Global Road Safety Week, June 2026

# TOLLING ON THE FRONT LINES OF SAFETY

## A Holistic Blueprint For Combating Distracted Driving

SIX CASE STUDIES


19:55
57
MEDIA
NAV
TRAFFIC
CLIMATE
CAR
SETUP
AUTO
OFF
REST
PASSENGER AIR BAG

FOREWARD

# A HOLISTIC BLUEPRINT FOR **COMBATING DISTRACTED DRIVING**

**In Support of IBTTA Global Road Safety Week | June 2026**

## THE OPERATIONAL IMPERATIVE

Distracted driving is no longer an isolated behavioral anomaly; it is a systemic crisis degrading the global roadway ecosystem. In the U.S. alone, it claims over 3,300 lives annually and generates a $123.9 billion economic toll, while international data attributes 30% of all collisions to driver inattention. Crucially, this epidemic threatens our frontline workforce. It drives up to 17% of all work zone crashes and doubles the risk to emergency responders. With motorists now cognitively diverted for nearly 45% of their total driving time, the scale of this threat demands an immediate, operational response.

When a driver's eyes leave the road for an average of 4.6 seconds at highway speeds, the equivalent of driving a football field blind, traditional analog countermeasures become functionally invisible. Solving this technology-induced challenge requires a multi-disciplinary defense. Infrastructure operators must transition from reactive postures to an integrated strategy fusing predictive technology, forgiving infrastructure, and behaviorally informed policies.

### The Spectrum of Intervention: From Research to Response

Securing the modern roadway requires a layered defense rooted in the globally recognized Safe System Approach. The foundational premise is that human error is inevitable, but should not result in fatalities. Because distracted driving represents a profound behavioral vulnerability, the burden of safety cannot rest solely on the driver. It must be shared across the entire ecosystem through overlapping layers of protection.

This playbook was developed in support of Global Road Safety Week and reflects the collective expertise of transportation operators, safety professionals, and industry partners committed to reducing distracted driving and saving lives.

The six case studies contained in this playbook demonstrate that distracted driving cannot be addressed through any single solution. Success requires a coordinated strategy that combines behavioral science, roadway design, technology, enforcement, data analytics, and rapid incident response. Together, these approaches form a comprehensive framework for reducing distraction-related crashes and improving roadway safety.

By synthesizing proven infrastructure deployments and behavioral data from across North America, Europe, Australia, and Asia, the Best Practices Track worked diligently to consolidate the data into six distinct categories of distraction mitigation:

**1. The Digital Offensive: Leveraging Technology and AI to Combat Distracted Driving** (Led by Samrat Valani, Transurban; page 5) provides an executive blueprint for deploying tech-enabled solutions, shifting agencies from reactive to predictive safety postures to match the digital threat, drawing on data from Transurban operated Express Lanes in Virginia and Australian state networks.

**2. The Physical Defense: Infrastructure and Engineering Solutions to Mitigate Distracted Driving Risks** (Led by Kartheek Shanmukhappa, TEXPRESS; page 11) demonstrates how strategic geometric design, high-contrast delineation, and tactile sensory interruption act as a subconscious failsafe to recapture a distracted driver's attention, based on interventions along high-volume managed lanes in Texas.

**3. Human-Centered Work Zone Design: Addressing Distracted Driving In Dynamic Work Zones** (Led by Smita Sharma, Lindsay; page 15) details how positive protection and automated lane management physically eliminate the consequences of driver error in highly volatile work zones, leveraging insights from infrastructure mega-projects across Australia, Italy, and Japan.

**4. Data-Driven Governance: Safe Roads Through Smarter Data** (Led by John M. Keller, Deloitte; page 19) outlines how pairing automated speed safety enforcement with advanced tolling analytics forces behavioral compliance and drastically reduces crashes, utilizing data from high-speed toll networks and active work zones in Pennsylvania.

**5. The Psychological Baseline: Applying Behavioral Science To Understand and Combat Distracted Driving** (Led by Erika Spissu, Transurban; page 25) explores the psychological drivers of in-cabin distraction, proving we must rearchitect the social context to make safe choices the intuitive default, evaluating peer-to-peer behavioral campaigns deployed across North America and Australia.

**6. The Operational Failsafe: Rapid Incident Response And Secondary Crash Reduction** (Led by Diane Shields, Elizabeth River Crossings; page 29) highlights how disciplined, coordinated clearance strategies immediately halt queue propagation and limit responder exposure, acting as our final defense, modeled on operations within constrained tunnel and bridge geometries in Virginia.

## A CALL FOR CONTINUOUS COLLABORATION

We extend our deepest gratitude to the authors who dedicated their time to compiling these foundational strategies.

The threat of distraction is constantly evolving, and so must our response. We view this playbook as a living document. We invite all IBTTA members and industry partners to share the specific tactics, technologies, and policies that have succeeded or failed on your networks. Your ongoing contributions will be critical as we prepare to publish the next iteration of this playbook in the second half of the year.

We request every agency executive, policymaker, and traffic engineer to treat this as an operational mandate. By weaving these practices together, we possess the tools to secure our networks, optimize mobility, and ultimately, save lives.

Sincerely,

**Samrat Valani**
IBTTA Roadway Safety Steering Committee

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## CASE STUDY 1: THE DIGITAL OFFENSIVE

# LEVERAGING TECHNOLOGY AND AI TO COMBAT DISTRACTED DRIVING

### EXECUTIVE SUMMARY

With motorists distracted for nearly 45% of their total time behind the wheel, distracted driving has evolved from a behavioral safety hazard into a systemic risk impacting the entire roadway ecosystem, from high-speed corridors to urban arterials, school zones, and neighborhood streets. While technology alone is not a silver bullet, representing just one critical tool in a holistic safety toolbox, it is the only countermeasure dynamic enough to combat in-cabin digital distraction. Synthesizing proven best practices from North America, Europe, Australia, and Asia, this playbook introduces the “Distraction Mitigation Maturity Model,” a strategic framework empowering infrastructure operators to transition from reactive safety postures to predictive, algorithmic interventions. **By integrating a portfolio of four technological pillars: AI powered camera networks, Smartphone Telematics, V2X Digital Alerting, and In-Cabin Monitoring, agencies can optimize network throughput and community safety.** The strategic imperative is clear. To mitigate risk and protect the motoring public, pedestrians, and frontline workers, executives must reclassify these technologies from discretionary IT expenses to core capital infrastructure investments.

THOUGHT LEADER

**Samrat Valani**
Vice President Operations, Transurban

Samrat leads growth initiatives, asset management, and customer operations for Transurban across North America. He brings extensive international leadership experience in public-private partnerships (P3s), business transformation, P&L management, and customer-focused operations. During his 19-year tenure with the company, he has held leadership roles across both Australian and North American markets.

**FIGURE 1.** High-definition infrared camera systems can be mounted on an existing gantry to establish network-wide behavioral baselines.

## THE OPERATIONAL CHALLENGE: A TECHNOLOGY-INDUCED SHIFT

With motorists diverted for nearly 45% of their driving time, traditional countermeasures yield diminishing returns. When a driver's eyes leave the road for 4.6 seconds at highway speeds, even high-contrast Variable Message Signs (VMS) become functionally invisible.

This cognitive blindness degrades the entire roadway ecosystem. On General Purpose lanes and urban arterials, it drives a constant baseline of rear-end collisions, erratic braking, and delayed reaction times. However, this operational friction is acutely magnified on high-speed, dynamically managed networks like Express Lanes, where distraction attacks specific design profiles:

**High-Speed Access and Egress:** On non-reversible managed lanes, a distracted driver easily misses critical advance signage. This cognitive delay forces abrupt, late merging at access points, destroying the reliability of the free-flowing lane and triggering high-speed rear-end collisions.

**Active Infrastructure:** On reversible corridors, cognitive overload drives severe physical infrastructure damage, most notably access-gate strikes. Because distraction is a constant behavior, these strikes occur persistently throughout the day, not just during directional transitions, as drivers blindly breach active control measures.

The true scale of this network-wide friction remains underreported. A recent North American pilot program by Transurban and local partners utilized AI roadside cameras to observe driver behavior. The results revealed a staggering distracted driving rate of nearly 13%, dwarfing previous national estimates of 3.0%.

Because modern distraction is exclusively digital, our countermeasures must match the threat across all roadway geometries. By looking to proven global deployments, operators can begin operationalizing Artificial Intelligence (AI) and connected technologies to close the safety gap.

