March 2023

U.S. Department of Transportation

Source: Denver DOTI

Vision Zero Rapid Response Program

Denver Department of Transportation and Infrastructure

Introduction

The US DOT adopted the Safe System Approach (SSA) to achieve the zero deaths goal. The SSA incorporates six principles and five elements of roadway safety, shown in Figure 1. "Applying the Safe System approach involves anticipating human mistakes by designing and managing road infrastructure to keep the risk of a mistake low; and when a mistake leads to a crash, the impact on the human body doesn't result in a fatality or serious injury."[1]. This document highlights Denver's Department of Transportation and Infrastructure (DOTI) Rapid Response program (RR Program or RR team) and shows how the program takes a systemic approach to safety and aligns with the Safe System principles to achieve Vision Zero in Denver. The Safe System principles that are aligned with Denver's program are highlighted in **bold** throughout this Noteworthy Practice.

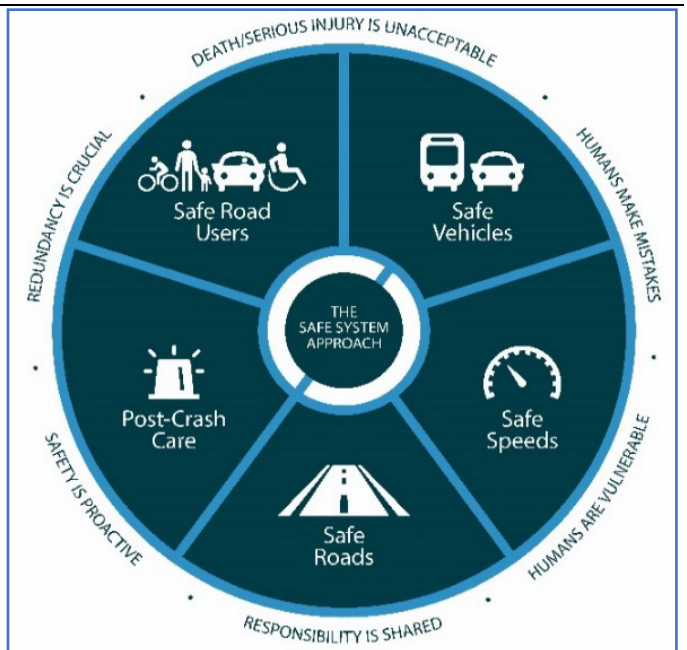

Figure 1: The six Safe System principles and the five Safe System elements.
Source: FHWA

Overview of the Vision Zero Rapid Response Program

In October 2017, Denver released their Vision Zero Action Plan[2] with a goal to eliminate traffic fatalities by 2030. In this plan, Denver recognized that **deaths and serious injuries are unacceptable** and preventable.

[1] https://highways.dot.gov/safety/zero-deaths
[2] https://www.denvergov.org/files/assets/public/vision-zero/documents/denver-vision-zero-action-plan.pdf

One of the goals of the Vision Zero Action Plan was to "perform engineering reviews at traffic fatality and high collision locations to identify risk factors that can be addressed citywide," which included the following two action items related to the creation of a RR program:

- *Until the end of 2017, convene rapid response meetings after pedestrian, motorcyclist, and bicyclist fatalities. Implement near-term safety improvements as appropriate and implement a strategy for rapid response meetings beyond 2017.*
- *Using crash trends, rapid response information, and other data and analytics that are available and appropriate, systematically identify locations that need street modifications and implement changes. Collaborate across agencies to identify problems and solutions and develop case studies or lessons learned where possible for future improvements.*

In response to these actions, the City created a Department of Transportation and Infrastructure (DOTI) RR program. The RR program reviews all crashes that result in a fatality, as well as crashes involving people walking, biking, or driving a motorcycle that result in a serious injury. The focus on people walking, biking, and riding motorcycles aligns with the Safe System principle that **humans are vulnerable**. At these locations, the RR team, which is currently made up of four engineers and planners from the DOTI staff, implements rapid changes to reduce the number of crashes that occur, and minimize the likelihood of a serious injury and/or a fatality when a crash does occur.

