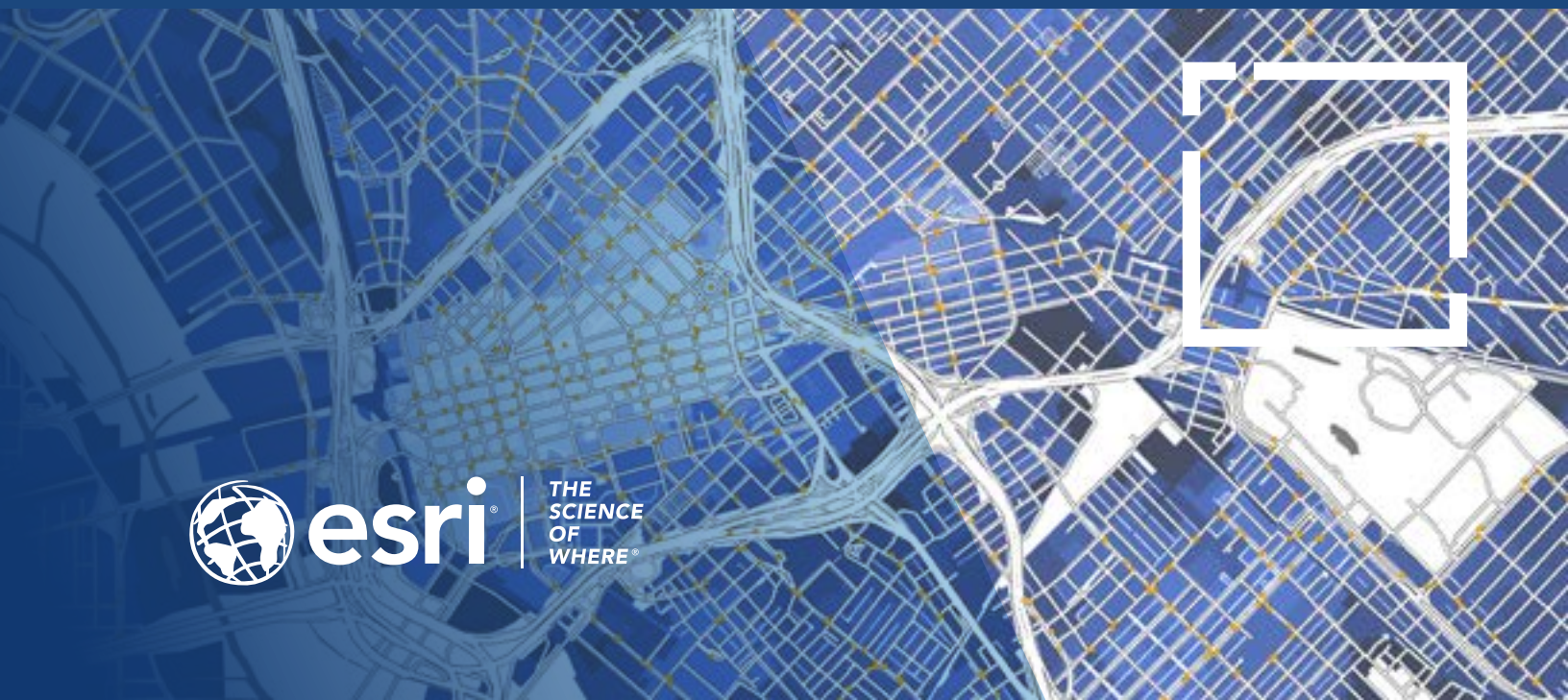
ACHIEVING SYSTEMATIC

Road Safety Improvements



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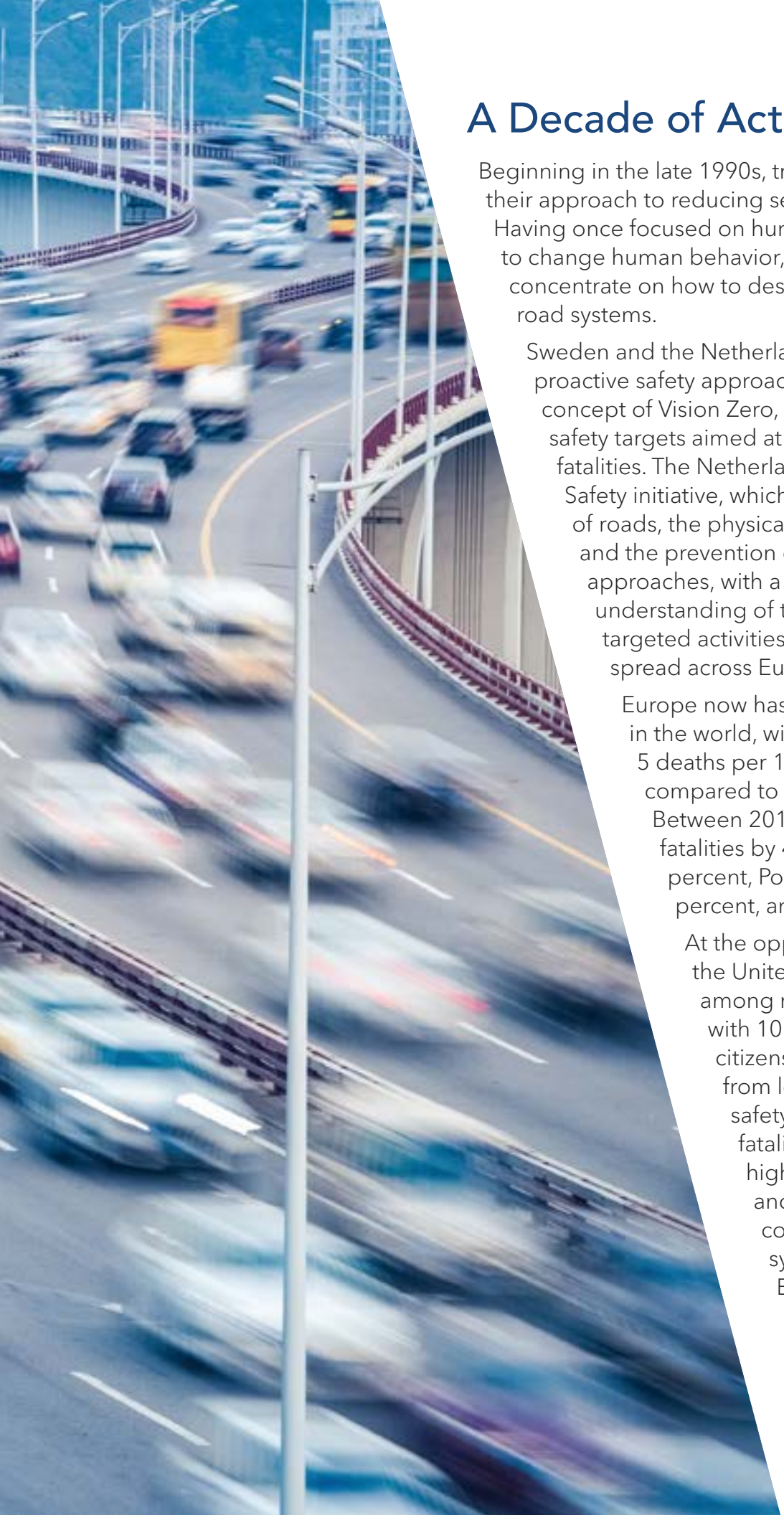


A Decade of Action

Beginning in the late 1990s, traffic safety experts recast their approach to reducing serious-injury and fatal crashes. Having once focused on human factors and attempts to change human behavior, they instead began to concentrate on how to design and build more forgiving road systems.

Sweden and the Netherlands pioneered these proactive safety approaches. Sweden originated the concept of Vision Zero, with aggressive roadway safety targets aimed at achieving zero traffic fatalities. The Netherlands launched its Sustainable Safety initiative, which focuses on the functionality of roads, the physical vulnerability of people, and the prevention of unsafe actions. These approaches, with a move toward a data-driven understanding of traffic safety and a range of targeted activities to improve design, soon spread across Europe.