## THE PREDICTIVE PLAYBOOK: FOUR STRATEGIC PILLARS

To evaluate an agency's technological evolution, we establish the Distraction Mitigation Maturity Model. This tracks progress from **Level 1** (Reactive: analog reliance on post-incident remediation), to **Level 2** (Active: manual reliance on police patrols), and ultimately to **Level 3** (Predictive: algorithmic and connected). Achieving Level 3 maturity requires deploying a balanced portfolio across four core pillars:

**Pillar A: Roadside AI (Maximizing Existing Asset Yield):** Utilizing multi-angle, infrared cameras, these systems capture high-definition images through windshields at highway speeds. Edge-based AI instantaneously analyzes these images to detect illegal phone use, immediately deleting compliant images to protect privacy.

> *The Operator Imperative:* Agencies already own the necessary real estate. By retrofitting existing overhead gantries, or by deploying mobile trailers, operators can establish a network-wide behavioral baseline today, arming state legislators with the empirical data required to champion new automated enforcement laws. (FIGURE 1)
>
> **To successfully navigate public concerns over surveillance, these deployments must be explicitly paired with transparent data governance policies and proactive community education.**

**Pillar B: Smartphone Telematics (Crowdsourced Diagnostics):** The most scalable sensor network on the road is the smartphone itself. Telematics providers utilize AI to analyze raw sensor data, accurately detecting when a driver is handling a phone.

> *The Operator Imperative:* Rather than relying on lagging indicators like crash reports, operators can geofence specific corridors and ingest anonymized telematics data. This acts as a real-time diagnostic tool to measure actual cognitive load and validate the ROI of physical safety interventions. (FIGURE 2)

**Pillar C: V2X Digital Alerting (Penetrating the Dashboard):** If inattentive drivers miss physical signs, infrastructure must communicate directly to the vehicle. Vehicle-to-Everything (V2X) technology pushes real-time alerts directly into consumer navigation apps (e.g., Waze) and native infotainment screens.

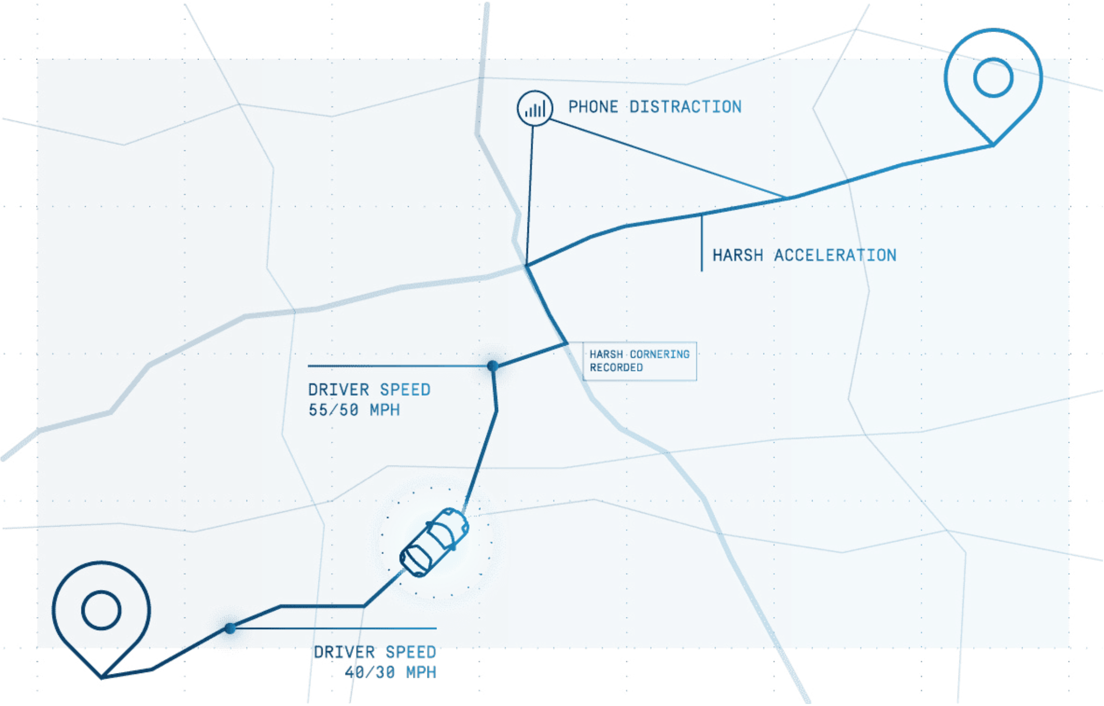


**FIGURE 2.** Telematics data sourced from smartphones can be analyzed by AI to provide a real-time diagnostic tool.

*The Operator Imperative:* Operators do not need to wait for universal automaker adoption. By outfitting their own incident response units and maintenance trucks with cloud-based V2X transponders, agencies instantly make their fleets "digitally visible" to approaching drivers. (FIGURE 3)

**Pillar D: Advanced DMS (In-Cabin Intervention):** Advanced Driver Monitoring Systems (DMS) utilize in-vehicle cameras and AI to track eye movement, triggering immediate seat vibrations or auditory alarms when focus leaves the road, actively snapping attention back to the driving task.

*The Operator Imperative:* While operators cannot force immediate turnover of consumer vehicles, they control their own assets. Mandating advanced DMS within agency and contractor procurement standards immediately protects frontline employees and establishes a vanguard safety standard.


**FIGURE 3.** Vehicle-to-Everything (V2X) technology pushes real-time alerts directly into consumer navigation apps and native infotainment screens.

## THE IMPACT: INTEGRATED OPERATIONS AND EMPIRICAL ROI

These four pillars unlock exponential value when integrated. An agency cannot deploy AI enforcement cameras on every mile of road. However, by aggregating the phone-use heat maps generated by Smartphone Telematics (Pillar B), operations teams can precisely allocate mobile AI powered enforcement trailers (Pillar A) to high-risk corridors. Simultaneously, those identical hot zones can be prioritized for heavy V2X digital alerting (Pillar C), maximizing proactive driver awareness and optimizing resource deployment.

The empirical data across these pillars demonstrates profound safety and operational ROI:

**Roadside AI (Automated Deterrence):** Certainty of detection fundamentally disrupts the habit of distraction. In New South Wales, automated enforcement **dropped illegal phone use by over 80%.** Locally, a pilot deployment on a congested North American East Coast commuter corridor captured over 590,000 vehicle images, confirming nearly **77,000 mobile device offenses** in a short window, proving the immediate need for algorithmic intervention.

**Smartphone Telematics (Behavioral Validation):** The Ohio DOT partnered with Cambridge Mobile Telematics to analyze network-wide data, confirming an **8.6% sustained decrease** in driver phone usage one year post-implementation. This verifiable behavioral shift prevented an estimated 3,600 crashes, avoided over 1,600 injuries, and **saved the state approximately $144 million** in economic impact.

**V2X Digital Alerting (Kinetic Mitigation):** A joint study by Purdue University and the Indiana DOT evaluated queue-warning trucks equipped with cloud-based digital alerts. The study found that when digital alerts were transmitted directly to approaching drivers' dashboards, **hard-braking events decreased by approximately 80%,** drastically reducing the risk of secondary rear-end collisions.

**In-Cabin DMS (Fleet Protection)**: When Toll Group, a major international logistics operator, deployed advanced Driver Monitoring Systems across its heavy-vehicle fleet, the organization achieved a **90% reduction in fatigue and distraction-related driving events,** setting a new standard for operational safety.

## THE EXECUTIVE IMPERATIVE: THE IMPLEMENTATION BLUEPRINT

To operationalize a Level 3 Predictive safety model, agencies should adopt a phased integration blueprint:

**Phase 1 (Short-Term):** Fleet Digitization & Procurement: Operators can immediately protect frontline workers by outfitting maintenance and incident response vehicles with cloud-based V2X transponders (e.g., HAAS Alert). Simultaneously, agencies should update procurement standards to mandate advanced In-Cabin DMS (e.g., Seeing Machines, Smart Eye) for all newly acquired agency and contractor fleets.

**Phase 2 (Medium-Term):** Telematics Baselining: Partner with telematics data providers (e.g., Cambridge Mobile Telematics, Arity, Compass IoT) to establish a network-wide safety baseline. Utilize this data to identify behavioral hotspots before they manifest as crash statistics.

**Phase 3 (Long-Term):** Automated AI Enforcement: Maximize existing infrastructure by retrofitting overhead gantries with AI powered enforcement cameras (e.g., Acusensus), transforming passive assets into active safety enforcement mechanisms.

