding 43 mi/h (70 km/h). If there is a high volume of heavy vehicles, this speed should not exceed 31 mph (50 km/h). If these conditions cannot be met, then physical separation must be installed.
- Where curbside activity is expected to take place, speeds cannot exceed 43 mi/h (70 km/h) or 31 mi/h (50 km/h) if the roadside contains objects such as trees.

The English-language website of the Swedish Transport Administration provides a repository of information on additional technical aspects of Vision Zero. Four “key innovations” of Vision Zero, comprising engineering, enforcement, and vehicle technology, are highlighted:

- Alcohol interlock ignition technology on fleet vehicles.  
Individual drivers charged with DUIs may apply for alcohol interlock in their car rather than having their license suspended. No statistics are provided on the rate of interlock adoption in fleet vehicles, though Johansson (2009) notes that 50% of Swedish school buses feature them.
- On high-speed intercity roads, median barriers have found to be an effective treatment against collisions between oncoming vehicles, and have been applied widely throughout the country.



- Roundabouts are preferred over traffic signals for intersections because they provide a traffic calming effect and reduce the severity of crashes. The government notes that roundabouts might actually cause more frequent collisions but result in fewer fatalities and serious injuries due to slower speeds.
- Speed management is an important component of Vision Zero, which is achieved through the widespread use of speed cameras and increasing use of intelligent speed adaption (ISA) technology in vehicles. Such technology alerts the driver when they exceed the speed limit and may even include features to automatically slow the vehicle. No statistics are provided on how widely ISA technology has been saturated into the vehicle fleet (Swedish Transport Administration 2015).

When Vision Zero was introduced in 1997, the road fatality rate in Sweden was 6 in 100,000. In 2006, after nine years of implementation, it had been reduced to 4.7 in 100,000. However, the spatial distribution of fatality reductions is telling. In locations where robust physical changes have been made (primarily in urban areas and along some major rural roads, following the principles outlined above), there has been a tenfold reduction in risk. In locations where no physical interventions have been made, there has been a 2 – 3 % reduction in risk, attributable mainly to advances in vehicle technology (Johansson 2009).

## 2.5 Critical Perspectives

This section summarizes some of the critical perspectives of the Vision Zero policy goals and implementation process in its native context in Sweden. Within the scholarly literature, the commentary was found to cluster around three distinct thematic areas. The first concerns the nature of the goal itself, considering questions of its validity, necessity and achievability. This includes covers political questions regarding the role of government regulation. The second focuses on the degree to which the policy has actually influenced the attitudes and practices of road safety professionals. Finally, there is the consideration of how Vision Zero fits into the broader context of transportation policy and sustainability.

### *Validity and Necessity of the Goal*

During the debate leading up to Vision Zero's adoption, various critical and supportive perspectives emerged. Much of the initial criticism against Vision Zero can be characterized as coming from a libertarian free-market perspective (Fahlquist 2006). Rosencrantz et al (2007) summarize some of the main critiques of the policy:

1. Vision Zero is irrational as a goal because it is unlikely to be attained, and therefore it might not be taken seriously by those implementing it.

2. The costs of eliminating traffic fatalities and serious injuries might outweigh the benefits, and there may be more cost-efficient ways to minimize overall mortality.
3. Individuals should be free to choose the level of risk they are willing to accept (e.g., even though motorcycles are more dangerous than cars, people should be free to ride them nonetheless) so long as it does not harm others (Rosencrantz, Edvardsson, and Hansson 2007).

In terms of rationality, Edvardsson and Hansson (2005) argue that attainability should not be the primary measure of whether or not a goal is rational. Rather, goals should be seen as rational if they are achievement-inducing. One way to implement broad, visionary goals is to break them down into precise, measurable sub-goals (Edvardsson and Hansson 2005). Indeed, the Swedish government established interim road safety targets upon the adoption of Vision Zero in 1997 (Elvebakk and Steiro 2009). Rosencrantz et al. (2007) counter the second critique by noting that cost-effectiveness comes down to the cost of specific measures. Johansson (2009) suggest that while certain measures are costlier than others, the overall economic benefits of reduced injuries and fatalities will ultimately outweigh the costs.

The third critique comes from a highly individualistic perspective, and in this way it aligns with the traditional approach to road safety (Larsson, Dekker, and Tingvall 2010). Zein and Navin (2003) argue that this view is

simplistic because it ignores the dynamics of the system that lead to the crash, which include the road environment, vehicle, and road users. Within a systems-based perspective, all individual actions have causal relationships with outcomes, therefore the notion that individual choices do not affect others within the system is false (Zein and Navin 2003; Larsson, Dekker, and Tingvall 2010). In other words, argument ignores the fact that crashes impose externalities beyond the individuals affected by the crash (C. A. McAndrews 2010).

Elvik (2009) explores the question of whether or not road safety measures implemented strictly according to economic cost-benefit analysis produce “fair” results. Considering that “fairness” does not have a standard definition, the researcher uses Pareto-optimality to define fairness; that is, changes in road safety should benefit disadvantaged groups but not to the extent that they have negative consequences for any other group. Based on the results, the researcher concluded that there is no obvious equity benefit from using the most economically efficient road safety measures. Requiring road safety initiatives to pass cost-benefit criteria would, he argues, not reduce disparities between different road user groups in terms of fatalities, benefit wealthier households initially, and concentrate road safety measures on high-volume roads. Transportation policymakers must make some degree of tradeoff between economic efficiency and equity (Elvik 2009).

### *Perceptions and Responsibilities of Road Safety Professionals*

Nearly two decades have passed since its initial adoption in 1997, which has allowed for retrospective research and analysis. Fahlquist (2006) speculates that the achievability of Vision Zero will be determined by the degree to which system designers internalize their responsibility for preventing future crashes. Vision Zero is rooted in a strong ethical perspective but lacks any legal penalties to require system designers to assume responsibility. Thus, those professionals charged with responsibility for road safety under the policy are not responding to incentives but rather are expected to self-enforce the policy (C. McAndrews 2013).

Professionals oriented towards the traditional road safety paradigm may have more at stake in maintaining the status quo and therefore less likely to change (C. McAndrews 2013). However, market forces, public pressure and bad press are other ways that system designers could be held accountable (Fahlquist 2006). McAndrews (2013), through interviewing professionals involved with Vision Zero implementation in Sweden, found that those working in road safety disciplines did not report changes to their work and responsibilities after the implementation of Vision Zero. This is evidence, she suggests, that they are not adopting more responsibility in their professional roles as a result of the policy (C. McAndrews 2013).

### *Vision Zero and Transportation Sustainability*

Some scholars have proposed that Vision Zero fails to consider the broader context of road transportation policy, particularly in regards to

environmental sustainability and public health. May et al. (2008) point out that the transportation system's reliance on private motor vehicles imposes many negative externalities including climate change, local air pollution, obesity, and fatalities. By focusing narrowly on road safety for motor vehicle occupants without addressing the underlying problem of car dependency, Vision Zero risks perpetuating these issues (May, Tranter, and Warn 2008). May et al. (2011) characterize Vision Zero as an example of "adaptive" change, which they contrast with "deep" change. Adaptive change does not fundamentally alter the underlying systems and our relationships with them, and in many cases can perpetuate and protect the structures at the root of the problem. They suggest that transportation policy should instead focus on promoting public transit, walking, and cycling as a way to both improve road safety, increase sustainability, bolster community health, and harness social capital (May, Tranter, and Warn 2011).

It is worth noting that the Vision Zero initiatives described on the Swedish Road Administration's website are exclusively geared towards motor vehicle occupants, with no mention of vulnerable road users or of policies to encourage sustainable transportation modes. A review of the agency's Swedish language website (translated via Google Translate) does, however, contain information on recent funding of safety initiatives aimed at vulnerable road users, and a page on bicycle planning at the municipal level.

Toleman and Rose (2008) consider some ways that Vision Zero might impact mode choice. While maintaining the individual right to mobility is an

implied part of the Vision Zero framework, it may result in different forms of mobility being favored over others if those implementing the policy maintain a strong focus on sustainability. Following this logic, modes such as walking, cycling, and public transit should be favored for the economic and environmental efficiency benefits they offer while preserving individual mobility and enhancing safety. Restrictions on one mode, for instance driving, could increase demand for other modes. However, simply restricting the use of specific modes without investing in other modes could have negative consequences for mobility. Mode shift towards forms of transportation that impose less environmental and social externalities might be a beneficial outcome of Vision Zero, but mode shift is not the end goal itself. They proposed that managed transition towards sustainable transportation modes while maintaining individual mobility should be the result of a successful Vision Zero policy (Toleman and Rose 2008).

## **2.6 Vision Zero Goes Abroad**

Elvebakk and Steiro (2009) provide a detailed account of Norway's adoption of a Vision Zero policy. Vision Zero was introduced in Norway in 2001 as a part of a national transportation plan, rather than as an act of legislation, as in Sweden. The authors suggest that this indicates a lower level of political commitment at the outset. The plan called for improved data and understanding of road safety outcomes based on specific interventions. In terms of technical implementation, the Norwegian approached mirrors that

of Sweden in its deployment of medians barriers on two and three-lane roads; interventions are also largely focused on motor vehicle occupants.

The researchers conducted interviews with road safety professionals working inside and outside of government, including employees of the national road administration and a variety of stakeholder non-governmental organizations (NGOs). Many of the interviewees felt that there was not enough discussion and debate leading up to the adopting of Vision Zero, and that the policy was therefore lacking the necessary buy-in and understanding of a shared vision. As a result, the researchers argue, Vision Zero is not commonly understood among the general public and is largely technocratic; road safety professionals know what Vision Zero is but vary in their interpretation of what it means for their work. For them, it may be little more than a slogan that has the same level of meaning as other statements and initiatives. However, most interviewees pointed to a renewed interest and excitement about road safety and that it had increased the level of cooperation between agencies. The researchers note that while this development is valuable, it may not be enough to reach the ultimate goal of zero fatalities and serious injuries in the roadway system.

Representatives of NGOs felt that road system designers should be mandated to take on more responsibility for road safety, and that road users had for too long been blamed solely as the cause of crashes. Representatives of environmental and alternative transportation advocacy organizations questioned the idea that motor vehicle occupants should be the default



design user. They were critical of the idea that making car use safe should be the main objective because of the environmental and social externalities caused by car usage. It would be better to devote resources to more sustainable forms of transportation than to making driving safer. The cyclist's organization complained that road designers were creating roads solely for cars at the exclusion of non-motorized users such as cyclists and pedestrians. They noted the only major conversation about bicycle safety was regarding the possible requirement of bicycle helmets. This critique mirrors that of May et al. (2011). The researchers ultimately concluded that Norway's Vision Zero is an "impoverished" version of the original as a result of being fragmented and interpreted differently by different actors (Elvebakk and Steiro 2009).

Vereek and Vrolix (2007) analyzed statistics on corruption and road safety in 15 European Union countries from 1996-2002 and found a strong correlation between willingness to comply with the law and traffic fatalities. While this is not directly related to Vision Zero implementation, it does consider how the political environment might influence road safety. Traffic exposure, economic development, traffic speeds, and alcohol consumption were significant factors in traffic safety, but differences in national laws had no statistically measurable effect. To measure corruption, the researchers used the Corruption Perceptions Index compiled by Transparency International, an aggregated survey of business professionals and academics. The researchers make the assumption that in countries with higher levels of

corruption, individuals will be less likely to follow the laws, including traffic laws. Their conclusion is that the language of traffic laws has little impact on traffic safety, and more complex traffic law may limit the capacity of individuals to comply. Improved road safety, they propose, comes from increasing economic development (which allows people to buy safer cars), reducing drunk driving, managing transportation demand, and fighting corruption (Vereeck and Vrolix 2007). Overall, these results suggest that good governance and public perceptions of corruption might be an important indicator of the success of Vision Zero policies in U.S. cities.