When a crash is assigned to the RR program, the RR team activates their standard 13-step operating procedure, shown in Figure 2, which typically takes 60-days to complete. The standard operating procedure allows the RR team to review each crash in a repetitive and consistent method. This allows the RR team to operate efficiently while continuously improving upon the existing process.

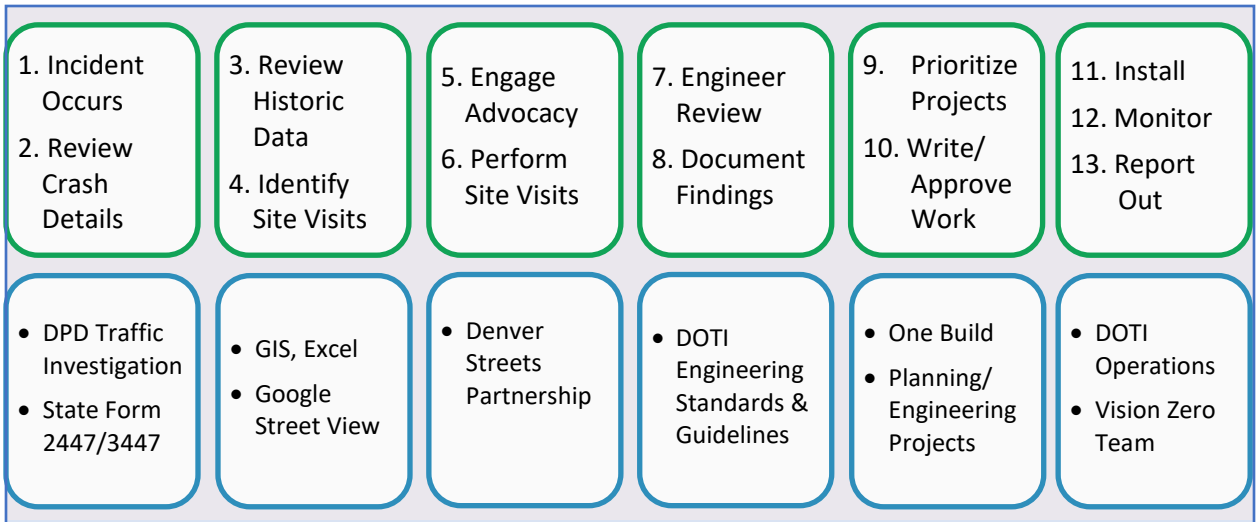

Figure 2: The Rapid Response program's 13-step, 60-day standard operating procedure for when a crash occurs.
Source: Denver DOTI

Make Decisions with Data

The RR program uses data to drive the decision-making process. The use of data corresponds to the first three steps of the operating procedure, which include reviewing the crash report and historic crash data. The RR team explores the historic crash data to identify major patterns at the location. Through the RR team's partnership with the Denver Police Department (DPD), contributing factors for each crash are determined, such as aggressive driving and/or speeding. The RR team then proposes countermeasures to help address the contributing factor(s).

After enough time passes and data is collected, some sites are compared with a post-implementation study to measure the effectiveness of the countermeasures implemented. The City of Denver is exploring expanding the RR program to adopt a more systemic approach that identifies specific characteristics of a crash, recognizes other locations that meet the same criteria, and target those locations for a future safety project. Identifying safety improvements before they result in fatalities or serious injuries highlights the Safe System principle that **safety is proactive.**

Collaborate with other Agencies

The RR program embodies the Safe System principle that **responsibility is shared** by making partnerships central to the implementation of the program. While partner agencies are involved throughout the process, it is emphasized in steps 5-6 of the operating procedure, where the RR team engages advocates and performs a site visit. The DPD is a critical partner as it is responsible for crash reporting, which DPD uses to identify the contributing factors of the crash. Historic crash data and police crash reports are also used to identify crash patterns. Crash patterns are used to help the RR team propose appropriate safety countermeasures that solve the immediate safety challenges.