## STRATEGIC CAPITAL ALLOCATION

A primary hurdle for infrastructure agencies is legacy procurement models. To overcome this, executives must reclassify AI enforcement and connected V2X technologies by shifting them from discretionary IT operating expenses (OPEX) to core safety capital investments (CAPEX). **Because these solutions align directly with the Safe System approach, agencies should aggressively leverage federal safety grants (e.g., USDOT's Safe Streets and Roads for All) to accelerate this funding transition.**

The ultimate return on investment (ROI) for these deployments is measured first in human lives. Beyond this, secondary ROI is realized rapidly by avoiding catastrophic secondary collisions and preventing costly physical infrastructure damage across the network. Distracted driving is fundamentally a technology-induced challenge. To secure the modern roadway ecosystem, infrastructure operators must deploy technology-enabled solutions.

**Supporting Evidence and References**


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CASE STUDY 2: THE PHYSICAL DEFENSE

# **INFRASTRUCTURE AND ENGINEERING SOLUTIONS** TO MITIGATE DISTRACTED DRIVING RISKS

## EXECUTIVE SUMMARY

While technological and behavioral interventions are critical components of a modern safety strategy, physical roadway geometry remains the foundational failsafe against driver error. This case study explores how strategic geometric design, combined with advanced roadside hardware and safety devices, can naturally recapture the attention of distracted motorists. By analyzing interventions on the North Tarrant Express (NTE) managed lanes in Texas, this paper demonstrates how the deliberate use of alignment, high-contrast delineation, and multi-sensory feedback creates subconscious alerts that increase driver awareness. The results prove that an integrated infrastructure approach, marrying passive pavement markings with active digital signage, can yield an **87% reduction** in infrastructure collisions, effectively mitigating the risks of late-exit attenuator strikes and wrong-way incursions.

THOUGHT LEADER

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Chief Operations Officer,
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Kartheek is Chief Operations Officer at LBJ Infrastructure Group, responsible for operational strategy and performance across major DFW tollway concessions. He leads multi-disciplinary teams in roadway maintenance, traffic management, and field systems, driving safety, compliance, and reliability at scale. With over a decade of experience, he focuses on operational excellence, risk management, and innovation to enhance asset performance and customer experience.

## THE CHALLENGE: GORE AREAS AND COGNITIVE OVERLOAD

The North Tarrant Express (NTE) operates along a high-volume urban freeway corridor in the Dallas–Fort Worth Metroplex. The concessionaire, North Tarrant Express Mobility Partners (NTEMP), identified a persistent operational vulnerability. The numerous ramp gore areas where entrance and exit ramps diverge from the mainlanes posed a major challenge.

Gore areas represent critical points of driver decision-making. High traffic volumes, complex interchanges, and driver unfamiliarity with managed-lane access points create **a highly demanding driving environment. When a driver enters this environment already distracted by a digital device, their margin for error is entirely eliminated.** For a distracted or fatigued driver, this cognitive overload frequently results in a failure to perceive the diverging geometry in time, leading to late, erratic lane changes and high-speed attenuator strikes at gore noses.

NTEMP continuously tracks incidents and infrastructure repairs through its asset management system. Analysis of historical crash and maintenance data revealed a persistent pattern. Crash attenuators at ramp gore locations were being struck at disproportionately high rates. Eleven high-risk gore locations were identified based on incident frequency. Prior to intervention, these 11 locations collectively recorded 186 attenuator hits over the study period (2017 to 2022), representing substantial risk to both driver safety and infrastructure integrity. The two highest-risk sites alone accounted for 89 incidents:

- EBFR Haltom Bypass: 50 attenuator hits (pre-improvement)
- EBGP Exit to SH 121: 39 attenuator hits (pre-improvement)

Root-cause analysis by the operations and maintenance engineering team identified several infrastructure vulnerabilities **exacerbating this behavioral risk:**

- Inadequate delineation contrast at gore noses, especially at night and in wet conditions.
- Insufficient visual cues to communicate divergence geometry to approaching drivers.
- **Lack of sufficient pavement marking width and retroreflectivity** necessary to capture the attention of distracted or fatigued drivers.
- An absence of active or LED warning devices at the highest-risk locations.

These incidents posed serious safety risks to motorists and maintenance personnel, caused repeated damage to crash attenuation devices, and generated significant operational costs for repair and replacement.

## THE ENGINEERING PLAYBOOK: A PHASED INFRASTRUCTURE APPROACH

To recapture the attention of distracted drivers before impact, NTEMP developed and implemented a two-phased, integrated safety program. **This approach combined** enhanced pavement markings, upgraded raised pavement markers (RPMs), and active signage devices at the 11 identified gore locations:

**Pillar A: High-Contrast Visual Delineation:** Upgraded pavement markings were installed to drastically increase visual prominence. Conventional striping was replaced with TxDOT-approved 12-inch solid white lines (using 3M Stamark High Performance Tape Series 380I ES), giving drivers earlier recognition of the gore geometry. Furthermore, 24-inch-wide chevron pavement markings were installed within the gore area, creating a highly retroreflective pattern that visually reinforces the no-travel zone and directs driver attention.

**Pillar B: Tactile and Auditory Interruption:** To combat visual distraction (e.g., looking at a smartphone), physical infrastructure must engage other senses. NTEMP installed Diamond Grade Raised Pavement Markers (3M RPM Series 290). Featuring Diamond Grade microprismatic optics, these markers provide up to 4.5 times the initial retroreflected luminance required by ASTM standards. Crucially, they generate an immediate, highly noticeable auditory and tactile rumble alert when contacted by drifting tires, physically snapping a distracted driver's attention back to the driving task.

**Pillar C: Active, Dynamic Signage:** At the two locations with the highest historical incident rates, NTEMP augmented the passive striping with active warning devices in coordination with engineering partners. High-visibility object markers were installed at the gore noses to provide active, dynamic warnings under all light and weather conditions, directly addressing nighttime and adverse weather incident patterns. Overhead chevron warning signs were added to reinforce roadway geometry and guide drivers safely through the transition zone.


**FIGURE 4.** Reflective chevron sign improves Exit signage visibility, especially at night.

## THE IMPACT: DRAMATIC SAFETY GAINS

The results of this integrated engineering approach were immediate and measurable. By addressing distracted driving through multiple simultaneous channels (visual contrast, retroreflectivity, and tactile rumble), the probability of alerting an inattentive driver increased exponentially.

The post-implementation data, tracked via the Vueworks asset management system, revealed profound operational improvements across the 11 sites:

- **System-Wide Success:** An **87% overall reduction** in attenuator hits across all 11 sites combined (dropping from 186 pre-improvement hits to just 24 total hits after improvements).
- **High-Risk Site Mitigation (Haltom Bypass):** Incidents fell from 50 pre-improvement hits to just 1 after full Phase 1 and Phase 2 implementation, marking a **98% reduction.**
- **Total Elimination (SH 121 Exit):** Incidents were reduced from 39 pre-improvement hits to 0 after full implementation, achieving a **100% reduction** in attenuator strikes.

**FIGURE 5.**
On-road engineering improvements, clockwise from top: 24" chevron pavement markings installed at gore nose with chevron sign; Widened gore striping with 3M Stamark tape and additional RPMs; LED object marker and chevron sign.

- **Passive Effectiveness:** Sites that received only the passive striping and RPM upgrades (Pillars A and B) also demonstrated meaningful, sustained reductions, confirming the efficacy of pavement marking and RPM upgrades as a standalone, **high-ROI, low-cost intervention.**
- **Resource Allocation Efficiency:** Average annual combined attenuator hits across the two highest-risk sites fell from approximately 29 per year to 14 per year following Phase 1 alone, and dropped to near zero after Phase 2 signage enhancements were added.

## THE EXECUTIVE IMPERATIVE: EVOLVING THE INFRASTRUCTURE

The NTE case study offers vital lessons for infrastructure operators. Safety performance improves dramatically when data-driven site selection is paired with multi-sensory engineering. By using asset management tool incident data to identify high-risk locations, agencies can deploy relatively low-cost pavement markings and RPM upgrades to produce substantial reductions before incurring the heavier capital cost of active warning devices.

However, the ultimate goal of gore-area design is to prevent the most catastrophic failure of driver attention, which is wrong-way driving incursions.
The infrastructure enhancements deployed on the NTE represent the foundational layer of safety. The logical next step for infrastructure operators is to integrate these physical safeguards with advanced technologies, moving from passive delineation to a fully integrated, real-time safety ecosystem:

- **AI Enabled Wrong-Way Detection:** Strategically deployed AI camera systems at gore locations can identify wrong-way vehicle movements in real-time, distinguishing wrong-way vehicles from normal traffic within seconds of the incursion beginning.
- **Automated Dispatch Integration:** Detections can be immediately routed to the Traffic Management Center (TMC). Operators can verify the event on live camera feeds and instantly dispatch Customer Assistance Vehicles (CAVs) or emergency responders to intercept the wrong-way vehicle.
- **Dynamic Message Sign (DMS) Alerting:** Detections can trigger automated, real-time alerts on upstream DMS boards (e.g., “WRONG WAY DETECTED AHEAD”), creating a critical window of protection for oncoming, compliant motorists in the affected corridor.