Dolowitz and March (2000) consider how policy transfer happens in a general sense and which factors might influence the success of transplanted policies. They propose that policy transfer is a significant component in policy growth and development. Policy lessons are drawn from a range of sources and levels of government. Transferred policies can be implemented at every level of government even if the original policy model was from a different level of government.

While there are many examples of successful policy transfer, the authors identify three primary reasons why policy transfer might fail: uninformed transfer, incomplete transfer, and inappropriate transfer. Uninformed transfer results when those engaged in policy implementation lack sufficient information about the original policy. When a crucial element that made a policy successful in one jurisdiction is missing in the transferred policy, incomplete transfer results. Policy implementers who fail to account

for differing social, economic, ideological and political environments or show a lack of sensitivity to popular concerns run the risk of an inappropriate transfer (Dolowitz and Marsh 2000). While their contextualization of policy transfer is based on considerations of nation-states acting within the realm of globalized economic policy, it bears applicability to sub-national governments such as cities and states because questions such as who engages in policy transfer, what is transferred, and what opportunities and limitations might arise from policy transfer are relevant at all levels of government.

## **2.7 Vision Zero in the U.S.**

Vision Zero and related policies have been adopted by a number of U.S. jurisdictions and at various levels of government in recent years (Brozen and Shockley 2016). Although traffic safety in the U.S. has improved since the 1970s, it still ranks low among comparable developed nations (Luoma and Sivak 2014; Sung et al. 2016). At the federal level, the U.S. Department of Transportation Federal Highway Administration (FHWA) has adopted Towards Zero Deaths. Like Vision Zero, its long-term goal is the elimination of roadway deaths. Towards Zero Deaths was initiated in response to the United Nations' Decade of Action for Road Safety 2011-2020 which called upon member states to reduce the forecasted level of roadway fatalities by 2020 (Birdsall 2016). The initiative is a collaboration between the FHWA, the American Association of State Highway and Transportation Officials (AASHTO), and various law enforcement, public health and private sector

stakeholder organizations (Toward Zero Deaths Steering Committee 2014). It is worth noting that Towards Zero Deaths emerged from within government bureaucracy, rather than as a legislative measure subject to public debate, as in Sweden. In this way, it more closely mirrors Norway's Vision Zero policy which emerged from the national road agency's planning process (Elvebakk and Steiro 2009).

As of April 2016, 18 U.S. municipalities have adopted Vision Zero policies (Birdsall 2016). New York City was the first U.S city to adopt Vision Zero in January 2014 (Anonymous 2016). This appears to have had a cascading effect, considering the significant amount of uptake during the following year. The movement to implement Vision Zero in the U.S. has been steered to large extent by the leadership and constituency of bicycle and pedestrian advocacy organizations, who have increased in stature and national organizing power in recent years (Birdsall 2016). Vision Zero represents an integration of sorts for these organizations who may have previously operated separately and sometimes in opposition to each other. The expanded focus on safety and integration of bicycle and pedestrian interests may represent a more inclusive and appealing message. In particular, the Vision Zero Network campaign has lead nationwide organizing, coordination, and information sharing efforts (Birdsall 2016).

Several recently published studies have investigated various quantitative aspects concerning Vision Zero adoption in the U.S. Brozen and Shockley (2016) investigated how collision analysis is being conducted

within state and municipal Vision Zero policies in the U.S. The researchers looked at peer-reviewed articles on collision analysis best practice, reviewed municipal Vision Zero websites and planning documents, and conducted original analysis of collision data in Los Angeles. They found that municipal collision analyses typically used the previous five years' worth of collision data, though the exact approaches to analysis were not easily discernable based on published material. High traffic volumes and arterial streets were consistently found to be linked with collisions. They concluded that, in order to accurately assess risk, accurate data on pedestrian and cyclist volumes is needed. Yet, this data was missing in nearly all of the municipal programs examined (Brozen and Shockley 2016).

Sung et al. (2016) used regression analysis to study the effectiveness of various traffic safety countermeasures previously established by U.S. National Highway Traffic Safety Administration's (NHTSA) in 2013. Specifically, they examined differences between states in terms of the relationship between number of countermeasures used and safety outcomes. Fatality rates were found to be generally lower in states with more countermeasures in place (Sung et al. 2016). However, their study looked primarily at countermeasures for vehicle occupants and did not consider those aimed at vulnerable road users.

Ahangari et al. (2016) investigated the relationship between changes in bicycle mode share between 2000 – 2013 and traffic safety in the 50 most populous U.S. cities. Using regression analysis, they found a significant

negative relationship between bicycle mode share and roadway fatalities; that is, as bicycle mode share increased, fatalities decreased for all transportation modes. The results controlled for vehicle miles traveled, motorization level, and socioeconomic variables. This study further verifies earlier research that shows roadway safety increases as bicycle use and dedicated bicycle infrastructure increases (Lusk et al. 2011; Wesley E. Marshall and Garrick 2011; Lusk et al. 2013). While the study does not investigate the factors associated with an increase in bicycle mode share, the positive relationship between improved bicycle facilities and ridership has been well-established in scholarly research. Buehler and Dill (2015) conducted a meta-analysis of recent research on bikeways and found a preponderance of evidence linking separated bicycle facilities with both increases in ridership after facilities are built, and increasing the appeal of cycling to broader segment of the population (Buehler and Dill 2015).

### 3 Methods

This chapter describes the research methodology, including sample selection, data collection, and analytical processes. The research methods for this project consist of two approaches. First, a content analysis of Vision Zero policy documents released by U.S. cities with Vision Zero policies was conducted using qualitative data analysis (QDA) software. Second, municipal officials involved in implementing Vision Zero were interviewed. Interview questions were informed by the research questions, literature review, and results of content analysis.

The methodologies constitute a sequential qualitative mixed-methods research approach (Gaber and Gaber 2007). The research design aligns with a *complementary* strategy, which Gaber and Gaber (2007, pg. 140) describe as a method to “measure overlapping, as well as different, aspects of a situation in order to get an enriched enhancement of that situation.” A complementary mixed-methods strategy is typically employed when the data slices have a clear relationship to one another and can only be fully understood when considered together (Gaber and Gaber 2007).

Prior to embarking on the research, all required documentation was submitted to the Tufts Institutional Review Board (IRB) for review. The research was determined to be “excluded” from further review on the basis that it does not constitute human subject research because the questions focus on the details of municipal policy rather than on the individual. Appropriate steps were taken to present the results of interviews in an

anonymous manner so as to protect the identity of interview subjects. Specifically, the names of the interviewees and the names of the municipalities that they work for is not disclosed. The nature of their position (e.g., planner, engineer, etc.) is only disclosed where relevant to the results.

### **3.1 Content Analysis**

#### *Sample Selection*

As of this writing, 18 U.S municipalities have adopted Vision Zero policies. Candidate cities were identified using a web search that involved reviewing Google search results, advocacy organization websites (in particular, Vision Zero Network), Wikipedia, blogs, and municipal web pages. In order to understand how cities are conceiving of Vision Zero, sample texts were limited specifically to material released publicly by city governments. Initially, several types of texts were identified, including action plans, web pages, press releases, task force meeting presentations, and enacted city council resolutions.

However, these texts were found to vary significantly in terms of length, content, and purpose and therefore did not as a whole constitute comparable data set (Gaber and Gaber 2007). Therefore, the sample was limited to action plans, as these documents are by far the most content-rich and are the result of a deliberative planning effort. They are the most publicly-oriented documents and reflect the stated goals and intentions of the policy. Action plans are aspirational and signal the direction in which the



City intends to move forward. Presumably, they set a benchmark to which the City government should be held accountable.

City	City abbreviation	Document title	Publication date	No. pages*
New York, NY	NYC	<i>Vision Zero Action Plan 2014</i>	2014	42
San Francisco, CA	SF	<i>Vision Zero San Francisco: Two-Year Action Strategy</i>	2/2015	24
Seattle, WA	SEA	<i>Vision Zero</i>	2/2015	26
San José, CA	SJ	<i>Vision Zero San José</i>	4/2015	30
Los Angeles, CA	LA	<i>Vision Zero Los Angeles 2015-2025</i>	8/2015	18
Boston, MA	BOS	<i>Vision Zero Boston Action Plan</i>	12/2015	26
Ft. Lauderdale, FL	FL	<i>Vision Zero Quick Guide</i>	12/2015	16
Washington, D.C.	DC	<i>A Plan of Action</i>	12/2015	56

\* includes all pages including cover, title pages, front matter, table of contents, content, back matter, etc.

*Table 3: List of Vision Zero cities with action plans*

As a result of this selection process, the final sample consists of eight Vision Zero action plans released by U.S cities, including Boston, MA, New York, NY, Fort Lauderdale, FL, Washington, DC, Seattle, WA, San Francisco, CA, Los Angeles, CA, and San José, CA. Action plans were downloaded as portable document files (PDFs) from their respective city’s websites. In total, these documents represent 238 pages’ worth of content. Average document length is 30 pages; the longest is 56 pages, the shortest 16 pages.

### *Approach*

The content analysis was conducted using a *grounded theory* methodology as outlined by Corbin and Strauss (2014). The process began

with an “open reading” of the text to establish a basic familiarity with the content. This was followed by an open coding process whereby specific ideas, themes and concepts were identified. The open coding process involved a close reading of the text in which recurring themes and relationships between themes were identified. Thus, an underlying theory is formulated that is grounded in the textual data (Corbin and Strauss 2014). Using QDA software, each document was coded to identify basic concepts and themes. This was a somewhat iterative process that involved re-reading, layering new codes, and modifying codes as necessary. Within each code, a series of sub-codes were created to add specificity and nuance.

Grounded theory focuses on the notion of *sensitivity* in qualitative research, which contrasts with objectivity. Sensitivity refers to the researcher’s knowledge of a topic area and subsequent ability to understand the relevance of the data (Corbin and Strauss 2014). The sensitivity of this research is enhanced by the researcher’s professional experience with Vision Zero policy development. The overall intention of the content analysis was to investigate the research question of *how* Vision Zero is conceived of in the context of municipal level policies in the U.S. This is an intentionally broad question designed to allow a flexible approach. Through qualitative research, the investigator explores and generates new knowledge of a topic area that is not fully developed or understood (Corbin and Strauss 2014). Though several quantitative studies on the topic of Vision Zero implementation in the U.S. have recently been published (see Section 2.7 Vision Zero in the U.S.), no

qualitative research on the topic was identified during the literature search. Considering that Vision Zero originated in Sweden, the question of how U.S. municipal policies are adapting this policy for their own purposes was of particular interest. The literature on Sweden's Vision Zero policy provided a basis for comparison.

The intention of the research was not to create an exhaustive database of proposed countermeasures—similar resources have already been developed for planners and engineers—but rather to understand the principles, priorities and strategies at the root of U.S. municipal Vision Zero policies. Ultimately, the degree to which professionals understand and internalize their role in road safety will have bearing on the success of Vision Zero policies (Fahlquist 2006). While the action plans do not, in of themselves, provide a barometer for the perceptions of individual professionals, they do signify the overall direction of city leadership which in turn can shape how individuals perceive their roles.

## **3.2 Interviews**

### *Sample Selection*

Interview selection began by reaching out to Vision Zero project managers. Subsequent interviewees were identified through professional connections and “snowballing.” During the course of research, the researcher attended the Vision Zero Cities conference and made connections with several municipal officials in attendance. This resulted in a sample of six

interviews with officials in the disciplines of planning, engineering, public health and law enforcement. One interview was conducted in-person and the rest were conducted by phone.

### *Approach*

The interview portion of the research methodology consisted of interviewing municipal officials of various disciplines involved in the implementation of Vision Zero in their respective cities. The interviews explored specific themes and issues identified in the literature and through the content analysis of each action plan. Interviews were documented using detailed note taking during and directly following the interview. The format was semi-structured; a set of questions was developed for all interviewees, but the possibility was left open to explore additional questions raised during the interview. Questions were designed to be short, giving interview subjects an opportunity to provide longer, more interpretive answers (Kvale 2007, 80). Interviews lasted between 30 – 60 minutes depending on the conversation and the availability of the subject. Interviewees were notified that their identity would be protected in all publications related to the research.