Prior to the RR program, a DPD officer's primary focus was to investigate crashes and enforce appropriate behavior as trends arise. After attending a USDOT First Responder training, and through the participation in the RR program, the thought process that enforcement is the only tool has changed. Now, a DPD officer is able to recognize the crash causes and become more collaborative with the RR team. The RR team's ability to develop a relationship with DPD is important as transparency of information is critical. High profile crashes that include a fatality might have sensitive information, however the details of the crash are important to the success of the RR program.

The Colorado Department of Revenue (CDOR) in coordination with the Colorado State Traffic Records Advisory Committee (STRAC) developed and implemented the new State of Colorado traffic crash report form DR3447 in November 2021, replacing the old from DR2447[3]. DOTI was invited as a stakeholder to provide input. The new crash report form has led to an improved incident management system and more available data points which has helped the RR program identify crash patterns.

One of the RR team's future goals is partnering with the Colorado Department of Public Health and Environment (CDPHE) and local hospitals to help determine whether mental health factors, alcohol,

[3] https://www.codot.gov/about/committees/strac/dr3447

and/or drugs are involved in the resulting crash. Additionally, the RR team hopes to track unreported serious crashes by identifying people who arrive at clinics with injuries from a crash without having reported said crash. The RR team stated that sometimes the toxicology report takes 2-3 months to be finalized, and that could have a major impact on documenting the crash causes. When drugs, alcohol, and/or mental health are involved, multiple disciplines can work together to identify strategies to address the issue more holistically.

When a crash occurs on a State-owned roadway within the city limits that meets the RR program criteria, the RR team reaches out and follows-up with CDOT staff to discuss the crash. They participate in site visits and respond to inquiries. Local advocacy groups and the Regional Transportation District (RTD, Denver's public transportation agency) are also involved as partners to the RR program. Many additional partners that help lead to the success of the RR program include the Office of Community and Business Engagement (OCBE), local residents and business owners, and the Denver Parks and Recreation (DPR) when the rapid response action includes vegetation removal. The partnerships are not only important during the immediate response, but also the success of any long-term improvements that might be included in the future.

Recommend Countermeasures

Within the RR program, countermeasures fall into three categories: engineering, education, and enforcement. The three categories align with the Safe System principle that **humans make mistakes**. When humans inevitably make a mistake, the outcome should not result in serious injury or fatality. Many engineering countermeasures encourage people to drive slower, so that if an error occurs, the effects to people involved in a crash is lessened. Education countermeasures focus on messaging that targets behavior such as aggressive and distracted driving, speeding, and impaired driving. Lastly, many enforcement countermeasures create consequences when mistakes are made to ensure they will not happen again. By designing a system where it is expected that humans make mistakes, the severity of those mistakes can be minimized.

Steps 7-11 of the operating procedure are related to countermeasure identification, prioritization, and implementation. One of the primary objectives of the RR program is to write work orders and quickly implement safety countermeasures. The RR team uses the crash data, the site visit, the partner collaboration, and the contributing factors of the crash to assign a safety goal. The selected countermeasure(s) will achieve the safety goal.

At the intersection shown in Figure 3, the goal that the RR team identified was "to slow drivers and shorten crossing distance for pedestrians." The RR team suggested daylighting with flexible delineator posts as a countermeasure. Goals at other intersections include "to increase visibility of the curved geometry through the intersection and help drivers navigate through safely," or "to increase visibility of signals to drivers." [4]

Figure 3: A rapid response countermeasure to install daylighting with flexible delineator posts in commercial area with heavy pedestrian volumes with the goal "to slow vehicles and shorten the crossing distance"
Source: Denver DOTI

[4] Provided in the RR Program presentation delivered to Volpe on March 23, 2022

Deliver Results

After DOTI installs the countermeasure(s), steps 12-13 of the operating procedure, and any future action at the location, are related to monitoring and quantifying the results of the safety intervention. The RR team maintains an internal dashboard, as shown in Figure 4, that summarize the current status of the open investigations, the type of countermeasure applied, the crash location, the type of roadway user, the manner of collision, and whether the crash occurred in an equity area or a high-injury network (HIN).