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CASE STUDY 3: HUMAN-CENTERED WORK ZONE

# ADDRESSING DISTRACTED DRIVING IN **DYNAMIC WORK ZONES**


## EXECUTIVE SUMMARY

Work zones represent the most volatile, complex, and continuously changing environments on the modern roadway network. The introduction of dynamic lane shifts, crossovers, narrow physical lanes, and heavy machinery creates a highly challenging visual landscape. For a distracted driver, navigating this landscape requires sudden, intense bursts of cognitive processing, severely compressing their reaction times. This case study analyzes three of the most complex infrastructure mega-projects globally: the Warringah Freeway Upgrade in Australia, tunnel rehabilitation projects by ASPI in Italy, and expressway renewal projects by NEXCO-East in Japan. By examining the shared operational realities of these massive engineering projects, this paper demonstrates that traditional traffic management using cones and passive delineation is increasingly insufficient. To mitigate the devastating impacts of cognitive overload and protect vulnerable frontline workers, agencies must shift toward human-centered work zone design, utilizing positive physical protection and automated, dynamic lane management.



THOUGHT LEADER

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Smita is a transportation engineer and global leader in Applications Engineering for the Road Zipper moveable barrier system at Lindsay, specializing in roadway and work zone safety, traffic management, and mobility solutions. With expertise in transportation engineering, GIS, and informatics, she applies data-driven, top-down and bottom-up approaches to advance safer, more efficient roadway systems.

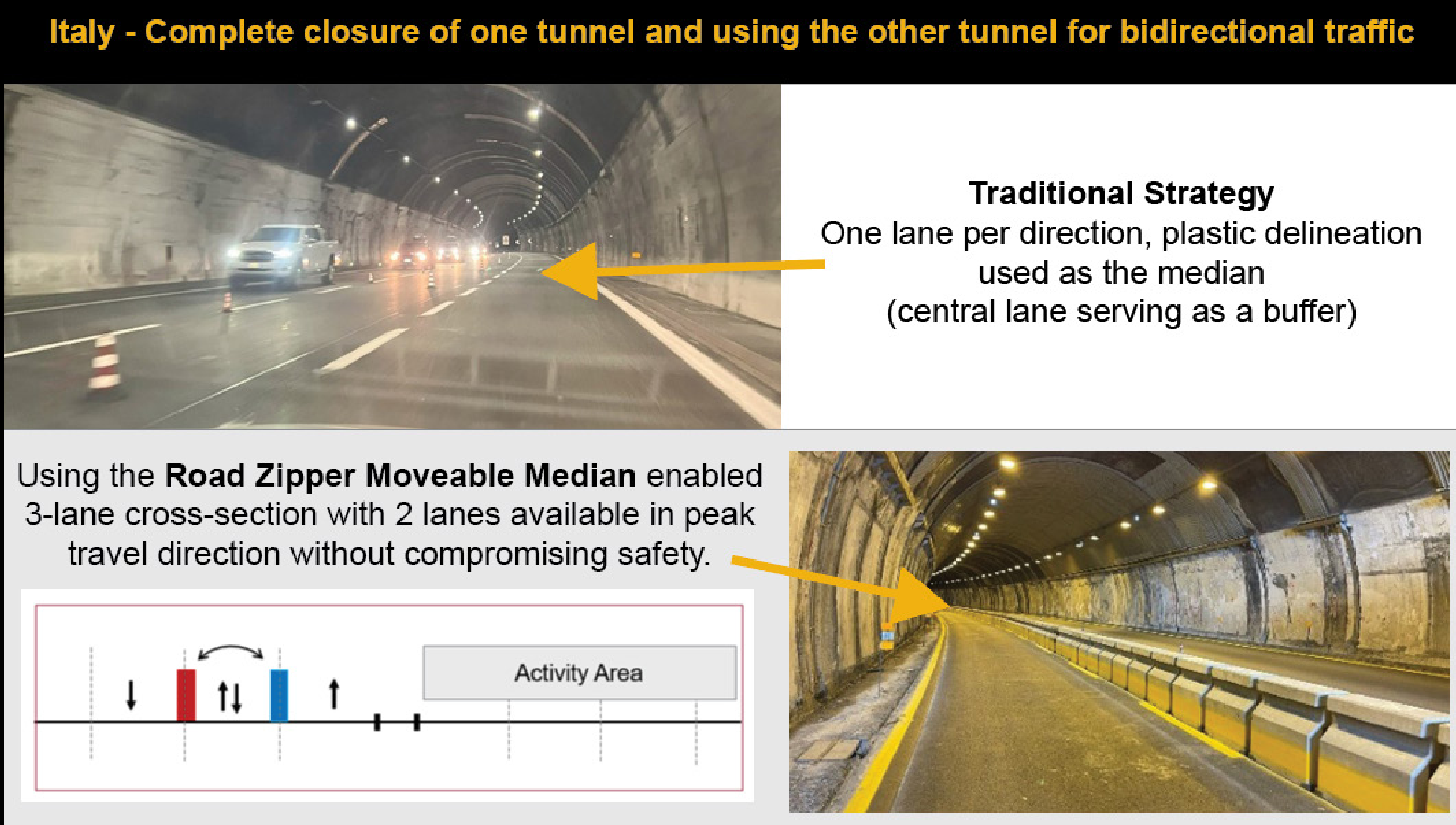
## THE CHALLENGE: COGNITIVE OVERLOAD AND WORKER EXPOSURE

Traditionally, dynamic work zones relied on cones, plastic drums, or temporary striping to visually guide motorists. However, these devices do not provide positive protection. In complex, high-speed work zones, inconsistent or dense delineation can contribute to driver confusion and lane path ambiguity, particularly for distracted or fatigued drivers who are estimated to miss up to 50% of critical roadway information. Furthermore, lane shifts, detours, and crossover configurations introduce non-standard traffic patterns that increase the risk of abrupt braking, erratic merging, and rear-end or head-on collisions.

For contractors and roadside personnel, the risk is exceptionally high. Workers are heavily exposed to live traffic during the manual setup and removal of temporary traffic control devices, and are highly vulnerable to errant vehicle intrusions when no crashworthy physical barriers exist between the work area and live travel lanes. Research indicates that driver distraction contributes to 8% to 17% of all work zone crashes, a figure that is heavily underreported. When crashes occur within these constrained environments, they instantly generate rapid traffic queuing, severely restricting emergency response times and compounding the risk of secondary, high-speed rear-end collisions. To address this gap, work zone design must assume that drivers will be imperfect, shifting the burden of safety away from driver attention alone.


**FIGURE 6.** Moveable barrier systems provide positive physical protection for workers while allowing for dynamic, automated lane management based on real-time traffic volumes.


**FIGURE 7 (Opposite Page).** Dynamic lane management using crash-tested moveable median.




## THE ENGINEERING PLAYBOOK: POSITIVE PROTECTION AND DYNAMIC LANE MANAGEMENT

To protect road users and frontline workers from distracted driving risks, Transport for NSW, ASPI, and NEXCO-East implemented a human-centered work zone strategy focused on positive protection, error tolerance, and adaptable lane management using the Road Zipper System (moveable barrier technology). This approach is built on four core pillars:

**Pillar A: Positive Protection (Physical Separation):** Conventional cones and delineators were replaced with crashworthy, highly visible moveable concrete barriers. **Because a driver looking at a smartphone cannot be stopped by visual warnings alone,** these barriers contain and redirect errant vehicles, eliminating work zone intrusion and median crossover risks, even when drivers drift out of their lane.

**Pillar B: Dynamic Lane Management:** Travel lanes were adjusted in real time based on traffic demand. For example, during off-peak or nighttime hours, travel lanes were rapidly closed to expand the construction footprint, while during peak hours, lanes were maximized to match directional traffic demand, significantly reducing congestion induced driver frustration and risky behavior.

**Pillar C: Automated Barrier Deployment:** Barrier transfer machines eliminated the manual labor and high worker exposure traditionally required to place, adjust, and remove heavy concrete or steel barriers. The moveable barrier system allows lanes to be shifted or closed in roughly one-third of the time required for traditional setups, without requiring additional temporary lane closures or workers exposure to live traffic.