Europe now has some of the safest roads in the world, with a traffic fatality rate of 5 deaths per 100,000 inhabitants, compared to 17.4 per 100,000 globally. Between 2010 and 2015, Norway reduced fatalities by 43 percent, Greece by 36 percent, Portugal and Spain by 32 percent, and Denmark by 30 percent.

At the opposite end of the spectrum, the United States has the highest rate among major industrialized countries, with 10.25 deaths per 100,000 citizens. The United States has gone from leading the world in vehicle safety in the 1970s to having a fatality rate that is 40 percent higher than those of Canada and Australia, two comparable countries with open highway systems. If it had followed Europe's trajectory, the United States could have saved more than 20,000 lives a year, according to one recent study.

What Can Be Done?

Many of the concepts Europe pioneered were adopted in the Decade of Action for Road Safety, proclaimed by the United Nations General Assembly in 2011. Governments worldwide committed to implementing new policies with a range of road safety measures to reduce roadway fatalities.

The International Transport Forum (ITF) research report for the Organisation for Economic Co-operation and Development (OECD), *Zero Road Deaths and Serious Injuries: Leading a Paradigm Shift to a Safe System*, includes 10 key recommendations. Among them is "that countries collect and analyze data and research on all aspects of a Safe System to enable new insights and a better understanding."

And in that context, geographic information system (GIS) technology—with its inherent capability of capturing, managing, and analyzing data and engaging stakeholders—has a critical role to play.

The ways that GIS can enable more effective safety analysis include the following:

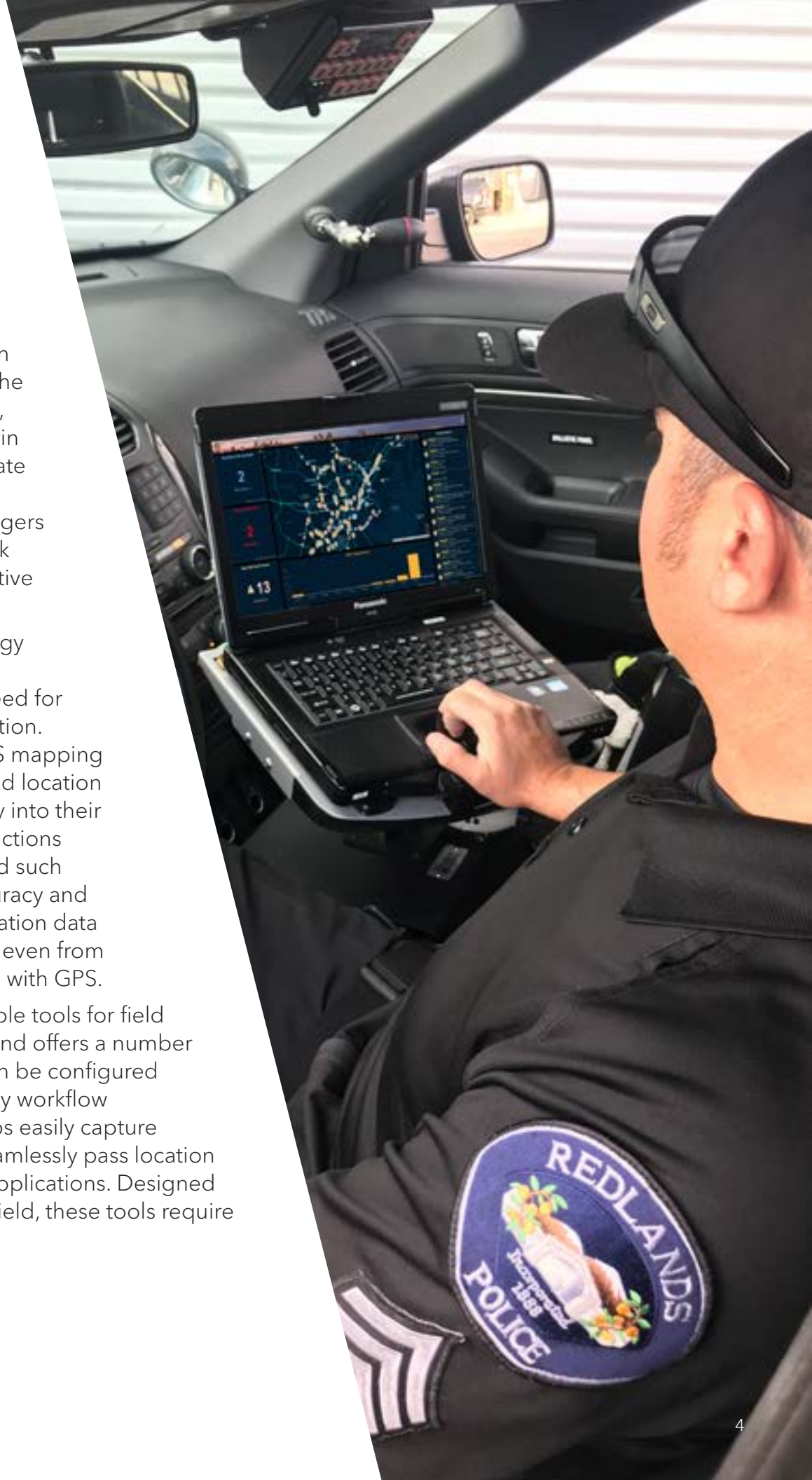
- Ensuring accurate crash data collection in the field
- Improving data management and safety data integration across systems
- Analyzing crash data and monitoring the effectiveness of countermeasures
- Communicating with and engaging stakeholders