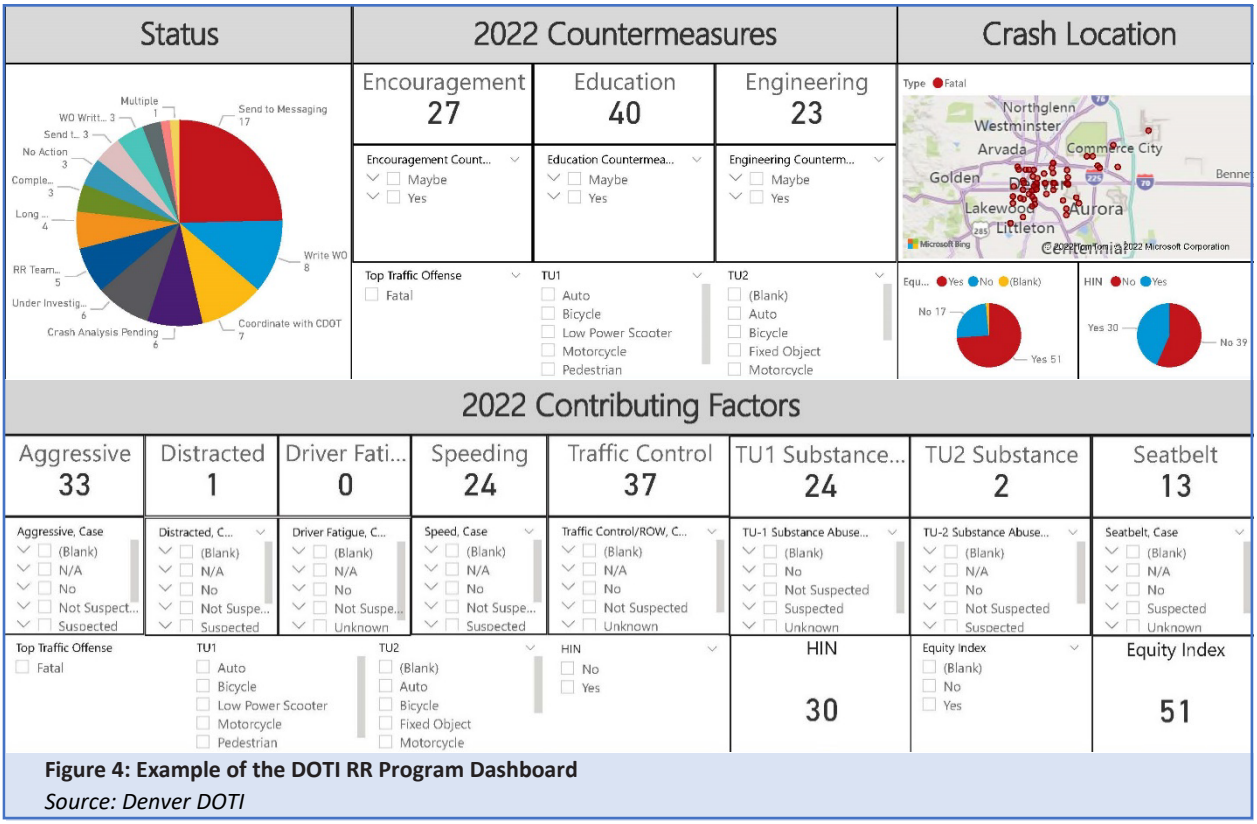

Figure 4: Example of the DOTI RR Program Dashboard
Source: Denver DOTI

The RR team has reviewed every fatal crash in Denver since the RR program launched. The RR team has recommended over 50 signage, pavement marking, or signal timing and phasing work orders since the beginning of 2020. Recommendations related to education or enforcement are typically handled through a mass effort, such as a marketing campaign or targeted enforcement effort, making it difficult to quantify. One example that the RR team identified as a success was the interchange of 20th Street/I-25, which experienced a high frequency of crashes, especially crashes that included impaired drivers. The RR team worked with CDOT to improve signage and DPD to increase enforcement. After the treatments were implemented the number of crashes decreased by 33 percent.