**Pillar D: Simplified, Ambiguity-Free Driving Environments:** Continuous, solid concrete barrier alignments provide a clear, intuitive visual path for motorists. This physical “wrapper” eliminates lane-path ambiguity, reduces sudden merging, and prevents the last-second decision-making that often triggers crashes among distracted or inattentive drivers.

## THE IMPACT: GLOBAL SAFETY, MOBILITY, AND PRODUCTIVITY GAINS

The deployment of moveable barrier technology across these global mega-projects delivered dramatic, quantifiable improvements in safety, construction productivity, and network performance:

**Significant Worker Exposure Reduction:** ASPI's multi-tunnel corridor rehabilitation on Italy's critical A26 freight route reported a **63% reduction in roadside personnel exposure hours** and a **23% reduction in security and access exposure hours.** By using a Road Zipper Moveable Median to safely run bi-directional traffic in a single tunnel tube during complete closures of the adjacent tube, ASPI maintained a safe, high-capacity three-lane cross-section.

**Drastic Crash Risk Mitigation:** To assess the safety benefits of positive protection over conventional rubber cones, NEXCO-East conducted a controlled experiment on Japan's high-speed Joban Expressway. The results showed that the deployment of moveable barriers led to a **15% reduction in vehicles performing evasive maneuvers** during traffic control installation and removal, and a **50% reduction in vehicles applying brakes** in response to lane closures. **This indicates a significantly calmer, more predictable driving environment that accommodates the delayed reaction times typical of distracted motorists.**

**Massive Productivity Increases:** On Australia's highly congested Warringah Freeway Upgrade in Sydney (handling 250,000 daily vehicles), executing 30% of construction overnight using the moveable barrier system provided up to **3 additional safe work hours per night shift.** This translated into a **60% increase in construction productivity,** allowing a traditional 16-week scope of work to be completed in just two weeks during the Christmas holiday period.

**Timeline Reductions:** The operational efficiency and reliable staging enabled by the moveable barrier system contributed to a **1 to 1.5 years reduction in overall construction duration** for the Warringah Freeway Upgrade, significantly mitigating the long-term impact on the local community.

## THE EXECUTIVE IMPERATIVE: DESIGNING FOR THE IMPERFECT DRIVER

The findings from these three global mega-projects establish a new standard for work zone safety. Distracted driving cannot be eliminated through education or enforcement alone, but its risks can be engineered out of the roadway environment. Executives managing capital projects and toll facilities must **treat distracted driving as a core design constraint rather than a behavioral compliance issue.**

Agencies should prioritize physical separation over visual guidance wherever feasible, adopting adaptive, data-driven lane management strategies to minimize congestion-driven risky driver behavior. **Recognizing that positive protection requires capital investment and roadway width, agencies must develop warrant-based policies that mandate physical separation on high-speed, high-volume, or long-duration projects where the risk of cognitive overload is most acute.** By shifting from driver-dependent work zones to forgiving, physically protected, and dynamically managed construction environments, infrastructure operators can ensure that the roadway remains safe even when the driver behind the wheel is imperfect.

**Partner Agencies**

Transport for NSW in Australia, Autostrade per l'Italia (ASPI) in Italy and East Nippon Expressway Company (NEXCO-East) in Japan), in collaboration with key partners including TECNE and Amplia Infrastructure in Italy, CPB Contractors and DT Infrastructure Joint Ventures in Australia, and NEXCO-East Innovations and Communications in Japan.

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Deloitte.

## CASE STUDY 4: DATA-DRIVEN GOVERNANCE

# SAFER ROADS THROUGH **SMARTER DATA**

### How the Pennsylvania Turnpike Commission's Work Zone Speed Safety Camera Program Points to a More Proactive Safety Model


## EXECUTIVE SUMMARY

Distracted driving remains one of the most stubborn roadway safety problems in the United States because it is both behavioral and systemic. It is behavioral because drivers make risky decisions behind the wheel. It is systemic because the institutions best positioned to reduce that risk,  transportation agencies, law enforcement, vehicle manufacturers, toll operators, and policymakers too often work in parallel instead of through a shared operating model. The real challenge is getting all the stakeholders to pull in the same direction.

For the tolling industry, that challenge is especially important. High-speed toll facilities concentrate risk. Drivers are moving quickly, traffic volumes are high, work zones traffic patterns reduce reaction time, and even a brief lapse in attention can have serious consequences for motorists and roadside workers. Improving safety in that environment requires more than isolated interventions. Unsafe outcomes on toll roads rarely stem from a single cause. More often, they reflect the interaction of speed, driver behavior, roadway design, work zone conditions, traffic patterns, enforcement visibility, and the quality of communication with the traveling public. A fragmented response to a multi-factor problem will not be enough.



THOUGHT LEADER

**John M. Keller, P.E., PMP**
Vice President,
Deloitte Consulting LLP


In his role at Deloitte, John helps advance national transportation initiatives and integrate AI and emerging technologies into industry practice. With more than 30 years of experience, he previously served as Executive Director of the New Jersey Turnpike Authority, overseeing major operations and capital programs. An internationally recognized transportation leader, Keller contributes to global asset management initiatives and is an active participant in the International Bridge, Tunnel and Turnpike Association.

## WHY TOLLING AGENCIES ARE POSITIONED TO LEAD

That is why the tolling industry is uniquely well positioned to lead. Tolling agencies are not just operators of infrastructure, they are stewards of a rich and continuous stream of operational data. Toll systems capture traffic flows, travel speeds, lane usage, transaction patterns, corridor congestion, and time-of-day variation at a level of consistency many other transportation entities cannot match. Used effectively, that data can help agencies identify where risk is concentrated, target interventions more precisely, and evaluate whether safety measures are changing behavior. Tolling agencies are uniquely positioned to make data-driven decisions that can drive meaningful and measurable safety advances because they already have abundant operational data at their fingertips.

## MOVING FROM REACTIVE TO PROACTIVE SAFETY MANAGEMENT

**A graduated enforcement model balances deterrence with fairness, signaling that the goal is a change in behavior rather than punishment alone.**

This is where AI and advanced analytics become especially relevant. Their value is not simply in automating reports faster. Their real value is in helping agencies move from reactive safety management to proactive safety management. When analyzed effectively, tolling data can reveal where speeding or erratic behavior is most likely to occur, predict periods of elevated work zone exposure, detect patterns associated with crash risk, and guide intervention where it can have the greatest effect. AI can help surface those patterns faster, improve deployment decisions, and strengthen the feedback loop among enforcement, engineering, incident response, and policy. In that sense, AI is not a substitute for safety strategy. It is a force multiplier for a better one.

## ALIGNMENT ACROSS THE SAFETY ECOSYSTEM

A strong safety strategy also depends on broad stakeholder alignment. Tolling entities, law enforcement, and auto manufacturers are part of the picture, but not the whole picture. Effective safety programs also require legislators, transportation agencies, contractors, engineers, technology providers, and public safety officials. Each one controls a different lever. Legislators establish legal authority and penalty structures. Law enforcement supports legitimacy and coordination. Contractors and work zone managers shape the real-world environment drivers experience. Toll operators manage the data, the systems, and the operational response. Safety outcomes improve when these groups align around common goals, common measures, and coordinated action. They weaken when each group acts alone.

## THE PENNSYLVANIA TURNPIKE: A PRACTICAL MODEL FOR WORK ZONE SAFETY

The Pennsylvania Turnpike Commission's (PTC) Work Zone Speed Safety Camera Program provides a strong example of what this more integrated approach looks like in practice. The program emerged in a high-speed toll road environment where speeding and distracted driving created real risks for both workers and motorists. Rather than relying solely on education campaigns or intermittent trooper presence, PTC implemented a structured intervention that combined automated speed enforcement with analysis of toll road data to better understand behavior in and around active work zones. That distinction matters. It moved safety from broad messaging to measurable intervention.

PTC's approach is especially notable because it did not treat enforcement as a stand-alone tactic. It connected policy, operations, enforcement, and analytics. Under the program, first speeding violations generate Warning Notices, while second and subsequent violations generate fines. That graduated model matters. It balances deterrence with fairness, signals that the goal is behavior change rather than punishment alone and offers a more practical path to public acceptance than a purely punitive system introduced without warning. In policy terms, it is disciplined, scalable, and operationally sustainable.