It All Begins in the Field

Accurate crash location information provides the key to reliable analysis, yet it remains wanting in many agencies. Accurate crash location data is crucial for safety managers to understand high-risk areas and define effective countermeasures.

GPS and GIS technology provide the tools that responding officers need for collecting this information. Organizations with GIS mapping tools have incorporated location information seamlessly into their crash reports. In jurisdictions that have implemented such technologies, the accuracy and timeliness of crash location data increases significantly, even from vehicles not equipped with GPS.

Esri has designed simple tools for field crash data collection and offers a number of applications that can be configured to meet varying agency workflow requirements. The apps easily capture crash data and can seamlessly pass location information to other applications. Designed for ease of use in the field, these tools require little training.

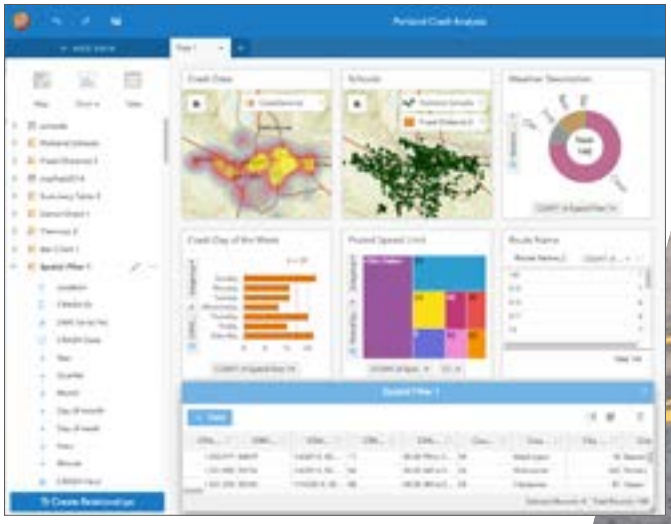


Data Management

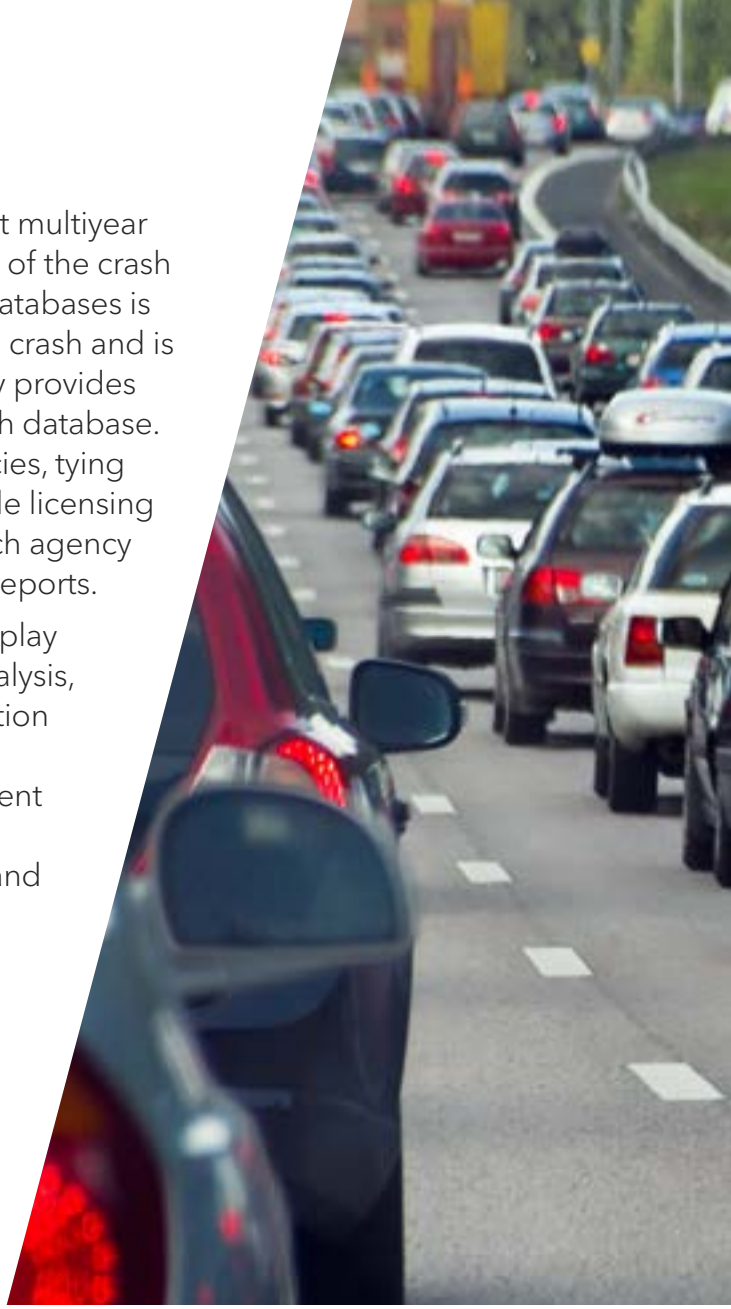
The starting point for reliable safety analysis is a robust multiyear crash database that captures all the relevant elements of the crash report. The ability to effectively query and filter such databases is essential, and because it includes the location of each crash and is linked to a relational database system, GIS technology provides an ideal framework to organize a comprehensive crash database. Often such databases can be integrated across agencies, tying together the roadway administration, the motor vehicle licensing agency, and the traffic police authority. This allows each agency access to the information needed for its analysis and reports.

To make headway on safety, it's not enough to just display each crash as a dot on a map. To perform effective analysis, the safety analyst needs access to a wealth of information such as traffic volumes; roadway characteristics and geometry; pavement and weather conditions; pavement friction ratings; and, ideally, a roadway video log. GIS supplies the integrative framework to bring this data and information together for complex analysis that gets to the root cause of accidents.

GIS can help establish a system of record for the safety analyst, bringing together data from across the organization into a single authoritative source. Information products can be designed to combine analysis and map-based visualizations that help the analyst make headway on problem areas. The system of record informs the system of insight, which identifies and prioritizes areas that need countermeasures to ensure the safest roadways possible.



Crash analysis includes weather conditions and proximity to schools.