In addition to the rapid implementation at serious crash locations, DOTI utilizes the Denver DOTI Vision Zero Capital Improvement Program (CIP) Project Pipeline for additional long-term actions to

permanently establish improvements at RR locations. The CIP also includes long-term projects from other DOTI safety initiatives. This tool is used to assign a funding source and the funding year to develop more robust holistic safety solutions throughout the City.

By completing the 13-step operating procedure, the RR team performs a holistic review of a crash to improve safety. The review can be used to identify other locations with safety challenges throughout Denver with similar roadway characteristics, such as surrounding land-use, speed, and lane configuration. This allows DOTI to address safety challenges and implement countermeasures before fatalities and serious injuries occur.

The Safe System Elements

The last Safe System principle pertains to redundancy. **Redundancy is crucial** as it helps ensure that when one part of the system fails, other parts continue to protect road users. These redundancies are reflected in the five Safe System elements below.

Safe Roads: The RR program correlates well with the Safe Roads element by rapidly implementing safety enhancements at locations where crashes occur. Many of the engineering countermeasures, such as flexible delineator posts, bollards, signage, and signal modifications, are design elements that physically change the roadway by narrowing the travelway for vehicles or protect pedestrians or bicyclists on the sidewalk or the bike lane. The design elements that are accepted by the City are published on the DOTI Engineering Standards, Details, Manuals, and Guidelines[5] website.

Safe Speeds: Many of the countermeasures encourage or compel drivers to slow down, which reinforces the Safe Speeds element. When a road user makes a mistake in a low-speed environment, the result is often less serious than in a high-speed environment. The RR program applies countermeasures that encourage safe speeds such as narrowing the roadway with paint and flexible delineator posts and installing high visibility chevron signs to indicate a curve, warning drivers to reduce their speed.

Post-Crash Care: The foundation of the RR program is post-crash care. Currently, the RR program begins after a crash involves a fatality, or a pedestrian, cyclist, or motorcyclist experiencing a serious injury. A key component of the RR program includes using crash data and performing a crash analysis to inform the decision-making process when selecting a countermeasure. The RR team also works closely with the DPD, the CDPHE, among other local emergency responders and local health departments, all of which are critical to post-crash care. While the current RR program may appear to be reactive, the steady growth and systematic nature of the program has led to a proactive approach to safety - DOTI identifies factors that cause the crash and prevents them from happening at other locations.

Safe Road Users: The RR program considers the safety of all roadway users when evaluating crashes and recommending countermeasures. Since people walking, biking, or riding a motorcycle are more likely to

[5] https://www.denvergov.org/Government/Agencies-Departments-Offices/Agencies-Departments-Offices-Directory/Department-of-Transportation-and-Infrastructure/Documents/Standards-Details

be killed or injured in a crash, extra emphasis from the RR team is related to these road users. The RR program addresses vehicle users during a fatality, which typically occur at high speeds, when the victim is not wearing a seat belt, or when driver impairment is identified as a cause.

Safe Vehicles: The RR team identified having access to vehicle data, such as the vehicle black box, as an opportunity to have better data and understand more about the crash than is immediately available. The RR team and DOTI have considered the legality of obtaining this information. Access to this data would lead to a better understanding of the Safe Vehicles element.

Summary

The RR program supports the Safe System Approach to reduce fatal and serious crashes. The RR program has been able to rapidly respond to many safety challenges and implement effective countermeasures throughout Denver. The RR program has also improved and evolved over time by developing strong partnerships with first responders and other key agencies. As the RR program grows, crash patterns will continue to emerge, allowing DOTI to build upon the comprehensive approach to transportation safety and develop a proactive approach to prevent fatal and serious injury crashes.