## 4 Results

This chapter describes the results of the content analysis of U.S. municipal Vision Zero action plans and interviews with municipal officials involved with Vision Zero implementation. In order to organize the ideas that constitute this theory, a hierarchical system consisting of dimensions, concepts, themes, and sub-themes was developed. Three different dimensions of meaning emerged, including core principles, problem framing, and solutions. These dimensions contain a series of concepts that add additional layers of meaning and interpretation.

The results were attained by examining both manifest content and interpretive meaning. Manifest content relates to the number of times a word or theme can be found in a document. This provides insight into how cities or agencies are organizing their priorities. The underlying assumption is that the more something is mentioned, the more important it is. The process of coding was iterative and involved several rounds of evaluation, definition seeking, and consolidations. Specific words used as well as interpreted meanings were considered, and those that were closely related were grouped together. Statements that reference more than one theme were inclusively coded—that is, a statement could be coded to more than one theme. Interpretive analysis provides a step further to understanding the nature of the concepts surrounding the manifest content.

## 4.1 Core Principles

Theme	DC	LA	BOS	SJ	SEA	SF	NYC	FL	Sum
collective responsibility	5	6	4	1	6	4	8	-	34
safety for all road users	7	3	3	4	8	1	-	1	27
individual responsibility	2	1	10	3	-	1	4	1	22
culture change	1	1	4	4	1	2	8	1	22
time-based goals	2	5	5	3	4	2	-	-	21
deaths and serious injury are preventable	1	4	1	2	3	2	6	1	20
no death is acceptable	3	4	3	4	3	1	-	1	19
safe system approach	2	7	1	2	1	3	-	-	16
we could be doing better	2	2	4	2	3	-	1	-	14
people make mistakes	3	3	1	2	-	5	-	-	14
safety vs. mobility	-	3	3	3	2	2	-	-	13
an ambitious goal	-	2	1	-	2	-	1	-	6
crash, not accident	-	1	1	1	1	-	-	1	5
Sum	28	42	41	31	34	23	28	6	233

*Table 4: Core Principles theme frequency by action plan action plan*

Core principles refers to how the Vision Zero policy is defined. Within this dimension are a specific set of concepts that form the meaning of the policy. Through the research process, many core principles were initially identified and eventually narrowed down to 13 through a process of consolidating conceptually similar concepts. As a general criterion, a concept would constitute a core principle if it appeared in at least four action plans. Table 4 shows the frequency that the concepts appear in individual action plans and across all action plans.

### *Who is Responsible?*

Collective responsibility for road safety is an important aspect of Vision Zero, yet one that road safety professionals and advocates may interpret differently (C. McAndrews 2013). This concept was manifested by

motivational statements referring to the need for various agencies, governments, stakeholders, individuals, or communities to work together in order to achieve the policy goals. This sentiment is typified in a statement which says that success “depends on City agencies and departments, elected officials, neighborhood councils, and community-based organizations, and the people” working together (City of Los Angeles, CA 2015).

However, the notion that system designers are ultimately responsible for safety outcomes is largely absent from the action plans. This idea addressed explicitly in only one instance; “[Vision Zero] promotes a culture of shared responsibility, where both designers and policymakers, not just the users, are held accountable for the deaths on our streets” (City of Los Angeles, CA 2015). Yet while this sentiment was not common in the action plans, two interviewees spoke directly to the need for greater system designer responsibility. One explained that “one of the biggest things is shifting responsibility to the creators of the transportation system,” and another stated that “government shares responsibility by designing the system.” Still, other interviewees did not speak directly to any shift in the onus of responsibility under Vision Zero.

The message that individual road users are responsible for their own safety and the safety of others is conveyed frequently. For example, one action plan states that the public should “actively participate in efforts to make [the streets] safer” (City of Fort Lauderdale, FL 2015). Another states that “much of the initiative’s success rests on the ability of [city residents] to

change the way they behave when they are behind the wheel of a car.” (City of Boston, MA 2015).

The question of individual responsibility for road safety varied among the interviewees. Certain officials felt that individual choice is an important component for Vision Zero. One attributed collision causality mainly to individual choice, noting that collisions “wouldn’t happen unless [a person] didn’t decide to speed,” and adding that pedestrians and bicyclists will have to “take responsibility for their behavior.” Contrasting this opinion, several interviewees spoke of the need to move away from the individual behavior model, a notion consistent with the original intention of Vision Zero. One interviewee offered, “we are not out to seek blame on an individual mode. We are looking at flaws in our system and how to address them.” Another critiqued the focus on road user behavior in assigning crash causality when the physical infrastructure does not meet user demand:

The highest number of failure to yields are cited as pedestrian failing to yield to vehicle. Yet when we look at those locations, 40% of those crashes occurred on streets that don’t have sidewalks. It means that we have infrastructure that’s not designed for people to walk.

It is worth noting that collective responsibility and individual responsibility often overlap in the action plans by invoking both the individual and collective role in creating a safe road environment, as in this statement: “we call on everyone who travels on our streets for their help as we strive to realize Vision Zero” (Government of the District of Columbia



2015). This sentiment was echoed often throughout the interviews, with officials pointing out that Vision Zero calls on active participation from all players.

Safety for all road users regardless of transportation mode was found to be another important core principle of Vision Zero. The frequent manifestation of this concept implies that policymakers feel Vision Zero signals a change from the status quo in which safety for certain modes is prioritized over others. In some cases, walking and biking are specifically mentioned. As one interviewee explained, “there was a deliberate choice to focus first on walking and biking” because “there is a significant overrepresentation of those modes” among fatalities and serious injuries. Yet, motor vehicles are not entirely excluded, as in this statement: “drivers and occupants of cars, trucks, motorcycles, and other motorized vehicles have been seriously and fatally injured on our streets” (Government of the District of Columbia 2015).

### *Changing the Culture*

Vision Zero actively seeks to change the social paradigm of road safety. Culture change is an important core principle to the extent that it is mentioned in every action plan and receives 21 total mentions. Within this concept, the idea that culture change can happen in the future is related to culture change that has already happened. For example, campaigns to promote seatbelt use or reduce drunk driving are cited as successful precedents. One interviewee noted that “Vision Zero is often compared with

tobacco cessation campaigns,” and while it has taken multiple decades, “people still smoke, but less and less.”

Part of the culture change that Vision Zero demands will involve changing how language is used, particularly in regards to how mortality in the roadway system is framed as being inevitable. “‘Accidents’ are not accidents,” noted one interviewee, “they are preventable tragedies because of some flaw in our system.” In its action plan, the City of Boston describes how the transportation commissioner has instructed staff to use the word “crash” instead of “accident” as an important symbolic step towards shifting their approach to road safety (City of Boston, MA 2015). This shift in terminology is also manifested by the use of the word “crash” to describe traffic incidents throughout the action plans. The idea that “no death is acceptable” is echoed throughout the action plans, and provides the normative basis for Vision Zero. Statements to this effect often link the unacceptability of mortality with the preventability of mortality.

Changing cultural norms surrounding the primary purpose of the roadway system is another important aspect of Vision Zero. That is, safety should take precedence over all other objectives, even if there are impacts on vehicle capacity. This idea is conveyed in a general sense within the action plans. For instance, San José notes that Vision Zero gives “priority to human safety rather than to efficient vehicular travel” (City of San José, CA 2015). Yet, while the action plans strike an optimistic tone, interviewees were quick to identify public support as one of the biggest potential barriers to

successful implementation. Several interviewees spoke of prevailing attitudes among the public that “driving is a ‘right’ and people can drive however they want.” One spoke of the need to “confront that perception head on.” That safety initiatives can sometimes get derailed during the public engagement process, especially if they involve removal of parking or vehicle travel lanes, was also noted by interviewees. Vision Zero, it seems, is about “communicating the greater good of transforming street.” Yet another noted, “people have a hard time reconciling their frustration with traffic congestion with safety improvements.”

It may be the case that professional attitudes about vehicle capacity and road safety are changing more quickly than public perceptions in certain cities. While agencies may be warming up to the idea of trading slower peak hour travel times for enhanced safety, the public may have a harder time understanding the benefits especially if the perception is that such measures could increase congestion. Part of the challenge may be raising awareness about the problem of road safety. One interviewee suggested that “we don’t have a level of outrage about this problem that we need” and that “people are more willing to tackle the problem of congestion.”

However, this sentiment was not shared by all of the interviewees. One suggested that Vision Zero has made it easier to garner public support for initiatives, noting that “the most important thing it’s done is changed the conversation in the community,” adding, “if you couch it in safety and crash reduction, it makes a big difference—who’s going to argue with you?” This

may ultimately be a reflection of a where individual cities are in regards to the community conversation over road safety. In cities with a longer history of road safety initiatives, especially for pedestrians and cyclists, the public may be more familiar and understanding. Cities without such a history may require additional time and effort to shift the public discourse, and Vision Zero could provide such an opportunity.

### *Characterizing the Goal*

Three related concepts address the character and nature of the Vision Zero goal. “Time-based goals,” which are mentioned in all but two action plans, discuss how soon the goal of zero deaths and serious injuries should be achieved. All but one specifies that the goal should be achieved within 10 or 15 years. San José takes a different approach, proposing “as soon as possible” as the target time period. The slow pace of state and federal policy change, on which safety outcomes are partly dependent, is cited as the reason (City of San José, CA 2015). Several cities characterize the goal as “ambitious.” Perhaps the policymakers feel this qualification is important to preempt any critics who might call the goal unrealistic. The idea that “we could be doing better” was manifested in both a positive and negative context. Cities with a good road safety record used this fact as reassurance—that is, Vision Zero should be easy since “we” are already doing so well. Conversely, cities with poor safety records cited this as a call to action.

Both the action plans and interviewees emphatically point to the need to use a systemic approach to improve road safety. In order to be successful,

Vision Zero must address the root causes of poor road safety through proven countermeasures. Interviewees, in particular, contrasted Vision Zero with the traditional approach to road safety which holds that a certain level of mortality is inevitable. “Right now we have a culture where we accept traffic violence as something we have to deal with—it’s unavoidable in a lot of people’s minds,” stated one interviewee.

Systemic thinking also requires a shift in how risk is perceived. Rather than asking what an individual road user did to cause a crash, Vision Zero accepts that people will inevitably make mistakes and that the system must mitigate against those mistakes. This sentiment, which appeared 14 times in the action plans, was summarized by an interviewee: “we want to get to a system that when a mistake happens, the cost is not someone’s life—it’s a fundamentally different approach from the individual to the system as a whole.”

It is also worth noting what is absent from the action plans. Throughout the literature, there is an explicit moral and ethical dimension to Vision Zero. That is, ethically speaking there cannot be any acceptable number of fatalities and serious injuries in the roadway system. Though this is portrayed as a central tenet of the original Swedish policy in the literature, none of the action plans specifically mention “ethical” or “moral” reasons to justify the policy. The action plans frequently use the word “unacceptable” when describing fatalities and serious injuries. Yet, this word does not carry

the same degree of normative weight and does not ground the policy in a fundamental interpretation of what is right and wrong.

## **4.2 Problem Framing**

Within the problem framing dimension, the case is made for why Vision Zero is necessary. It includes the concepts of “Who is Affected,” “Contributing Factors,” and “Why it’s Needed.” This dimension is embodied by a sense of urgency over the current road safety situation. Specific road users are shown as being more affected by the current road safety paradigm than others. Much of the argument fits within a positivist framework, using logic and data points to justify the need for action. Statements within this concept were inclusively coded. That is, if a sentence mentioned more than one theme, it was coded to each of the themes mentioned. For example, a sentence mentioning seniors, children, and cyclists as affected groups would be coded to each of those themes inclusively.