The program also shows how advanced analytics can extend the value of an already effective safety model. PTC paired enforcement with tolling data to understand traffic patterns, speed behavior, and potential risk points before, during, and after work zone activity. That creates a foundation for even more proactive safety management. A next generation model could use predictive algorithms to identify which work zones are most likely to experience dangerous speed variance, which hours create the highest exposure, and which traffic conditions correlate most strongly with excessive speeding. Computer vision, anomaly detection, and predictive risk scoring could help agencies prioritize deployment schedules, refine message timing, improve temporary traffic control plans, and alert operations teams when


**FIGURE 8.** Automated Work Zone Speed Safety Cameras utilize graduated deterrence, issuing warnings before escalating to financial penalties.

Photo Credit: https://workzonecameras.penndot.gov conditions begin to deteriorate. The implication is straightforward: tolling data can become more than a historical record. It can become a practical decision-support asset for preventing harm before it occurs.

The safety outcomes reported by PTC suggest that this integrated model can produce tangible results. According to information shared by PTC Director of Traffic Engineering & Operations Tom Macchione, work zone crashes across the Commonwealth were "consistent, approximately 1,800 annually" in the three years before Work Zone Speed Safety Camera enforcement began, from 2017 through 2019. In 2020, the first year of operation, work zone crashes declined to just over 1,400, although PTC noted that pandemic conditions likely affected traffic volumes. However, as traffic and construction activity returned closer to normal, work zone crashes in 2022 through the present have remained around 1,250, an approximate **30% reduction in accidents** as compared to pre-program levels. Macchione captured the significance of that trend directly "The trends seen since the start of the program run counter to the trends of increasing work zone crashes nationwide."

**For agencies trying to influence behavior at scale, that is the key distinction: messaging can raise awareness, but data-informed enforcement is more likely to change conduct.**

Speed data points in the same direction. During the primary 2025 construction months, Macchione reported that "speeding in WZSSC enforced work zones has been reduced to 15.8 percent of all traffic, and excessive speeding (11+ MPH over the posted speed limit) has been reduced to 2.0 percent of all traffic." Those numbers matter because they show movement in the exact behavior the program was designed to change. This is not anecdotal evidence or a general awareness claim. It is measurable behavioral improvement in active work zones, where risk is concentrated and consequences can be severe. The scale of the program reinforces that point. From March 2020 through the end of 2025, it completed 17,667 deployments and issued more than 2 million notices of violation. This was not a small pilot. It was a sustained, operational enforcement strategy.

## LESSONS FOR THE TOLLING INDUSTRY

For the tolling industry, one of the clearest lessons from the PTC case is that safety performance improves when enforcement is paired with analytics. The materials explicitly identify "the value of pairing enforcement with data analytics" as a key takeaway. That principle has immediate operational value. Agencies can use tolling and traffic data to deploy cameras or patrols where risk is most concentrated instead of spreading resources evenly. They can adjust work zone timing based on travel patterns. They can use AI-supported forecasting to distinguish between locations that are merely busy and locations that display the behavioral markers associated with elevated crash risk. They can also measure effectiveness more rigorously by tracking crash frequency, speed distribution, excessive-speed rates, repeat violations, and exposure by work zone type. That shifts safety from a compliance exercise to a performance discipline.

The case also offers a broader behavioral lesson. Work zone safety depends heavily on whether drivers believe conditions demand greater attention and lower speeds. Signs and public-awareness campaigns still matter, but their impact is often limited, especially when drivers become accustomed to standard messaging. Enforcement changes that equation because it creates visible and repeatable consequences. Drivers may ignore signs. They are less likely to ignore a system that consistently detects violations, issues warnings, escalates penalties, and is targeted using facility-specific operational data. For agencies trying to influence behavior at scale, that is the key distinction: messaging can raise awareness, but data-informed enforcement is more likely to change conduct.

There are also important governance implications. Programs like PTC's do not succeed on technology alone. They require legislative authorization, operational rules that can withstand scrutiny, coordination with law enforcement, and strong partnership with the contracting community managing work zone conditions in the field. Each stakeholder controls a different part of the safety system. Legislators define the legal framework. Law enforcement supports oversight and legitimacy. Contractors influence work zone setup, scheduling, and worker exposure. Toll operators manage data, integration, and execution. When those groups are misaligned, safety efforts tend to fragment. When they are aligned, agencies are better positioned to implement interventions that are both operationally practical and legally durable.

That has significance beyond Pennsylvania. If toll agencies are going to use AI and operational data more aggressively to improve safety, policymakers will need to think carefully about privacy safeguards, due process, enforcement authority, work zone definitions, data use, and outcome reporting. A strong legislative framework does more than authorize enforcement. It creates the conditions for responsible innovation. It can support common metrics, encourage data sharing across transportation and enforcement entities, and push the industry toward a more consistent and scalable model rather than a patchwork of one-off local efforts.

## A NEW INDUSTRY MODEL FOR PROACTIVE ROADWAY SAFETY

The broader strategic implication is clear. Tolling agencies can become leaders in modern roadway safety if they treat their data environment as a safety asset, not just an operational necessity. They already manage systems that generate continuous, high-quality information about how roadways are being used. With the right analytical tools, governance structure, and stakeholder alignment, those systems can support predictive safety management, smarter deployment of enforcement resources, stronger contractor coordination, and better evidence for policy decisions. The opportunity is not simply to improve one program. It is to build a more disciplined, proactive, and measurable model of roadway safety across the tolling industry.

The Pennsylvania Turnpike Commission's Work Zone Speed Safety Camera Program shows what an effective model can look like. It addressed a recurring work zone safety problem through a practical combination of enforcement, operational data, sustained deployment, and stakeholder coordination. The results, lower crash levels relative to pre-enforcement years, reduced speeding in active work zones, and large-scale execution over multiple years demonstrate practical gains, not theoretical promise. For tolling professionals, policymakers, and industry leaders, the lesson is straightforward, when agencies combine data, enforcement, and coordinated action, they can move beyond fragmented safety efforts and produce measurable results. That is where the industry has the strongest opportunity to lead.

Transurban

CASE STUDY 5: THE PSYCHOLOGICAL BASELINE

# APPLYING BEHAVIORAL SCIENCE TO UNDERSTAND AND COMBAT DISTRACTED DRIVING


## EXECUTIVE SUMMARY

Distracted driving remains a critical road safety issue, claiming thousands of fatalities annually and disproportionately affecting young drivers. Traditional awareness campaigns and purely punitive enforcement often fail because they ignore the underlying cognitive biases that drive this predictable, risky behavior. In some cases, poorly designed interventions have actually worsened network safety by creating a **"Hidden Distraction" effect,** where drivers conceal their devices and increase the time their eyes are off the road. This paper argues for a paradigm shift toward a behaviorally informed Safe System approach. Rather than relying on deterrence alone, agencies must focus on designing environments and social scripts that make safe choices intuitive. By analyzing the "Pass the Phone" peer-to-peer campaign, this study provides infrastructure operators and safety agencies with an operational blueprint for leveraging behavioral economics, specifically **pre-commitment and default-setting,** to create scalable, voluntary compliance across the roadway network.



THOUGHT LEADER

**Erika Spissu**
Director of Travel Behavior,
Transurban


As Director of Travel Behavior at Transurban, Erika leads market research and behavioral insights initiatives across North America. Leveraging deep expertise in travel behavior analysis, she helps inform traffic forecasting and supports multidisciplinary efforts spanning product development, road safety, and transportation innovation. Erika's work provides critical insights that guide strategic decision-making and enhance the customer experience.

## THE CHALLENGE: THE INTENTION-BEHAVIOR GAP AND HIDDEN DISTRACTION

As established in the Foreword, the scale and consequences of modern distraction are devastating, driven primarily by the ubiquitous smartphone. Beyond the physical metrics of diverted visual attention, research consistently shows that the cognitive impairment resulting from using a mobile device is equivalent to driving with a 0.08% blood alcohol concentration.

Despite these clear, well-documented risks, a profound intention-behavior gap persists among the motoring public, particularly among young drivers aged 15 to 20, who represent the largest percentage of distracted drivers involved in fatal crashes. According to the AAA Foundation for Traffic Safety, over 90% of drivers perceive texting, emailing, or scrolling social media as extremely dangerous. Yet, an alarming percentage of those same drivers, up to 37%, admit to actively engaging in these exact behaviors behind the wheel. This disconnect highlights a fundamental flaw in how the industry approaches safety. Awareness does not equal compliance.

Traditional countermeasures frequently fail to bridge this gap, and in some cases, they actually exacerbate the danger. The industry must recognize three specific failure modes of conventional interventions:

**The Hidden Distraction Effect:** Purely deterrence-based models, such as strict texting bans implemented without supportive infrastructure or behavioral nudges, can trigger dangerous unintended consequences. A landmark study by the Highway Loss Data Institute (HLDI) revealed that following the implementation of texting bans, collision insurance claims actually **increased by 1% to 9%** in several states. The data suggests that drivers did not stop texting. They simply moved their devices to their laps to avoid police detection. This drastically increased the time their eyes were completely off the road, making the network more dangerous.

