Motor Vehicle Crash Avoidance
Advancing Technology's Promise of Improving Safety

The best kind of car crash is the one that never happens.

What's one of the most promising ways to prevent crashes and save lives and money on America's roadways? Crash avoidance technologies that let cars communicate with drivers, each other, and infrastructure. For decades, **Volpe, The National Transportation Systems Center**, has collaborated on crash avoidance research with U.S. Department of Transportation (U.S. DOT) agencies, including the **National Highway Traffic Safety Administration (NHTSA)**, the **Intelligent Transportation Systems Joint Program Office**, and the **Federal Transit Administration**. Volpe analyzes the data and assesses the technologies that will continue to inform rulemaking, federal guidelines, and investment decisions on crash avoidance technology. In the evolution of active safety technology, Volpe is at the fore of crash prevention.

The front line of crash avoidance technology

In-vehicle warning systems use radar, cameras, and other sensors to scan the roadscape and warn drivers—with visual, auditory, and physical alerts—of impending crashes.

With **vehicle-to-vehicle (V2V)** technology, vehicles within range communicate wirelessly to exchange information such as speed and location to help drivers avoid catastrophic crashes.

Similar to V2V, **vehicle-to-infrastructure (V2I)** is a wireless info-swap between vehicles and roadside fixtures, such as traffic signals and signs.

If completely effective, the full suite of safety technology – V2V, V2I, and in-vehicle crash warning systems – could potentially address about **95 percent** of all vehicle crashes involving unimpaired drivers.

The Costliest Crashes

Driving is safer than ever, with just over 1 death per 100 million vehicle miles traveled. Still, the physical and economic costs of these crashes are staggering. Every year more than 30,000 people die in crashes, more than 2 million people are injured, and more than $230 billion is drained from the economy.

Volpe crunched the numbers to find the costs of every kind of crash. Here are the yearly consequences of three of the costliest light vehicle scenarios.

The price tag includes lost productivity, medical bills, emergency services, property damage, and other crash consequences—but not pain and suffering.

A driver is traveling too fast and loses control of the vehicle

$64.7 billion/year

Crash Count: **498,000**

Safety impact: With V2I, a connected roadside sign alerts drivers of upcoming unsafe conditions or road features, such as a sharp curve or slippery conditions, and advises the driver to reduce speed.

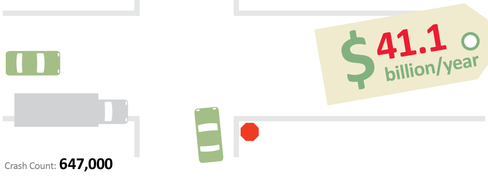
A driver slows down or stops and is rear-ended

$41.9 billion/year

Crash Count: **1,340,000**

Safety impact: In-vehicle crash avoidance alerts the trailing driver that the car in front has stopped or is slowing, giving the trailing driver advance warning to apply the brakes.

A driver crosses an intersection and collides with crossing traffic



$41.1 billion/year

Crash Count: **647,000**

Safety impact: A parked truck obscures the view of a driver turning left from a stop sign. With V2V, the car going through the intersection automatically alerts the driver turning left, enabling the driver to brake and avoid impact.

Key Volpe Crash Avoidance Projects

1991 – 1996: Volpe conducts an **in-depth review** of **national crash data** and identifies major crash causes and technologies that can prevent crashes.

1995 – 1999: Studies five frequent **pre-crash scenarios** to discover what happens just before some of the most common crashes.

1996 – 1999: Analyzes data from 108 drivers using **Intelligent Cruise Control**, which keeps cars at a safe distance behind other vehicles.

1998 – 2000: Estimates the potential **monetary** and **life savings** if crash avoidance systems were implemented nationwide.

2000 – 2005: Studies 96 subjects using a **rear-end crash avoidance system**, which alerts drivers of hazards and brakes automatically.

Evaluates **crash data recorders** and recommends ways to make these less expensive and improve crash data reporting.

2001 – 2003: Tests **radar-based crash warning systems** and adaptive cruise control for tractor-trailer trucks.

2001 – 2005: Evaluates driver acceptance of a **drowsy driver alert** system with 102 heavy-truck drivers.

Analyzes 80,000 miles of driving data from 78 participants **driving passenger cars equipped with lane departure and curve speed warning systems.**

2005 – 2009: Examines how harm from frontal crashes could be reduced by **brake-assist** and **improved restraints.**

2006 – 2010: **Prototype crash warnings: Integrated Vehicle-Based Safety Systems (IVBSS)**

Studies 108 subjects driving passenger cars and 18 subjects driving heavy trucks equipped with in-vehicle crash warning systems. Drivers log more than 800,000 miles.

Volpe found that if all cars had IVBSS crash warnings, up to **788,000** police-reported **crashes could be prevented** every year ...

... and that **82 percent** of drivers thought the crash avoidance system would **increase their driving safety.**

2011 – Present: **Connected Vehicles on the road**

Evaluating, analyzing, and providing project management for the **Connected Vehicle Safety Pilot**, a U.S. DOT model deployment initiative in Ann Arbor, Michigan, examining how 2,800 vehicles with V2V and V2I technology work in the real world.

2013 – Present: **Commercially available crash warnings: today's vehicle-based crash alert systems**

Studying how 36 drivers respond in everyday driving for a year in vehicles equipped with state-of-the-art collision warning systems.

A Crash-Scenario Nomenclature

2007: Volpe defines more than three dozen pre-crash scenarios.

Preventing a crash is really about avoiding the hazards that lead to a crash. Before Volpe researchers could analyze crash avoidance technology—in-vehicle, V2V, and V2I—they had to **define the hazardous events that crash avoidance technology would address.**

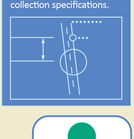
These events are called **pre-crash scenarios**—a lead vehicle stops short or a vehicle loses control on slippery roads. **Now, Volpe and other researchers speak the same crash language.**

Technology Assessment at Volpe

Volpe researchers develop specialized data-mining tools and algorithms to analyze and assess crash avoidance concepts based on realistic driving scenarios. Here's the step-by-step of how Volpe assesses the safety benefits of crash avoidance technology.

Volpe ...

Crafts experimental designs and data-collection specifications.



Develops data-mining algorithms and analytical tools.

Collects, manages, and analyzes massive naturalistic driving* datasets, giving researchers a large amount of driving data to analyze.

Evaluates how drivers accept and adapt to advanced safety technologies.

Creates methodologies that integrate real-world data, experimental data, and national crash statistics to estimate how well safety technologies prevent crashes.

Estimates reductions in crashes, injuries, and fatalities.

*Naturalistic driving studies use instrumented vehicles to collect data on how people actually drive in real traffic situations.

Volpe has contributed to more than **35 publications** on crash avoidance.

Contact the Volpe library at http://www.volpe.dot.gov/library

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Volpe, The National Transportation Systems Center