### *Who is Affected*

“Who is Affected” describes the specific user groups affected by the current road safety situation. Presumably, this also reflects who should benefit the most from interventions. This concept includes users by mode (e.g., pedestrians, cyclists, drivers) and by demographic (e.g., seniors, children, people with disabilities). Safety for all road users has already been established as a core principle of Vision Zero. Understanding “who is

affected” helps expand the narrative by showing which road users are most affected under the current road safety situation.

Theme	DC	LA	BOS	SJ	SEA	SF	NYC	FL	Sum
pedestrians	7	8	9	7	5	5	6	7	54
cyclists	7	6	9	5	4	2	2	6	41
seniors	1	4	-	4	3	3	4	-	19
children	1	6	-	1	1	2	5	-	16
drivers	4	1	5	4	-	-	1	1	16
VRUs disproportionately affected	2	8	2	-	1	1	-	1	15
motorcyclists	2	-	-	4	1	-	-	-	7
people with disabilities	3	-	-	-	-	2	-	-	5
transit riders	2	1	-	-	-	1	-	1	5
racial/ethnic minorities	-	4	-	-	-	1	-	-	5
low-income	-	3	-	-	-	1	-	-	4
skateboarders	-	-	1	-	-	-	-	-	1
Sum	29	41	26	25	15	18	18	16	188

*Table 5: Who is Affected theme frequency by action plan*

Pedestrians were the most frequently cited user group affected by the current road safety situation (54 mentions out of 188), followed by cyclists (42 mentions out of 188). Both user groups were mentioned at least twice in each action plan. Compared to motor vehicle occupants, pedestrians and cyclists are significantly more vulnerable to severe injury or death in roadway crashes, a point made throughout the action plans. In six out of eight action plans, vulnerable road users are characterized as being disproportionately affected (15 mentions). Every interviewee mentioned pedestrians and cyclists as user groups highly impacted by the current road safety situation. One stated, “31% of our fatalities are pedestrians, but 7% of trips are on foot, so there is a disparity.”

Demographics are another important factor in road safety. Seniors and children, irrespective of travel mode, are the most frequently named demographics affected. Two action plans specifically mention people with disabilities, who are characterized as experiencing a heightened state of risk. Los Angeles and San Francisco both highlight how social determinants are associated with increased risk of severe injury or death in the roadway system, especially for low-income and minority pedestrians (City of San Francisco, CA 2015; City of Los Angeles, CA 2015). Though only two action plans mention this specific risk factor, this challenge appears to be common to the extent that four out of six interviewees mentioned a focus on equity as part of their city's Vision Zero strategy. Two interviewees noted that people experiencing homelessness are disproportionately affected by pedestrian fatalities. One interviewee whose work focuses on crash data analysis corroborated the link between social determinants and traffic risk:

We [look at] communities of concern—census tracts with a high percentage of low income, non-English speaking, minority, or disability residents. We've overlaid that with the high-injury network—the high-injury network disproportionately impacts the communities of concern.

### *Contributing Factors*

Exploring the question of causality provides another way to understand the extent of systematic thinking and responsibility delegation within Vision Zero. According to the literature, attributing road safety outcomes to individual behavioral factors was associated with the traditional



approach to road safety from which Vision Zero intends to be differentiated (Zein and Navin 2003; Fahlquist 2006; Johansson 2009; Larsson, Dekker, and Tingvall 2010). The degree to which causality is weighted towards behavioral or systemic factors might reveal how much policymakers have internalized system designer responsibility and systemic thinking. Contributing factors were grouped into two overall themes: user behavior and systemic factors. Within these themes, subthemes were added to reflect specific user groups, behaviors, or conditions.

Theme	DC	LA	BOS	SJ	SEA	SF	NYC	FL	Sum
user behaviors									75
driver behavior									71
speeding	5	9	4	3	4	3	6	-	34
intoxication	2	-	3	2	-	-	2	1	10
failure to yield	-	1	-	-	-	1	5	-	7
distraction	3	1	2	-	1	-	1	-	8
hit & run	-	1	-	1	-	-	1	-	3
dangerous/aggressive driving	2	1	-	-	1	-	4	-	8
large/commercial vehicles	-	-	-	-	-	-	2	-	2
pedestrian behavior	-	-	-	-	-	-	2	-	2
signal violations	1	1	-	-	-	-	-	-	2
systemic factors									13
road design	-	1	-	4	1	-	-	-	6
temporal conditions	-	1	-	4	-	-	1	1	7
Sum	13	16	9	14	7	4	23	2	89

*Table 6: Contributing Factors theme frequency by action plan*

The action plans overwhelmingly cite user behavior as a cause when compared with systemic factors. User behavior receives 76 out of 89 mentions (85 percent). Within the user behavior theme, driver behavior

receives 71 mentions (93 percent); pedestrian behavior receives 3 mentions (4 percent) and signal violations not specific to any user receives 2 mentions (3 percent). The specific language used within the driver behavior theme is also worth noting. In many cases, crash responsibility is attributed directly to the driver (e.g., “drivers who travel 25 mph or faster above the speed limit needlessly endanger everyone on our streets” [Government of the District of Columbia 2015]) rather than using a passive voice (e.g., “being struck by a vehicle is the leading cause of injury-related death for children under 14,” [City of New York, NY 2014]). The former assigns responsibility to the individual driver, while the latter disassociates the action any individual behavior. Removing the sense of inevitability from our language is consistent with the overall message of Vision Zero which highlights that crashes are not inevitable but rather are predictable and preventable (Birdsall 2016).

Speeding is by far the most significant driver behavior mentioned (34 mentions). Throughout the documents, research is cited that found the speed of a vehicle to be a major determining factor of survival in a collision with a pedestrian. A pedestrian struck by a motor vehicle going 40 mi/h has only a 20% chance of survival, while a pedestrian struck at 20 mi/h has an 80% chance of survival. Although the action plans mention other driver behaviors, none are mentioned more frequently than speed. Speed was also universally mentioned as a contributing factor by interviewees. Pedestrian behavior was mentioned as a contributing factor in only one action plan. The specific behaviors mentioned were crossing against the light and crossing mid-block.

Systemic factors received 13 out of 89 mentions (15 percent), significantly less than user behaviors. Temporal conditions most frequently included time-of-day factors (e.g., more crashes occur after dark) and weather. Three action plans mention roadway design specifically. Roadway designs are characterized as “unforgiving” and having been focused on “efficiency, speed, and convenience [for] motorists” (City of San José, CA 2015). Interviewees—particularly those working as urban planners—emphasized systemic factors over individual behavioral factors. Roadway design and land use were the two primary factors mentioned. One planner remarked, “it’s not happening by accident—our roadways are designed improperly,” and another, “we’ve got a lot of very wide roads with very high speeds.”

Land use—particular of the low-density, suburban variety—was characterized as both of a major contributing factor as well as a barrier to implementation. In many cities, downtown areas and neighborhoods built prior to the 1950s generally possess urban design features—for instance, smaller block sizes, gridiron street networks, land use diversity, and higher housing density, to name a few that previous studies have identified—that have been shown to both increase safety for all road users and encourage walking and biking trips (Cervero 1996; Cervero and Duncan 2003; Wesley Earl Marshall and Garrick 2011; Wesley E. Marshall, Piatkowski, and Garrick 2014). In contrast, neighborhoods built after 1950 tend to feature disconnected street networks, highly concentrated land uses, and lack

connected sidewalks or bicycle networks. Such areas are structurally dependent on vehicle travel and tend to feature high-speed, high-volume roads that are associated with increased risk for all users (Wesley Earl Marshall and Garrick 2011). One planner summarized the relationship between land use and road safety:

We can control speed by land use. If we have land use patterns that support public transportation and make driving less desirable, then we have more people on transit. Vehicle miles traveled and traffic fatalities are correlated to the point that it's basically causal.

#### *Why it's Needed*

All of the action plans present justifying arguments for why Vision Zero is needed. This concept is largely dominated by positivist reasoning—that is, it relies on numerical figures to make the case that the present road safety situation is untenable and needs to change. This is particularly exemplified by the “by the numbers” theme in which statistics on road safety are presented, often broken down by mode of travel. These facts and figures add weight to the narrative, showing not just *who* is being affected but also *how many*. This appears to be an important part of framing the problem. The numbers provide a call to action and a hedge against potential political and public opposition to road safety initiatives.

Theme	DC	LA	BOS	SJ	SEA	SF	NYC	FL	Sum
by the numbers	8	8	8	4	9	1	3	4	45
livability and quality of life	-	2	8	2	1	5	-	-	18
economic reasons	-	3	3	-	-	-	-	-	6
mode shift	-	1	2	2	-	-	-	2	7
environmental reasons	-	3	1	1	-	-	-	-	5
for health	-	4	-	-	-	-	-	-	4
a growing city	-	-	-	-	3	1	-	-	4
the public wants it	-	-	-	-	-	-	-	3	3
safety for VRUs means safety for all	-	3	-	-	-	-	-	-	3
Sum	8	24	22	9	13	7	3	9	95

*Table 7: Why it's Needed theme frequency by action plan*

Beyond “by the numbers” none of the other themes were present across all action plans. “Livability and quality of life” was the second most cited justification. Within the context of Vision Zero, this theme appears to be making the case that increased traffic is related to decreased quality of life. For example, Boston notes that “speeding traffic, on main roads and neighborhood streets, decreases the quality of life and discourages walking and bicycling.” “Livability and quality of life” is frequently linked to “mode shift,” which implies that quality of life is enhanced by having more transportation options. One interviewee remarked, “I think it’s also an opportunity to step back and evaluate what streets *are* for and what they *should be* for—it’s an opportunity to reimagine what these huge spaces that are asphalt could be used for.” According to Seattle’s action plan, “a safe city is central to our quality of life and economy. A safe city means that everyone, whether or 8 or 8 years old, can get around comfortably and reliably” (City of Seattle, WA 2015).

There are also practical and economic reasons to implement Vision Zero. Los Angeles, in particular, makes the link between the public health burden of sedentary lifestyles and transportation infrastructure. By making walking, biking and transit use safer and more accessible, it stands to reason that Vision Zero could improve not only traffic safety but lead to a healthier population overall. In terms of economic reasons, one interviewee cited the cost burden of the current road safety situation, stating “70% of medical costs for traffic injuries [are] coming out of public funding.” Another noted the economic benefit of road safety improvements, citing research linking increased sales tax revenue from businesses districts that had received multimodal safety improvements.

The frequency of justifying themes by city is also worth noting because it may suggest how much each city feels the need to “sell” Vision Zero. Los Angeles and Boston lead with 24 and 22 mentions, respectively. New York City and Washington, DC contained the least number of mentions, and featured no mentions beyond “by the numbers.” In a car-dominated city like Los Angeles, the need to justify safety improvements for non-motorized users might be greater than in other cities. In walking and transit dominated cities such as New York City and Washington, DC, the need might be more self-evident. However, this notion is contradicted by Boston, a city also known for its walking and transit culture. For Boston, Vision Zero is focused on *retaining* livability, economic vitality, and mobility. For Los Angeles, Vision Zero appears to be about *attaining* these qualities. One interviewee,

located in a city known for its progressive transportation culture, remarked “there is a strong sense of pride around ... being a walkable, bikeable and growing transit-oriented city.”

### **4.3 Implementation Strategies**

This dimension relates to the technical and operational aspects of Vision Zero. While Core Principles and Problem Framing defines the policy and the problem it is address, this dimension describes what should be done about it. This concerns specific actions as well as the roles that different agents are expected to play. A wide range of concepts, themes, and sub-themes were identified within this dimension—this highlights the complexity of the challenge facing those charged with implementation, as well as the degree to which they are thinking about the system as a whole. In the action plans, the implementation strategy is portrayed as a series of initiatives delegated to various agencies. Many of the proposed initiatives are directly linked to the principles or problems that were identified in the previous two sections. For instance, many of the capacity building initiatives address the need to bring together various agencies and stakeholders, relating to the core principle of Vision Zero that road safety is a collective responsibility.