**Deterrence Decay:** High-Visibility Enforcement (HVE) waves can effectively reduce handheld phone use in the short term. Data from the National Highway Traffic Safety Administration (NHTSA) showed reductions of 33% to 57% during active campaigns. However, **compliance predictably reverts to the baseline** once the visible police presence diminishes, proving that fear of a ticket does not create a lasting behavioral habit.

**Cognitive Overload:** Campaigns relying on shock, fear, or humor often backfire. A recent study published in *Science* found that displaying fatality-count numbers on dynamic highway signs actually **increased crashes by 1.52%.** These hyper-salient messages elevated driver anxiety and increased cognitive load, pulling mental resources away from the primary task of driving safely.

To drive measurable, sustained behavioral shifts, the transportation industry must pivot. We must recognize that humans are wired to make mistakes, and distraction is not a rare, malicious choice. It is a predictable habit shaped by automatic impulses and dopamine loops.

## THE BEHAVIORAL PLAYBOOK: THE “PASS THE PHONE” MODEL

To successfully combat these deeply ingrained habits, the international Re:act program applied the Safe System concept by engaging university students, alongside partners like Transurban, the Maryland Department of Transportation (MDOT), and the Insurance Institute for Highway Safety (IIHS). The goal was to design authentic, peer-to-peer campaigns that leverage social proof rather than bureaucratic warnings.

The winning 2024 campaign, titled “Pass the Phone,” targeted the pervasive habit of mobile phone use among young drivers. Created by university student Danika Perez, who survived a distraction-related crash at age 16, the campaign was rooted in empathy, recognizing that distraction is a universal human vulnerability.

Rather than relying on fear or punishment, the campaign deployed four core behavioral science principles to fundamentally modify the in-cabin environment:


**FIGURE 9.** The "Pass the Phone" campaign utilizes digital billboards to deliver real-time behavioral nudges, encouraging drivers to make pre-commitments before putting the vehicle in gear.

Photo credit: reactforchange.org

**Pillar A: Pre-commitment:** The campaign prompts the driver to physically hand their device to a passenger prior to putting the vehicle in gear. By **forcing a decision before the drive begins,** this strategy removes the source of temptation entirely, eliminating the psychological pull of a ringing or buzzing phone.

**Pillar B: Making the Safe Choice the Default:** By physically transferring the device, the campaign changes the baseline state of the vehicle. Simple cognitive friction dictates behavior. **Abstaining from phone use becomes the default setting.** Overriding this default requires the driver to actively ask the passenger to hand the phone back. This introduces a socially awkward friction point that serves as a highly effective, subconscious deterrent.

**Pillar C: Rearchitecting the Social Context:** Crucially, the campaign shifts the passenger from a passive, quiet observer to an active participant in the vehicle's safety. This dynamic serves as a continuous source of normative feedback, establishing an **immediate micro-culture within the vehicle** where safety is the agreed-upon, shared baseline.

**Pillar D: Real-time Interruption:** Deploying the campaign on digital billboards across Maryland provided an immediate visual cue that disrupted a driver's autopilot behavior. By delivering the nudge **exactly when drivers were actively on the road,** it served as a real-time behavioral interrupter.

## THE IMPACT: NUDGES VS. PENALTIES

The strategic strength of "Pass the Phone" is that it achieves the behavioral modification of an advanced technology system, but with zero hardware investment.

Industry benchmarks demonstrate that immediate feedback loops are highly effective. For example, Usage-Based Insurance (UBI) models can lead to a **43% reduction in distraction events** through financial incentives, and advanced AI powered telematics can **reduce handheld phone use by 69% within 30 days** by providing immediate auditory alerts.

The "Pass the Phone" campaign drives toward comparable behavioral outcomes by replacing external, technological feedback with a non-verbal social script. It turns the passenger into the primary safety mechanism. Selected from 20 competing concepts for its brilliant simplicity, it proves the power of giving drivers a safe, tangible behavior they are comfortable following, rather than simply telling them what not to do.

## THE EXECUTIVE IMPERATIVE: ENGINEERING VOLUNTARY COMPLIANCE

For infrastructure operators, DOT executives, and safety policymakers, the data is unequivocal. We cannot simply arrest or scare our way out of the distracted driving crisis. When agencies rely exclusively on punitive enforcement or fear-based messaging, they risk triggering deterrence decay, cognitive overload, or the deadly "hidden distraction" effect.

To achieve sustained safety outcomes, executives must treat human psychology as a core component of the Safe System approach, giving it the same strategic weight as concrete barriers or AI cameras. Agencies should audit their existing public awareness budgets and pivot funding away from traditional "don't do it" messaging. Instead, campaigns should focus on **engineering voluntary compliance** by promoting tangible, friction-introducing habits, like pre-commitment and default-setting, that make safe choices the path of least resistance.

**For solo drivers, this means promoting both physical and digital pre-commitments, such as placing the device out of reach in a center console or universally activating automated "Do Not Disturb While Driving" modes, effectively turning the vehicle cabin into the behavioral failsafe.**

By integrating behavioral science into the DNA of our safety programs, we stop fighting human nature and start designing systems that protect the imperfect driver.

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## CASE STUDY 6: THE OPERATIONAL FAILSAFE

# RAPID INCIDENT RESPONSE AND SECONDARY CRASH REDUCTION


### EXECUTIVE SUMMARY

Traffic incidents are an unfortunate and common occurrence on our roadways. They present a significant operational and safety challenge for roadway agencies and facility operators. This case study examines the critical role of coordinated and disciplined Traffic Incident Management (TIM) programs in reducing secondary crashes. By analyzing the Elizabeth River Crossings (ERC) operations in Virginia, this paper outlines a highly disciplined response framework built on rapid detection and response, aggressive towing deployment, and multi-agency coordination. The ERC model demonstrates that treating incident clearance as a stopwatch-driven safety priority can drastically reduce congestion, limit responder exposure to live traffic, and ultimately protect the distracted motoring public from secondary impacts that threatens their safety and degrade the travel reliability across the transportation network.



THOUGHT LEADER

**Diane Shields**
Chief Operating Officer,
Elizabeth River Crossings


After more than 25 years in international manufacturing, Diane joined the transportation industry in 2013 as Quality Assurance Manager for Elizabeth River Crossings. She later served as Director of Capital Expenditures and Business Processes, overseeing CapEx, EHS, Quality Assurance, Sustainability, Risk Management, and Revenue Leakage. Now COO, she also leads Operations and Maintenance, with a leadership philosophy centered on empowering teams to perform at their best.

## THE CHALLENGE: THE LIFECYCLE OF AN INCIDENT

Transportation research has noted that traffic incidents account for approximately 25 percent of total congestion on U.S. highways, underscoring the importance of rapid detection, response, and clearance. In this context, rapid traffic incident response serves as both a mobility strategy and a roadway safety intervention.

When incidents remain active for extended periods, the incident scene becomes a persistent visual and operational disruption. Passing motorists may respond with abrupt braking, unsafe lane changes, reduced situational awareness, or other behaviors associated with distracted driving.

When crashes or vehicle breakdowns are cleared quickly, the "visual stimulus" that triggers these behaviors is significantly diminished. Prolonged incident scenes often lead to traffic congestion, driver frustration, and cognitive overload, all of which increase the likelihood of inattention and risky driving behaviors that contribute to secondary incidents. At the same time, prolonged lane blockages created by these incidents increase congestion and extend responder exposure to live traffic.

Restoring normal traffic flow more rapidly and reducing driver exposure to unexpected conditions are very basic but very fundamental goals when striving to minimize secondary accidents.