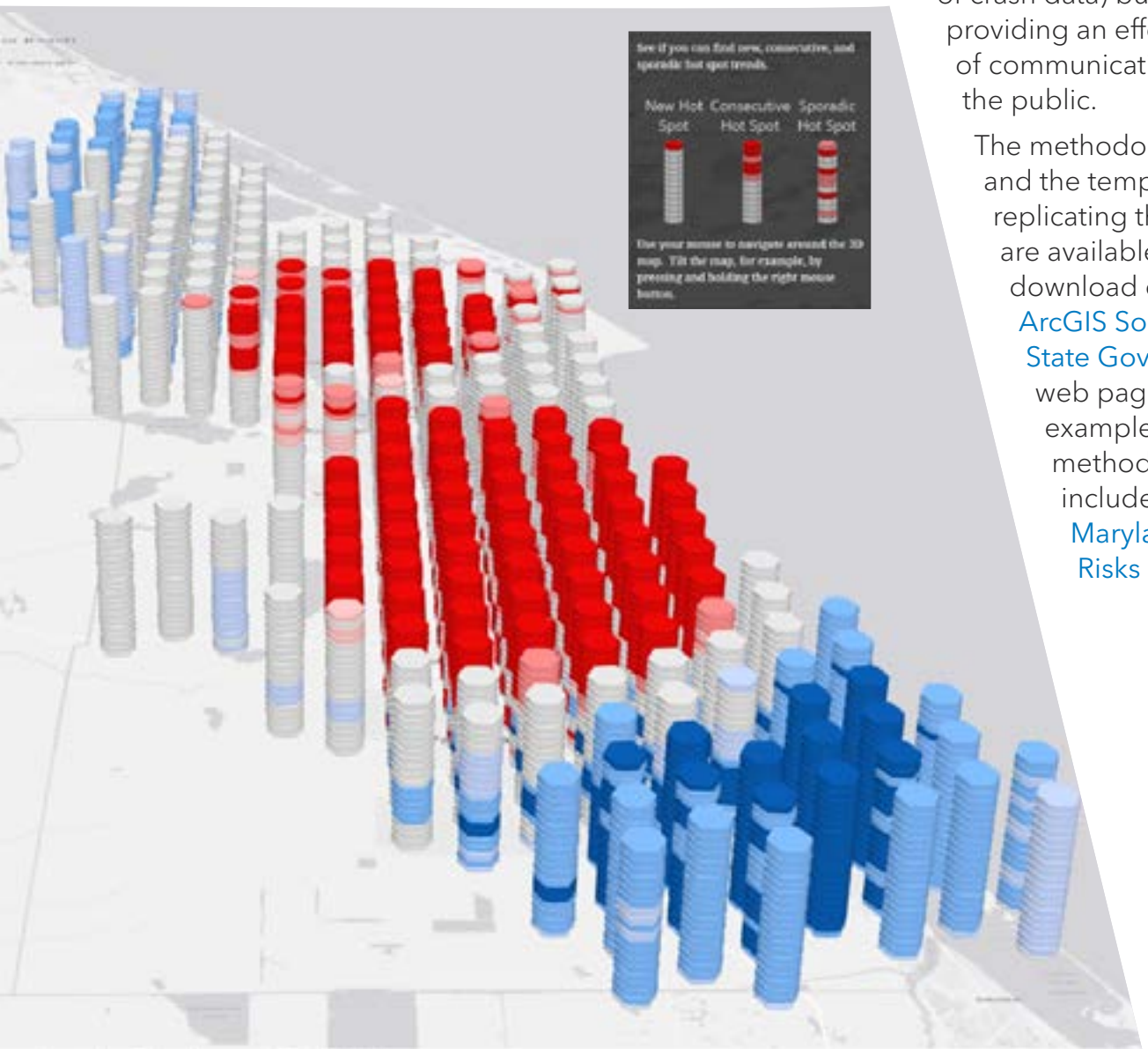
Crash Data Analysis

Safety professionals historically have used GIS to identify hot spots—locations where a large number of crashes occur. Such analyses can be presented in 2D or performed over a number of years in three dimensions to show how crash data stacks up over time.

Increasingly, analysts have been seeking more statistically significant measures for analyzing crash data, including risk calculations and roadway safety infrastructure evaluations. In addition, the use of geospatial statistics, artificial intelligence, and other evolving technologies is being investigated as providing ways to better understand the locations and causes of serious and fatal crashes.