#### *Building Capacity*

This theme encompasses a broad range of sub-themes, all concerned with the nature of how to build capacity to implement Vision Zero initiatives. There is also a range of specificity and subjectivity within this concept. For

example, themes such as “interagency cooperation” and “transportation advocates” have to do with *who* will be involved with implementation, while themes such as “pilot programs” and “rapid response” address *what* and *when*. The overarching commonality is that these themes relate to institutionalizing the policy within standard operating procedures. Several cities point towards existing initiatives that can be leveraged to complement and strengthen Vision Zero implementation.

Most action plans address a general need to use data, to improve the sharing of data between agencies, or explore new ways of analyzing data. Commonly identified data sources include police response, emergency response, and police enforcement. Private sector sources of data are also mentioned, though less frequently. Public health and emergency response professionals are intended to be key collaborative partners in accessing data, increasing data quality, and conducting data analysis.

One interviewee who works in the field of public health surveillance discussed some of the processes involved as well as data needs. The ultimate goal is to understand the full burden of injury, which means creating a comprehensive crash database using emergency response, hospital, medical examiners and police report data. A comprehensive database is needed because no one data source captures all crash information. For example, around 20% of pedestrian crashes go unreported to the police, yet these crashes might appear in hospital data. The interviewee also noted that



police-community relations can be a barrier—that is, certain communities may be less likely to report crashes to police due to longstanding mistrust.

Theme	DC	LA	BOS	SJ	SEA	SF	NYC	FL	Sum
data									112
general	17	11	13	10	5	16	14	3	89
crash profiling	5	2	1	-	-	-	-	1	9
improving data	8	-	-	-	-	-	-	1	9
counting	4	-	1	-	-	-	-	-	5
policy and legislation									106
general	2	1	6	11	4	15	13	1	53
increasing driver penalties	11	-	-	-	-	3	13	1	28
land use and development	1	-	-	1	2	4	-	-	8
local control of speed limits	-	-	1	2	-	1	5	-	9
complete streets policy	5	1	-	1	-	-	-	1	8
interagency cooperation	11	10	10	11	7	25	14	5	93
existing and complementary initiatives	3	11	22	5	-	-	-	-	41
public health and emergency response	9	4	6	3	2	6	4	-	34
private sector	5	-	3	5	3	6	9	-	31
technology									31
general	-	1	4	5	-	3	7	1	21
autonomous vehicles	2	-	-	6	-	-	2	-	10
funding	2	4	-	5	1	10	3	-	25
task force	1	2	9	-	-	3	3	3	21
transportation advocates	3	-	5	3	1	1	5	1	19
political authority	-	1	3	-	-	-	-	1	5
pilot programs	-	-	2	2	-	3	5	-	12
rapid response	4	-	3	-	-	-	-	-	7
regional coordination	5	-	-	-	-	-	1	2	8
standardizing design treatments	3	-	-	1	-	2	-	1	7
Sum	101	48	89	71	25	98	98	22	552

*Table 8: Building Capacity theme frequency by action plan*

Specific uses of data are identified in the action plans. For example, some agencies plan to target interventions at “hot spot” locations where crashes occur frequently. The specific nature of the interventions will be determined by the type of crash that occurs most frequently. “Crash profiling,” which several cities plan to use, goes a step beyond hot spot analysis. With this approach, analysts use crash data to identify the contributing factors that are most likely to lead to a fatality or serious injury. The analysts can then identify locations where these conditions are present and make changes even before a crash has occurred. Crash profiling also allows for the possibility of developing a standardized set of countermeasures, a strategy that four cities intend to implement. One interviewee stated that their health department was planning to hire an epidemiologist to monitor traffic injuries, something that had never been done before. Two cities plan to improve counting for non-motorized road users with the intention of using this data to prioritize interventions.

The action plans point to the need to create a regulatory environment in which initiatives are able to proceed, addressed in the “policy and legislation” theme. This includes both internal policy changes (e.g., implementing a complete streets policy and addressing land use issues) as well as legislative agendas at the state level (e.g., local control over speed limits). Automated enforcement, which is frequently cited as a desirable initiative, is either entirely banned by some state governments or only allowed in specific locations such as school zones. Several cities seek to lobby

their state legislature to allow expanded use of automated enforcement. Land use, which has been identified as a contributing factor, is another policy area where cities see the opportunity to improve safety. San José links “more urban land uses” with “streets [that] are safe for all users, particularly for people who walk and bike, and people who are young and old” (City of San José, CA 2015). Seattle, in particular, plans to work with developers to ensure safe access for all users during construction periods (City of Seattle, WA 2015). Considering the timeline of development, land use policies are not likely to result in short-term safety improvements but have the potential to fundamentally affect safety over the long term.

Collective responsibility has already been shown to be a core principle of Vision Zero. Therefore, interagency coordination is a crucial element of building capacity. Convening a task force comprised of agency leaders and outside stakeholders is the most common approach. At its most basic level, this increases face time between leadership and fosters relationship building. The stated role of the task force in most cities is to define goals and provide strategic direction for the policy. The need for regional coordination is also cited, though less frequently.

Interviewees were largely positive about the direction of the task force and interagency cooperation. This is seen as a new opportunity to break down silos between agencies and disciplines. Some safety work was happening before, but the process has created a formalized way to make new connections and institutionalize the cooperative process. According to

interviewees, several cities are using the task force to help determine project prioritization. The following quote captures the enthusiasm many of the interviewees expressed for the task force:

I think the creation of the task force has been a big success. We are talking about transportation safety in a different way. When we started ... our transportation department wasn't really on board with us. They've since really come around to us. They're helping bring this forward.

Political authority for implementation is implied in most of the action plans by an opening letter from the mayor and/or other agency leadership. However, three action plans specifically discuss the political authority behind Vision Zero. For Boston and Los Angeles, it is related to mayoral directives, while in other cities the policy has already been or is on the process of being passed by the city's legislative body. Given that there are a variety of different ways city government can be organized, it is hard to draw any conclusions from these statements that would apply broadly. However, political support for implementation could be expected to be an important factor, especially for controversial initiatives.

Several of the themes are more exploratory in nature. Private sector involvement might take on various different forms that include partnerships as well as regulation. Sectors that operate or control large vehicle fleets, such as the ride-for-hire and trucking industries, are frequently cited. Proposed initiatives include educating drivers and adding crash avoidance technology to vehicles. New York City, in particular, is interested in exploring the

possibility of docking pay from taxi drivers who speed using in-vehicle monitoring (City of New York, NY 2014). In a broader sense, crash avoidance technology is frequently mentioned in the context of emerging autonomous vehicle technology.

Cities are looking at ways they can regulate vehicle safety. In particular, Boston has already mandated that all city-contracted trucks be equipped with side guards to deflect pedestrians or bicyclists and prevent them from getting swept under the wheels in a collision. Other cities are exploring similar initiatives on city-operated fleet vehicles. These initiatives are important but limited in scope considering that cities have limited authority over vehicles from outside jurisdictions operating on their streets. Cities can still support these efforts in a broader sense by working with vehicle manufacturers and lobbying federal regulators. Ultimately, changing vehicle technology in the consumer market will take decades to complete because of the slow rate of turnover in the vehicle fleet.

All interviewees identified lack of funding as a major barrier towards implementation. Roadway reconstruction projects that incur capital expenditures may take years to complete, which has implications for how fast safety goals can be achieved. Staffing levels for project oversight can be limited by funding as well. One interviewee pointed out that when projects are funded from state or federal sources, the engineering guidelines required by such funding is more conservative than standards cities are using. While this research does not attempt to exhaustively explore how Vision Zero

programs are being funded, it is worth noting how funding is addressed in the action plans. Cities with identified funding strategies are using a combination of local and state funding such as Capital Improvement Project (CIP) funding. Washington, D.C., Los Angeles, CA, and San Francisco, CA identified the need to develop a long-term coordinated funding strategy. Seattle is using revenue generated from its school zone photo enforcement program to directly fund infrastructure improvements near schools. In San Francisco, CA, three voter-approved transportation bond will help fund safety improvements.

### *The “E’s”*

Many of the specific programs and initiatives proposed under Vision Zero can be classified under the so-called “E’s” of traffic safety. The exact number and composition of “E’s” varies across the documents. At its core are three “E’s”—engineering, enforcement and education; others include evaluation, engagement, equity, and encouragement. This strategy is not new or unique to Vision Zero; it can be found in existing road safety initiatives such as Safe Routes to School. Table 9 shows the manifest and latent frequency of focus area by document. That is, it includes word frequency (e.g., number of mentions of “enforcement”) as well as theme frequency (e.g., number of mentions of something related to enforcement, such as “set up a DUI checkpoint”). This type of analysis can signal to what extent cities are prioritizing, or at least conceiving of, certain interventions.

Theme	DC	LA	BOS	SJ	SEA	SF	NYC	FL	Sum
engineering	36	12	36	54	39	38	60	17	292
enforcement	39	13	28	35	23	37	45	5	225
education	28	10	15	14	19	36	34	11	167
evaluation/accountability	23	14	19	14	1	54	5	13	143
engagement	10	11	23	3	4	6	10	1	68
equity	2	6	-	-	-	3	-	-	11
encouragement	-	-	-	2	-	-	1	7	10
Sum	138	66	121	122	86	174	155	54	916

*Table 9: The "E's" theme frequency by action plan*

Within the engineering category, infrastructure improvements for cyclists and pedestrians emerged as a frequent theme. In particular, cities are interested in creating separated infrastructure for cyclists, improving signal timing, and improving crosswalks and sidewalks for pedestrians. Considering that these two modes are portrayed as the most affected by the current road safety situation, this result is not surprising. Traffic calming and speed reduction closely follows in terms of theme frequency.

Enforcement efforts are largely to be targeted towards enforcing driver behavior. There is a particular focus on automated enforcement, including red light and speed photo enforcement, in which citations are issued to the address associated with the vehicle involved with the violation. The ability of cities to carry out this type of enforcement varies significantly by state. For example, California does not allow automated enforcement under any circumstances. Two of the three California cities represented in the sample intend to lobby the state legislature to change these regulations. In other states, automated enforcement is only allowed in school zones.

Seattle, New York City, and Washington, DC already use automated enforcement, while Boston is interested in exploring its feasibility and effectiveness. Neither Los Angeles nor Ft. Lauderdale mentioned any interest in automated enforcement in their action plans.

Education-related initiatives largely center around “rules of the road” messaging. “A lot of these people don’t know what they’re legally allowed to do on the road,” remarked one interviewee in regards to pedestrians and cyclists. Several cities plan to target individualized educational initiatives at specific groups, including taxi drivers, school children, senior citizens, pedestrians and cyclists. Public messaging campaigns will target safety education towards the general public. Positive reinforcement campaigns will also play a role. Washington, DC, Seattle, and New York City plan to create a recognition program for fleet vehicle or taxi drivers who have outstanding safety records.

Evaluation is the fourth-most frequently mentioned “E” throughout the action plans. There is a need to conduct both backward-looking and forward-looking evaluation. Backward-looking evaluation involves understanding the specific nature of the current road safety situation in order to more systematically target interventions. Forward-looking evaluation is concerned with developing evaluation criteria and monitoring the progress of implementation. Evaluation may also vary depending on the target audience. Cities talk of the need to use evaluation for internal purposes and stakeholder meetings, as well as to create publicly-facing platforms to



disseminate information. A common approach will be to use a dedicated Vision Zero website to display crash statistics and present interactive online maps showing crash location by mode of transportation. Some cities plan to share raw data on their websites to leverage help from outside researchers.

Engagement required some interpretation to differentiate from education, as these two themes have similarities. Statements were coded as engagement if they specifically mentioned the word, or if they were about activities that involve reciprocity with the public such as community meetings or soliciting online feedback. Most cities, though not all, pointed to the need to partner with community organizations to build support for and implement safety improvements. Having support for street redesign projects, especially if they involve removing parking or vehicle travel lanes, can provide a hedge against potential opposition. Several cities have already solicited public feedback regarding problem locations and suggestions through in-person engagement and online platforms.