## THE OPERATIONAL PLAYBOOK: SITUATIONAL AWARENESS AND SENSE OF URGENCY

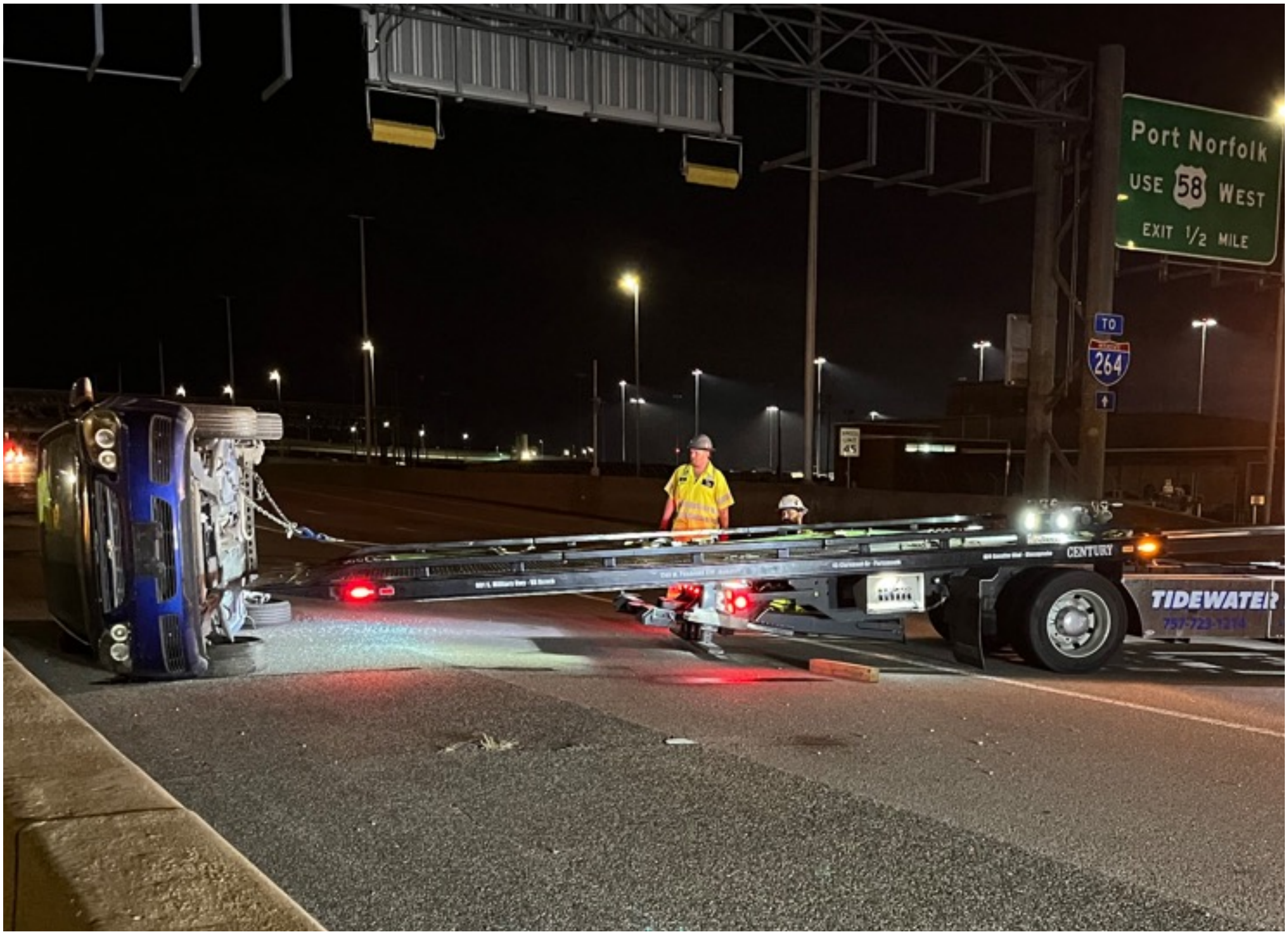
Elizabeth River Crossings (ERC), located in the Hampton Roads region of Virginia, operates four underwater tunnel facilities and their connecting highways. As a concessionaire to the Virginia Department of Transportation (VDOT), ERC implements rapid traffic incident response practices aligned with broader Traffic Incident Management principles consistent with VDOT's approach. This approach prioritizes quick and safe clearance, effective interagency coordination, clearly defined vehicle removal authority, and consistent communication among roadway personnel, law enforcement, emergency responders, and support teams. Fundamental principles include:

**Rapid Incident Detection:** Incident detection and verification rely on a layered system that draws from multiple operational sources, including internal sources like Control Room CCTV, roving Safety Service Patrols (SSP), Inspection Station observations, maintenance workforce alerts from the field, and external notification sources from Local and State police. ERC data identifies that nearly 70% of their incident detection comes from internal sources.

Coordinated Response: **Once an incident is identified, ERC moves quickly** into a coordinated response model shaped by the realities of what ERC's Operations Manager, Angelica Logan describes as "working in the gray area," where conditions are often uncertain, highly variable, rarely routine, and time-sensitive". Well defined Traffic Incident Management protocols based on the initial identification of the incident are initiated in the Tunnel Traffic Management System (TTMS) with almost simultaneous coordinated dispatches to SSP and wrecker services, supporting rapid arrival on scene. Responders position vehicles strategically to minimize the number of travel lanes affected. First on the scene responders quickly assess the scene and communicate the need for additional law enforcement support and/or fire-rescue partners.

**Communication:** Communication with motorists is also a central part of the response strategy. Motorists are kept informed through a coordinated communications strategy that includes navigation app notifications and HAAS alerts, variable message signs, 511 notifications, and social media.

**Minimize Travel Lanes Impacted:** In ERC's areas of responsibility, about 50% of all incidents annually are lane-impacting incidents. Responders first on scene quickly position vehicles strategically to minimize the number of travel lanes affected. This is especially important during heavy congestion, when compliance with "Move Over" law requirements can be difficult and disciplined traffic control becomes critical. As a result of this strategy, ERC has been able to maintain an overall tunnel availability average of 99.4% or greater.




With ERC's unique footprint and patterns of known congestion periods, the company supports rapid clearance through the staging of key wrecker resources at strategic locations, with additional resources deployed during peak travel periods and a heavy wrecker always available on site. ERC's authority to remove vehicles, together with fleet service availability from towing partners, helps reduce delays and supports faster roadway recovery. In 2025, Wrecker response times averaged 2.7 minutes and 7.4 minutes for clearance of incidents on the shoulders, not impacting travel lanes.

In 2025, crashes with lane closures involving First Responders were all cleared within 90 minutes, with Average Clearance Time of 34 minutes. Crashes with lane closures not involving First Responders resulted in an Average Clearance Time of 14 minutes.

**Safety Precautions:** As the incident is being cleared, traffic control is reinforced by SSP presence at each incident or tunnel. In addition, roadway maintenance personnel are on standby Maintenance of Traffic (MOT) support for detours. These safety precautions and the strong established working relationships with local first responders help to maintain a disciplined and safe incident scene, which is essential to protecting responders and restoring mobility.

**FIGURE 10.**
Pre-positioned towing assets allow for rapid response and clearance, even in the most difficult situations.

## THE IMPACT: SAFETY FOR ALL

**Safety First:** From a safety perspective, faster clearance reduces the duration of responder exposure on active roadways and limits the roadside distractions that contribute to unsafe driver behavior near incident scenes. These effects are especially important in constrained facilities such as underwater tunnels and adjacent approach roadways, where limited operating space can increase operational complexity.

**Cultural Approach:** Across the ERC organization; safety for motorists, employees, and first responders is embedded in every procedure, protocol, and operational decision, with a clear understanding that reducing incident duration also reduces the risk of secondary crashes, lessens congestion, protects revenue and resources, and improves overall transportation system performance.

**Always Training and Learning:** ERC actively enrolls their field personnel in TIM training which identifies coordinated multidisciplinary response and safe, quick clearance as essential practices. Nationally, more than 800,000 responders had completed National Traffic Incident Management Responder Training as of October 2025, reflecting broad institutional support for standardized incident management practices.

**Measure What You Do:** Together, these practices reflect a performance-driven culture supported by staff training, well-defined procedures, after-action reviews, joint drills with first responders and wrecker services, and ongoing data analysis.

## THE EXECUTIVE IMPERATIVE: DISCIPLINED AND COMMITTED PARTICIPANTS

Within this framework, the use of consistent TIM practices is intended to reduce secondary incidents, improve response and clearance times, increase tunnel and roadway availability, and improve the use of resources. Organizations that incorporate safety, response, and clearance time metrics into their operational protocols will realize the benefits resulting in less secondary incidents, less third-party damage to assets, and less safety near-misses.

There is no doubt about the value of rapid traffic incident response as an integrated operational and safety practice. By reducing incident duration and supporting safe, coordinated clearance protocols organizations can help mitigate secondary crash risk, improve transportation system performance, and strengthen protection for both motorists and responders.

Technology will constantly strive to develop products to minimize incidents and influence human behaviors that contribute to distracted driving. But until these technological solutions are widely adopted, it will be the disciplined and reliable Traffic Incident Management strategies and the personnel that are committed to execute them that will have the greatest impact on minimizing secondary accidents most often resulting from distracted drivers.

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