The Utah Department of Transportation (UDOT), working with the United States Road Assessment Program (usRAP), developed a methodology for calculating the risk of serious-injury or fatal crashes for each highway segment. By aggregating crash data by highway segment and comparing highway segments that are similar to each other, UDOT produced a set of risk maps that include the potential savings associated with making a high-risk segment safer.

The resultant analyses and maps were useful not only in helping the safety professionals at UDOT understand the location of current high-risk highway segments (based on five years of crash data) but also in providing an effective way of communicating risk to the public.



The methodology and the templates for replicating this work are available for download on Esri's ArcGIS Solutions for State Government web page. Another example of the methodology includes Maryland's Crash Risks Briefing.

Real-time awareness dashboard shows crash count and crash severity.

While these examples relied on using crash data to derive their insights, another approach focuses on roadway infrastructure instead, shifting the emphasis to building more forgiving roads. The International Road Assessment Programme (iRAP) provides a good example of such an approach. Based on more than 40 different roadway design and traffic control variables, iRAP assigns a star rating for every highway segment and then identifies roadway deficiencies against best practices and suggests a series of countermeasures.

Abley, a safety consulting firm in New Zealand, has developed a similar approach with GIS at the center of the analyses. These GIS-based tools are deployed at a network level and are tailored to address key road safety issues and themes such as rural roads, urban intersections, and vulnerable road users.

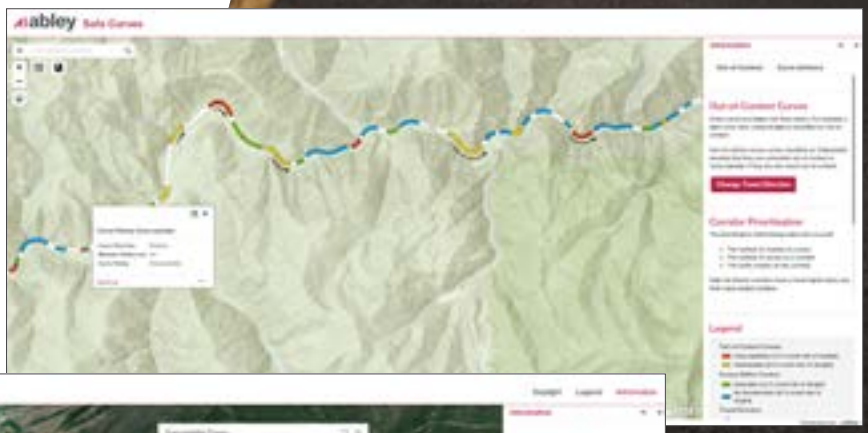
One such tool examines high-risk roadway curves, as more than half of rural crashes involve a driver losing control on a curve. Using GIS, posted speed limits, and elevation models, Abley can identify "out-of-context" curves, where a driver would be more likely to lose control of the vehicle.

Another GIS-based tool that is focused on rural roads is Infrastructure Risk Rating (IRR), which examines eight roadway characteristics that can be captured from readily available, high-quality street centerline files. "Risk can be predicted based on infrastructure, operational, and environmental factors," says Paul Durdin, director of Abley's transportation group. "This is very important on lower-volume roads, where crash history may not be a reliable indicator of underlying risk."

Employing five years' worth of crash data from UDOT, Abley mirrored the usRAP results, using only 8 variables as opposed to the 44 variables required under the usRAP protocols. Abley has applied IRR analysis in New Zealand and a number of Australian states and has made it the centerpiece of safety and enforcement efforts in those areas.