In terms of equity, cities plan to consider how resources are distributed to ensure that all neighborhoods are served equitably. Beyond that, some cities have identified a higher crash rate in neighborhoods that have higher rates of social disparities. San Francisco and Los Angeles emphasized the need to focus improvements on such communities. One interviewee discussed how equity could be built into enforcement measures. The intention should be to use enforcement to educate, rather than for revenue. Public messaging regarding enforcement initiatives, such as press

releases and electronic billboards, would be part of this strategy. The idea is to let people know that enforcement will be happening and give them an opportunity to avoid a citation, rather than be caught off guard.

Encouragement, when it is mentioned, generally centers around two focus areas: encouraging better driver behavior and encouraging the use of alternative modes of transportation.

### *Priorities*

Using a manifest content frequency analysis, this section shows which user groups and which locations are the intended focus of interventions. The intention is to look beyond how the prioritization process is described within the action plans and see what the frequency of mentions reveals about the nature of priorities under Vision Zero.

Theme	DC	LA	BOS	SJ	SEA	SF	NYC	FL	Sum
pedestrians	13	3	14	11	18	8	26	10	103
cyclists	15	1	17	14	11	5	9	8	80
schools and children	6	5	5	13	8	8	8	1	54
ride-for-hire industry	9	-	1	-	1	1	23	-	35
drivers	5	1	7	-	5	3	10	3	34
transit	4	-	3	2	6	2	2	2	21
fleet vehicles	4	-	1	-	-	2	12	-	19
trucks	5	-	5	-	2	1	3	-	16
seniors	1	1	2	2	3	6	-	-	15
disability	2	1	1	1	-	6	1	1	13
"disadvantaged" communities	2	1	3	-	-	-	-	-	6
VRUs	7	-	2	-	-	-	-	-	9
ATVs	3	-	-	-	-	-	-	-	3
non-English language	-	-	1	-	-	1	-	-	2
highway workers	-	-	-	-	-	-	2	-	2
Sum	76	13	62	43	54	43	96	25	412

*Table 10: Users and Groups theme frequency by action plan*

Statements were coded as being about specific user groups if they mentioned a specific user group within the context of a proposed safety intervention. It is worth noting the similarities between Table 10 and Table 5 on page 51. Pedestrians and cyclists, the two most affected user groups, are also the two most frequently mentioned user groups to be targeted by proposed interventions.

There were notable differences in the spirit and intention of proposed interventions targeted at specific user groups or populations. Certain groups will be the beneficiaries of improvements, while other groups will receive enforcement and regulation, some of which could be perceived as punitive. The measures aimed at vulnerable road user groups or populations (e.g., pedestrians, cyclists, school children, transit users, seniors, disability, non-English speakers, highway workers) are generally positive in spirit and beneficial. Examples of initiatives encompassed infrastructural changes, education and enforcement. Enforcement initiatives were generally aimed at citing drivers who endanger vulnerable road users. Conversely, automotive users, trucks and fleet vehicles will be subject to an increased degree of scrutiny and regulation. Many such proposed interventions will involve enforcement and education. While it has already been established that vulnerable road users bear a disproportionate burden of fatalities and serious injuries and that collisions with motor vehicles are largely responsible, there may still be some risk in being perceived as overly

punitive towards drivers if the overall need for such measures is not effectively communicated.

The analysis of priorities also reveals some specific issues for individual cities. New York City intends to focus heavily on the ride-for-hire industry using its regulatory authority. This is not surprising considering the city is well known for its large taxi fleet. Pedestrians are also a major focus in New York City's Vision Zero initiatives, which may be a reflection of the outsized risk pedestrians face in that city. Washington, DC, the only city to mention all-terrain vehicles (ATVs), takes an entirely punitive stance against this user group. Interventions will include new laws against their use, education and enforcement campaigns against their use, and expanded ability for police to seize ATVs operated on public streets.

## **5 Conclusion**

### **5.1 Summary of Research Findings**

The findings of this qualitative research represent a working theory of what Vision Zero means within the context of U.S. municipal level policy. The research investigated the question of how Vision Zero is conceptualized at the municipal level in the U.S. through a content analysis of Vision Zero action plans and interviews with municipal officials. Three primary dimensions of Vision Zero were explored: core principles, problem framing, and implementation strategies. Throughout these dimensions, the original Swedish policy was used as a basis for comparative analysis.

Vision Zero is proposed by its supporters to represent a departure from traditional road safety thinking and replace it with a systematic, data-driven approach. With the rapid spread of Vision Zero policies across a diverse array of U.S. cities, it is important to examine what the content of published planning documents and the perceptions of officials charged with enacting the policy reveal about the underlying policy principles and implementation strategies. This is particularly important because it is being introduced to a new population and a new political context, and has implications for how much of a shift away from traditional road safety thinking the policies may or may not represent.

### *Core Principles*

The core principles identified through the content analysis and interviews show a clear relationship to the original Swedish Vision Zero policy. These included an assertion that no deaths or serious injuries are acceptable, an emphasis on collective responsibility for road safety, a need to design a system that is tolerant of mistakes, and to prioritize safety above other objectives of the road system. There were, however, points of departure from the original policy. System designer responsibility, an important aspect of the original policy, was not explicitly iterated often in the action plans, though it was implied. Several interviewees spoke of the need for system designers to take on more responsibility for road safety, though this was not a universally shared sentiment. The degree of emphasis on individual responsibility within the action plans was also notable, considering that the original policy framers associated this way of thinking with the traditional approach to road safety. While it is not possible to extrapolate the degree to which this will affect outcomes, it does indicate that additional work might be needed on behalf of policy advocates to further convey the message of system designer responsibility.

### *Problem Framing*

The problem that Vision Zero proposes to address is the present road safety situation in which a certain number of people are killed or seriously injured every year. Pedestrians and cyclists are characterized as being the most affected by the present road safety situation. Correspondingly, these

two user groups will be the focus of the bulk of safety initiatives. Specific demographic sub-groups were also identified, including children, seniors, and populations subject to negative social determinants. This is different from the Swedish Vision Zero policy, which is not mode- or user group-specific, and has generally been focused on motor vehicle occupants (Swedish Transport Administration 2015). The focus on pedestrians and cyclists is not surprising, however, when one considers that the policies examined in this research are focused on urban areas where these modes are generally more common and seeing increased interest. As noted in the literature review, Vision Zero policies in U.S. cities have largely been promoted by bicycle and pedestrian advocacy organizations.

When contributing factors are mentioned, they frequently fell into the “user behavior” category rather than the “systemic factors” category. Motor vehicle speed is widely identified as a contributing factor, and emphasis is placed on managing speed as a safety strategy. In addition to speed, vehicle miles traveled is another major contributing factor identified in scientific research on road safety. Yet there is little discussion of increasing safety through reducing vehicle miles traveled. Scientific research has also found that bicycling is positively correlated with safety for all modes of transportation. By promoting alternative forms of transportation, cities could reduce vehicle miles traveled while preserving—and possibly enhancing—overall mobility. However, this does not appear to be an explicit goal of Vision Zero. Several action plans mentioned a need to increase walking,

cycling, and public transit use, but none of them linked this directly with increasing safety.

### *Implementation Strategies*

In terms of implementation strategies, the use of data, policy and legislation and interagency cooperation were found to be important capacity building strategies. There is a universal focus on targeting identified crash hot spots. Some cities are focusing on intensive crash modeling and public health surveillance to prioritize initiatives; however, the lack of good data sources was frequently cited as a challenge. The “E’s” of traffic safety are a major component of implementation, particularly engineering, enforcement and education. The “E’s” approach to traffic safety, however, is not new or unique to Vision Zero. Physical measures focus on reducing vehicle speeds and decreasing exposure for vulnerable road users. Enforcement generally focuses on infractions most likely to lead to fatal or serious crashes. Certain cities are already using or are interested in using automated enforcement, though this is not universal. Automated enforcement is legally limited or prohibited in certain states. Education efforts will center on informational campaigns and “rules of the road” messaging. Messaging will be targeted at the general public as well as specific users.

This research did not attempt to exhaustively inventory specific measures that each city has implemented or intends to implement. The documents analyzed varied significantly in their level of detail in this regard. If cities are modifying their approach or employing additional strategies not



listed within the action plans, this would not have been captured in the research.

## **5.2 Limitations**

It is worth approaching the results of manifest and latent content frequency with some caution, especially as a basis for comparing action plans to one another. This is because of differences in length and content among the sample. Some action plans contained significantly more text than others, while some were more graphically-oriented. Additionally, certain documents resembled policy briefs, while others contained detailed lists of activities and responsible parties. Word frequency could be expressed as a percentage of the overall word count of a document. However, this analysis was concerned with both word frequency and theme frequency, which complicates the possibility for a clean quantitative ratio.

The research focused specifically on Vision Zero within the context of municipal-level implementation. Considering that policy adoption and implementation happens within a larger context that includes various actors such as the public, news media, stakeholders, and other levels of government, it is difficult to make any predictions about the success of Vision Zero. The results of this research are not necessarily applicable to other levels of government such as state and federal agencies. Finally, as Belin et al. (2012) note in their content analysis of Swedish government documents describing the Vision Zero policy, there is a certain level of generalization and loss of detail that happens in the production of summary documents.

### **5.3 Future Research Potential**

Road safety has broad implications and touches upon many different disciplines including urban planning, political science, and engineering. Future qualitative and quantitative research in all of these fields could provide additional insight for proponents looking to implement Vision Zero in their cities. This thesis focused on how Vision Zero is conceived by municipal governments and their employees, leaving open the possibility for further exploration of road safety sentiment among the general public. Using social media, and especially Twitter, could be one approach to probe the public conversation surrounding Vision Zero.

Vision Zero proposes to use data to understand crash risk and prioritize locations for improvement. Yet, this research revealed that data quality is a deficiency that needs to be addressed if the policy is to fulfill this goal. For example, although pedestrian and bicycle safety are to be a major focus area, existing methods for understanding crash risk for these modes are still relatively rudimentary. This is because most cities do not have comprehensive and accurate data on pedestrian and bicycle volumes. If pedestrian and cyclist volumes could be predicted with some degree of accuracy, it would greatly improve the ability to identify the highest-risk locations. This would in turn allow cities to more clearly define priority areas. Future research could explore how technology, such as fitness tracking apps or automatic counting stations, could be used to improve volume prediction for pedestrians and cyclists. An important focus should be to

develop tools that planning practitioners outside of academic research fields can easily use.

The question of responsibility designation under Vision Zero is one that could be explored through further qualitative research. The literature emphasized that the policy assigns additional responsibility to road system designers for ensuring safety outcomes, yet the research found that system designer responsibility is not a message that is explicitly conveyed throughout documents analyzed. This question could be explored through interviewing a larger and more professionally diverse sample of subjects than interviewed in this research. The sample could be expanded to include those outside of government, including road safety advocates representing various interest groups. The question of road system designer responsibility could also be explored a robust research project to investigate the perceptions of road safety professionals in cities with and without Vision Zero policies to understand whether and how the policies have influenced perceptions. Such a research project could use surveys, interviews, or both.

#### **5.4 Implications for Practice**

Taken as a whole, the results indicate that Vision Zero has indeed mobilized cities to intensify their focus on road safety and involve a broader array of stakeholders in realizing the goal of zero fatalities and serious injuries. This is tremendously positive development. Yet, the research revealed several risks towards successful implementation. Given the broad array of professional disciplines involved in the inception and

implementation of such policies, the implications herein are specifically grounded in the research results and scholarly literature.

For policy proponents within government, having deliberate internal conversations is an important step in the process. Interviewees reported that the task force was one of the most valuable elements because it fostered new connections between previously siloed professions. Proponents should invest time researching Vision Zero, especially the more nuanced aspects of the policy. This is important because as more cities that adopt Vision Zero policies, there is more potential for the message to get diluted or lose its meaning. It may be easy to build agreement around the basic tenet of zero deaths and serious injuries, but topics such as system designer responsibility, vulnerable road user safety, and prioritizing safety over speed are equally important though potentially more controversial aspects of the policy.