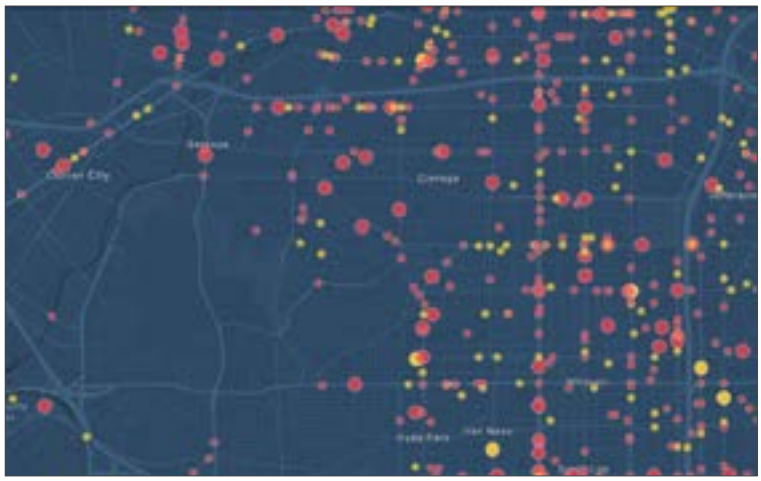
A growing number of safety analysts have begun to apply advanced geospatial statistical procedures and to investigate using artificial intelligence and machine learning techniques in safety analysis. Esri has developed several demos of these techniques, Artificial Intelligence and Machine Learning with ArcGIS and GeoAI: Machine Learning Meets ArcGIS. The use of these statistical techniques holds great promise for safety analysts.

In addition, Esri has teamed with Mobileye to use its machine vision technology to identify pedestrian safety risk areas, based on near collisions captured on video by dash-mounted cameras in city fleet vehicles and taxis. As more and more vehicles become equipped with dash-mounted cameras and vehicle-to-infrastructure (V2I) technology, this methodology holds great promise as a way to reduce pedestrian-involved crashes.



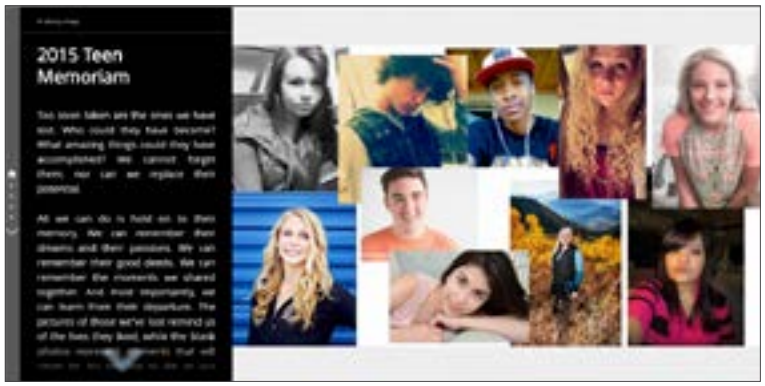
Community Engagement and Effective Communication

For Vision Zero and other safety management programs to be effective, they must be well understood and effectively communicated to the public. A key strength of GIS is its ability to distill complex data and present it in a way that is easily understandable. Esri has worked alongside many cities on Vision Zero templates that effectively present traffic safety data to the public.



The City of **Los Angeles** created a series of maps, delivered via LA GeoHub, that provide a good example of GIS-based presentations that increase public awareness and involvement. Similarly, New York City's Vision Zero View communicates map-based study results, allowing the public to see data for the city's combined boroughs.

New York City's results have been impressive: from 2013 through 2017, fatalities have dropped 28 percent, with pedestrian fatalities decreasing by 45 percent. These mark the lowest levels since record keeping began, in 1910. These results highlight the impact of sustained policies to address traffic safety through better design and a data-driven approach to traffic safety.



UDOT has created a number of effective maps to better communicate the safety risk of various state highway segments. UDOT also provides an Esri Story Maps app to personalize the tragedy of teen fatalities.

A Platform Approach to Traffic Safety

At Esri, we think there is much more that we collectively need to do to address the issue of traffic safety. In 2016, the US Department of Transportation launched the Road to Zero campaign, which adopts the Vision Zero concepts for the United States. We can only hope that these focused efforts will yield results that are similar to those of our European counterparts.

If your safety management program has yet to fully embrace GIS, it's time to arrange a preliminary assessment to see how ArcGIS can help your organization achieve your safety goals. Esri will connect you with our GIS and safety experts, who will show you how GIS can help you more effectively collect, manage, and analyze your crash data, leading to more effective countermeasures and comprehensive safety improvement plans.

To maximize your road safety capabilities, contact Esri Transportation:

go.esri.com/RoadSafety

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