Practitioners should focus on building public support for roadway safety projects. Public acceptance was identified by interviewees as a potential barrier to implementation; projects that appear to increase congestion, or to take away space from motor vehicle travel or parking, may continue to face opposition. Shifting the conversation towards fatality and injury prevention could be an effective strategy to turn public opinion. An engaged and vocal advocacy community can help shape the dialogue.

The literature revealed several important focus areas for transportation planners and engineers. First, increase the supply of separated bicycle infrastructure. As previous research has shown, an

increase in cycling has been shown to increase safety for all users at the citywide level (Wesley E. Marshall and Garrick 2011; Ahangari, Garrick, and Atkinson-Palombo 2016). Multiple studies have also shown that separated bicycle infrastructure that provides physical barriers between cyclists and vehicle traffic increases ridership (Goodno et al. 2013; Monsere et al. 2014). This type of infrastructure is especially key to attracting more risk averse demographics who wouldn't be comfortable cycling in mixed traffic (Dill and McNeil 2013). Both of these points should be emphasized within internal and public discourse, especially considering the contentious nature of public conversations about bicycle infrastructure. Emphasizing the benefit to all road users will be especially important. Implementing separated bicycle infrastructure can be politically challenging but it is worthwhile as a cost-effective strategy to both improve safety and induce mode shift.

Second, consider intersection designs that reduce speeds. In particular, roundabouts with dedicated pedestrian and bicycle circulation should be considered for arterial intersections. Under Vision Zero in Sweden, roundabouts are the preferred treatment for arterial intersections because they reduce entering vehicle speeds (Swedish Transport Administration 2015). While overall crash numbers may be lower at signalized intersections, the crashes that do occur are significantly worse because of higher vehicle speeds. Roundabouts may incur more crashes, but these crashes are less likely to result in fatalities or serious injuries. Understandably, arterial roundabouts may be challenging to implement in many cities because they

require more space than traditional intersections. They should be considered when new roads are being developed or where space exists. Roundabouts can pose challenges to pedestrians and cyclists, so engineers should use the latest design guidelines to ensure that designs give priority to these modes through dedicated circulation and reduce entry/exit speeds through narrow roadway geometry, raised crossings, and other techniques. At lower volume intersections, such as those along neighborhood streets, small traffic circles can be installed to reduce vehicle speed and to provide a disincentive to cut-through traffic.

Finally, Sweden focused on categorizing roads and defining corresponding design criteria for each type. This creates standards and conditions regarding speed limits, mixing of different user types, and curbside activity, as described in Section 2.4: Technical Implementation on page 19. Roadways are categorized by the maximum speed allowed and what type of curbside activity (e.g., parking) is present. Recognizing differences in scale between national and municipal policies, it is still possible for cities to implement a form of this categorizing through designating neighborhood slow zones. Neighborhood streets have the capacity to form important connections within a citywide low-stress bicycle network; these streets often carry low traffic volumes and do not require major modifications to be appealing as bicycle routes. Treatments such as speed humps, wayfinding signage, and allowing bicyclists to travel both directions on certain one-way streets may be all that is needed in some cases.

## 6 Bibliography

- Adkins, Arlie, Jennifer Dill, Gretchen Luhr, and Margaret Neal. 2012. "Unpacking Walkability: Testing the Influence of Urban Design Features on Perceptions of Walking Environment Attractiveness." *Journal of Urban Design* 17 (4): 499–510. doi:10.1080/13574809.2012.706365.
- Ahangari, Hamed, Norman Garrick, and Carol Atkinson-Palombo. 2016. "Is Building Bicycling Infrastructure a Path Towards Zero Vision for Traffic Fatality?" *Journal of Transport & Health* 3 (2, Supplement): S51–52. doi:10.1016/j.jth.2016.05.108.
- Anonymous. 2016. "Vision Zero IN New York City." *Institute of Transportation Engineers. ITE Journal* 86 (5): 18–21.
- Belin, Matts-Åke, Per Tillgren, and Evert Vedung. 2012. "Vision Zero – a Road Safety Policy Innovation." *International Journal of Injury Control and Safety Promotion* 19 (2): 171–79. doi:10.1080/17457300.2011.635213.
- Berg, H. -Y., J. Ifver, and M. Hasselberg. 2016. "Public Health Consequences of Road Traffic Injuries – Estimation of Seriously Injured Persons Based on Risk for Permanent Medical Impairment." *Transportation Research Part F: Traffic Psychology and Behaviour* 38 (April): 1–6. doi:10.1016/j.trf.2015.12.007.
- Birdsall, Michelle. 2016. "All Roads Lead to Zero: Realizing Vision Zero." *Institute of Transportation Engineers. ITE Journal* 86 (4): 26–28.
- Blincoe, Lawrence, Ted R. Miller, Eduard Zaloshnja, and Bruce A. Lawrence. 2015. "The Economic and Societal Impact of Motor Vehicle Crashes, 2010 (Revised)." DOT HS 812 013. Washington, D.C: U.S. Department of Transportation Federal Highway Administration, National Highway Traffic Safety Administration. <https://trid.trb.org/view.aspx?id=1311862>.
- Brozen, Madeline, and Daniel Shockley. 2016. "Collision Analysis for Vision Zero Programs: How Data Decisions Can Lead to Different Results." *Journal of Transport & Health* 3 (2, Supplement): S66. doi:10.1016/j.jth.2016.05.010.
- Brugge, Doug, Allison P. Patton, Alex Bob, Ellin Reisner, Lydia Lowe, Oliver-John M. Bright, John L. Durant, Jim Newman, and Wig Zamore. 2015. "Developing Community-Level Policy and Practice to Reduce Traffic-

- Related Air Pollution Exposure." *Environmental Justice* 8 (3): 95–104. doi:10.1089/env.2015.0007.
- Buehler, Ralph, and Jennifer Dill. 2015. "Bikeway Networks: A Review of Effects on Cycling." *Transport Reviews* 0 (0): 1–19. doi:10.1080/01441647.2015.1069908.
- CDC. 2012. "Motor Vehicle Crash Deaths in Metropolitan Areas — United States, 2009." 61(28);523-528. *Morbidity and Mortality Weekly Report*. Washington, D.C.: U.S. Centers for Disease Control and Prevention. <https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6128a2.htm>.
- Cervero, Robert. 1996. "Mixed Land-Uses and Commuting: Evidence from the American Housing Survey." *Transportation Research Part A: Policy and Practice* 30 (5): 361–77. doi:10.1016/0965-8564(95)00033-X.
- Cervero, Robert, and Michael Duncan. 2003. "Walking, Bicycling, and Urban Landscapes: Evidence From the San Francisco Bay Area." *American Journal of Public Health* 93 (9): 1478–83.
- City of Boston, MA. 2015. "Vision Zero Boston Action Plan." Boston, MA: City of Boston Transportation Department. <http://www.visionzeroboston.org/download>.
- City of Fort Lauderdale, FL. 2015. "Vision Zero Quick Guide." Fort Lauderdale, FL: City of Fort Lauderdale, FL.
- City of Los Angeles, CA. 2015. "Vision Zero Los Angeles 2015-2025." Los Angeles, CA: City of Los Angeles, CA. <http://visionzero.lacity.org/wp-content/uploads/2015/09/VisionZeroLosAngeles.pdf>.
- City of New York, NY. 2014. "Vision Zero Action Plan 2014." New York, NY: City of New York, NY. <http://www.nyc.gov/html/visionzero/pages/the-plan/the-plan.shtml>.
- City of San Francisco, CA. 2015. "Vision Zero San Francisco: Two-Year Action Strategy." San Francisco, CA: City of San Francisco, CA. <http://visionzerosf.org/about/two-year-action-strategy/>.
- City of San José, CA. 2015. "Vision Zero San José." San José, CA: City of San José, CA. <https://www.sanjoseca.gov/DocumentCenter/View/42849>.
- City of Seattle, WA. 2015. "Vision Zero." Seattle, WA: City of Seattle. <http://www.seattle.gov/Documents/Departments/beSuperSafe/visionzeroplan.pdf>.



- Corbin, Juliet, and Anselm Strauss. 2014. *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory*. 4th edition. Los Angeles: SAGE Publications, Inc.
- Dill, Jennifer, and Nathan McNeil. 2013. "Four Types of Cyclists?: Examination of Typology for Better Understanding of Bicycling Behavior and Potential." *Transportation Research Record: Journal of the Transportation Research Board* 2387 (December): 129–38. doi:10.3141/2387-15.
- Dolowitz, David P., and David Marsh. 2000. "Learning from Abroad: The Role of Policy Transfer in Contemporary Policy-Making." *Governance* 13 (1): 5–23.
- Dula, Chris S., and E. Scott Geller. 2007. "Creating a Total Safety Traffic Culture." In *Improving Traffic Safety Culture in the United States - The Journey Forward*, 177–99. Washington, D.C: AAA Foundation for Traffic Safety. <https://www.aaafoundation.org/sites/default/files/DulaGeller.pdf>.
- Edvardsson, Karin, and Sven Ove Hansson. 2005. "When Is a Goal Rational?" *Social Choice and Welfare* 24 (2): 343–61. doi:10.1007/s00355-003-0309-8.
- Elvebakk, Beate, and Trygve Steiro. 2009. "First Principles, Second Hand: Perceptions and Interpretations of Vision Zero in Norway." *Safety Science* 47 (7): 958–66. doi:10.1016/j.ssci.2008.10.005.
- Elvik, Rune. 1999. "Can Injury Prevention Efforts Go Too Far?: Reflections on Some Possible Implications of Vision Zero for Road Accident Fatalities." *Accident Analysis & Prevention* 31 (3): 265–86. doi:10.1016/S0001-4575(98)00079-7.
- . 2009. "The Trade-off between Efficiency and Equity in Road Safety Policy." *Safety Science* 47 (6): 817–25. doi:10.1016/j.ssci.2008.10.012.
- EPA. 2016. "Greenhouse Gas Emissions: Transportation Sector Emissions." *U.S. Environmental Protection Agency*. May 26. <https://www3.epa.gov/climatechange/ghgemissions/sources/transportation.html>.
- Fahlquist, Jessica Nihlén. 2006. "Responsibility Ascriptions and Vision Zero." *Accident Analysis & Prevention* 38 (6): 1113–18. doi:10.1016/j.aap.2006.04.020.

- Federal Highway Administration. 2016. "Toward Zero Deaths." *U.S. Department of Transportation*. June 15.  
<http://safety.fhwa.dot.gov/tzd/>.
- Ferreira, Joseph, Mi Diao, and Jingsi Xu. 2013. "Estimating the Vehicle-Miles-Traveled Implications of Alternative Metropolitan Growth Scenarios: A Boston Example." *Transactions in GIS* 17 (5): 645–60.  
 doi:10.1111/tgis.12017.
- Forsyth, Ann. 2015. "What Is a Walkable Place? The Walkability Debate in Urban Design." *Urban Design International* 20 (4): 274–92.  
 doi:<http://dx.doi.org.ezproxy.library.tufts.edu/10.1057/udi.2015.22>.
- Gaber, John, and Sharon Gaber. 2007. *Qualitative Analysis for Planning & Policy: Beyond the Numbers*. Chicago, IL: APA Planners Press.
- Goodno, Mike, Nathan McNeil, Jamie Parks, and Stephanie Dock. 2013. "Evaluation of Innovative Bicycle Facilities in Washington, D.C." *Transportation Research Record: Journal of the Transportation Research Board* 2387 (December): 139–48. doi:10.3141/2387-16.
- Government of the District of Columbia. 2015. "A Plan of Action." Washington, DC: District Department of Transportation.  
<http://www.dcvisionzero.com/assets/updated-dc-vision-zero-action-plan.pdf>.
- Hinde, Sarah, and Jane Dixon. 2005. "Changing the Obesogenic Environment: Insights from a Cultural Economy of Car Reliance." *Transportation Research Part D: Transport and Environment* 10 (1): 31–53.  
 doi:10.1016/j.trd.2004.09.003.
- Johansson, Roger. 2009. "Vision Zero – Implementing a Policy for Traffic Safety." *Safety Science, Occupational Accidents and Safety: The Challenge of Globalization / Resolving multiple criteria in decision-making involving risk of accidental loss*, 47 (6): 826–31.  
 doi:10.1016/j.ssci.2008.10.023.
- Johnston, Ian. 2010. "Beyond 'best Practice' Road Safety Thinking and Systems Management – A Case for Culture Change Research." *Safety Science, Scientific Research on Road Safety Management*, 48 (9): 1175–81. doi:10.1016/j.ssci.2009.12.003.
- Kvale, Steinar. 2007. *Doing Interviews*. Sage Qualitative Research Kit. London: SAGE Publications.

- Larsson, Peter, Sidney W.A. Dekker, and Claes Tingvall. 2010. "The Need for a Systems Theory Approach to Road Safety." *Safety Science* 48 (9): 1167–74. doi:10.1016/j.ssci.2009.10.006.
- League of American Bicyclists. 2015. "Where We Ride: Analysis of Bicycle Commuting in American Cities." Washington, D.C: League of American Bicyclists.  
[http://www.bikeleague.org/sites/default/files/Where\\_We\\_Ride\\_2014\\_data\\_web.pdf](http://www.bikeleague.org/sites/default/files/Where_We_Ride_2014_data_web.pdf).
- Lovegrove, Gordon Richard, and Todd Litman. 2007. "Using Macro-Level Collision Prediction Models to Evaluate the Road Safety Effects of Mobility Management Strategies: New Empirical Tools to Promote Sustainable Development." In *TRB 87th Annual Meeting Compendium of Papers DVD*. Washington, D.C.  
<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.186.4693&rep=rep1&type=pdf>.
- Luoma, Juha, and Michael Sivak. 2014. "Why Is Road Safety in the U.S. Not on Par with Sweden, the U.K., and the Netherlands? Lessons to Be Learned." *European Transport Research Review* 6 (3): 295–302.  
 doi:<http://dx.doi.org.ezproxy.library.tufts.edu/10.1007/s12544-014-0131-7>.
- Lusk, Anne C., Peter G. Furth, P. Morency, L. F. Miranda-Moreno, W. C. Willett, and J. T. Dennerlein. 2011. "Risk of Injury for Bicycling on Cycle Tracks versus in the Street." *Injury Prevention* 17 (2): 131–35.  
 doi:10.1136/ip.2010.028696.
- Lusk, Anne C., Patrick Morency, Luis F. Miranda-Moreno, Walter C. Willett, and Jack T. Dennerlein. 2013. "Bicycle Guidelines and Crash Rates on Cycle Tracks in the United States." *American Journal of Public Health* 103 (7): 1240–48. doi:10.2105/AJPH.2012.301043.
- Marshall, Wesley Earl, and Norman W. Garrick. 2011. "Does Street Network Design Affect Traffic Safety?" *Accident Analysis & Prevention* 43 (3): 769–81. doi:10.1016/j.aap.2010.10.024.
- Marshall, Wesley E., and Norman W. Garrick. 2011. "Evidence on Why Bike-Friendly Cities Are Safer for All Road Users." *Environmental Practice* 13 (01): 16–27.
- Marshall, Wesley E., Daniel P. Piatkowski, and Norman W. Garrick. 2014. "Community Design, Street Networks, and Public Health." *Journal of Transport & Health, Walking & Cycling: The contributions of health and transport geography*, 1 (4): 326–40.  
 doi:10.1016/j.jth.2014.06.002.

- May, Murray, Paul J. Tranter, and James R. Warn. 2008. "Towards a Holistic Framework for Road Safety in Australia." *Journal of Transport Geography* 16 (6): 395–405. doi:10.1016/j.jtrangeo.2008.04.004.
- . 2011. "Progressing Road Safety through Deep Change and Transformational Leadership." *Journal of Transport Geography*, Special section on Alternative Travel futures, 19 (6): 1423–30. doi:10.1016/j.jtrangeo.2011.07.002.
- McAndrews, Carolyn. 2013. "Road Safety as a Shared Responsibility and a Public Problem in Swedish Road Safety Policy." *Science, Technology & Human Values* 38 (6): 749–72. doi:10.1177/0162243913493675.
- McAndrews, Carolyn Ann. 2010. "Road Safety in the Context of Urban Development in Sweden and California." Berkeley, CA: University of California, Berkeley. <http://escholarship.org/uc/item/40j8660h.pdf>.
- McKenzie, Brian. 2014. "Modes Less Traveled—Bicycling and Walking to Work in the United States: 2008–2012." American Community Survey Reports. Washington, DC: U.S. Census Bureau.
- Monsere, Christopher, Jennifer Dill, Nathan McNeil, Kelly Clifton, Nick Foster, Tara Goddard, Mathew Berkow, et al. 2014. "Lessons from the Green Lanes: Evaluating Protected Bike Lanes in the US." National Institute for Transportation and Communities. [http://works.bepress.com/christopher\\_monsere/34/](http://works.bepress.com/christopher_monsere/34/).
- NHTSA. 2016. "Quick Facts 2014." DOT HS 812 234. Washington, D.C: U.S. Department of Transportation National Highway Traffic Safety Administration. <http://www-nrd.nhtsa.dot.gov/Pubs/812234.pdf>.
- Patton, Allison P., Jessica Perkins, Wig Zamore, Jonathan I. Levy, Doug Brugge, and John L. Durant. 2014. "Spatial and Temporal Differences in Traffic-Related Air Pollution in Three Urban Neighborhoods near an Interstate Highway." *Atmospheric Environment* 99 (December): 309–21. doi:10.1016/j.atmosenv.2014.09.072.
- Peden, Margie, Richard Scurfield, David Sleet, Dinesh Mohan, Adnan Hyder, Eva Jarawan, and Colin Mathers, eds. 2004. *World Report on Road Traffic Injury Prevention*. Geneva: World Health Organization.
- Pollack, Stephanie, Barry Bluestone, and Chase Billingham. 2010. "Maintaining Diversity In America's Transit-Rich Neighborhoods." Boston, MA: Dukakis Center for Urban and Regional Policy. <http://www.reconnectingamerica.org/assets/Uploads/TRNEquityfinal.pdf>.

- Pucher, John, Ralph Buehler, and Mark Seinen. 2011. "Bicycling Renaissance in North America? An Update and Re-Appraisal of Cycling Trends and Policies." *Transportation Research Part A: Policy and Practice* 45 (6): 451–75. doi:10.1016/j.tra.2011.03.001.
- Richter, Elihu D., Tamar Berman, Lee Friedman, and Gerald Ben-David. 2006. "Speed, Road Injury and Public Health." *Annual Review of Public Health* 27 (1): 125–52. doi:10.1146/annurev.publhealth.27.021405.102225.
- Rosencrantz, Holger, Karin Edvardsson, and Sven Ove Hansson. 2007. "Vision Zero – Is It Irrational?" *Transportation Research Part A: Policy and Practice* 41 (6): 559–67. doi:10.1016/j.tra.2006.11.002.
- Smith, Karen, and John W. Martin. 2007. "A Barrier to Building a Traffic Safety Culture in America: Understanding Why Drivers Feel Invulnerable and Ambivalent When It Comes to Traffic Safety." In *Improving Traffic Safety Culture in the United States - The Journey Forward*, 201. Washington, D.C: AAA Foundation for Traffic Safety. <https://trid.trb.org/view.aspx?id=810101>.
- Sucha, M. 2014. "Vision Zero from the Perspective of Traffic Psychology." *Transactions on Transport Sciences* 7 (1): 1–8. doi:<http://dx.doi.org.ezproxy.library.tufts.edu/10.2478/v10158-012-0048-6>.
- Sung, Jonathan, Krista Mizenko, Randolph Atkins, and Heidi Coleman. 2016. "P05 - A Comparative Analysis of State Traffic Safety Countermeasures and Implications for Progress 'Toward Zero Deaths' in the United States." *Journal of Transport & Health* 3 (2, Supplement): S65. doi:10.1016/j.jth.2016.05.008.
- Swedish Transport Administration. 2014. "Origin and Background Vision Zero." *Swedish Transport Administration (Trafikverket)*. October 31. <http://www.trafikverket.se/en/startpage/operations/Operations-road/vision-zero-academy/Background-Vision-Zero/>.
- . 2015. "Key Innovations Based on Vision Zero." *Swedish Transport Administration (Trafikverket)*. March 14. <http://www.trafikverket.se/en/startpage/operations/Operations-road/vision-zero-academy/Key-innovations-based-on-Vision-Zero/>.
- Sweet, Matthias. 2014. "Traffic Congestion's Economic Impacts: Evidence from US Metropolitan Regions." *Urban Studies* 51 (10): 2088–2110. doi:10.1177/0042098013505883.
- Toleman, Roger, and Geoff Rose. 2008. "Partnerships for Progress: Toward Sustainable Road Systems." *Transportation Research Record: Journal of*

*the Transportation Research Board* 2067 (December): 155–63.  
doi:10.3141/2067-18.

Toroyan, Tami. 2015. *Global Status Report on Road Safety 2015*. [S.l.]: World Health Organization.

Toward Zero Deaths Steering Committee. 2014. "Towards Zero Deaths: National Strategy on Highway Safety."  
[http://www.towardzerodeaths.org/wp-content/uploads/TZD\\_Strategy\\_12\\_1\\_2014.pdf](http://www.towardzerodeaths.org/wp-content/uploads/TZD_Strategy_12_1_2014.pdf).

U.S. Census Bureau. 2015. "Population Estimates." *Incorporated Places and Minor Civil Divisions Datasets: Subcounty Resident Population Estimates: April 1, 2010 to July 1, 2014*.  
<https://www.census.gov/popest/data/cities/totals/2014/SUB-EST2014.html>.

USDOT. 2014. "Safer People, Safer Streets: Summary of U.S. Department of Transportation Action Plan to Increase Walking and Biking and Reduce Pedestrian and Bicyclist Fatalities." Washington, D.C.: U.S. Department of Transportation.  
[https://cms.dot.gov/sites/dot.gov/files/docs/safer\\_people\\_safer\\_streets\\_summary\\_doc\\_acc\\_v1-11-9.pdf](https://cms.dot.gov/sites/dot.gov/files/docs/safer_people_safer_streets_summary_doc_acc_v1-11-9.pdf).

Vereeck, Lode, and Klara Vrolix. 2007. "The Social Willingness to Comply with the Law: The Effect of Social Attitudes on Traffic Fatalities." *International Review of Law and Economics* 27 (4): 385–408.  
doi:10.1016/j.irl.2007.07.002.

Weijermars, Wendy, and Fred Wegman. 2011. "Ten Years of Sustainable Safety in the Netherlands." *Transportation Research Record: Journal of the Transportation Research Board* 2213 (August): 1–8.  
doi:10.3141/2213-01.

Weisbrod, Glen E, Donald Vary, George Treyz, National Cooperative Highway Research Program, American Association of State Highway and Transportation Officials, National Research Council (U.S.), and Transportation Research Board. 2001. *Economic Implications of Congestion*. National Cooperative Highway Research Program, Report 463. Washington, D.C.: National Academy Press.

Wong, S.C, and N.N Sze. 2009. "Is the Effect of Quantified Road Safety Targets Sustainable?"

Wong, S. C., and N. N. Sze. 2010. "Is the Effect of Quantified Road Safety Targets Sustainable?" *Safety Science*, Scientific Research on Road Safety Management, 48 (9): 1182–88. doi:10.1016/j.ssci.2009.12.020.

Zein, Sany, and Francis Navin. 2003. "Improving Traffic Safety: A New Systems Approach." *Transportation Research Record: Journal of the Transportation Research Board* 1830 (January): 1-9.  
doi:10.3141/1830-01.