TOGETHER FOR SAFER ROADS

COMPANIES DRIVEN TO SAVE LIVES™

Optimizing Fleets with Telematics

A Guide for Today's Fleet Managers

OCTOBER 2025

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ABOUT THIS REPORT

This report began with a technical question: are key telematic metrics calibrated the same way across differing telematics provider platforms? And if so, how might that impact an operator's ability to understand safety performance in their fleet? Essentially, in terms of G-force calibration, is a harsh braking event recorded the same way across telematics platforms and across fleets? The short answer to that question is, generally, yes. In interviews and conversations with telematics providers and fleet operators, we found that the G-force ranges for key safety metrics such as harsh braking, cornering, and acceleration were largely the same. While the exact G-force calibration of metrics differs slightly from telematics brand to brand and can be customized further by operators, most fall within relatively similar ranges.

However, in those same conversations, key differences appeared in what fleet operators chose to do with that telematic information; how they used trends to guide safety policy and practice, and to communicate with and train drivers. In conversations and research, additional questions appeared around best practices for communicating with drivers and in deciding what metrics best conveyed an accurate portrait of safety performance in a given industry (for example, should an operator focus on the same metrics for passenger vehicles in their fleet as they use for delivery or waste-hauling trucks?). Stepping back, a broader question surfaced around how to understand telematics in a larger context of safety policy and training and what a fleet operator might need to know to get started.

This resulting report explores how public and private sector fleet operators can use vehicle telematics to reduce crashes, encourage safer driving, support their drivers, and ultimately contribute to creating safer fleets. It looks to identify key safety metrics that operators can use to improve safety and outline the various ways that telematics can be used to improve safety outcomes at a driver and organizational level. It looks at what technologies are needed to gather different types of telematic information, and how broad differences in industry application or vehicle type, can impact which telematic metrics will give operators the best understanding of fleet safety performance.

Throughout the report you will see case studies and examples that highlight best practices or key insights and examples from Together for Safer Roads (TSR) members and partners. If there are certain ideas that seem particularly relevant to your organization, we encourage readers to reach out directly to TSR so we can facilitate introductions and further learning.

EXECUTIVE SUMMARY

Telematics provide fleet operators with a unique and invaluable tool for improving fleet safety and driver performance. However, with a potentially overwhelming wealth of data available, fleet operators need guidance in selecting safety metrics, understanding key best practices for effectively using telematics systems, and understanding how telematics technologies work, in order to fully realize their potential in improving fleet safety.

Across the world and across industries, speed remains the most important indicator for safety; as speed increases, the risk of a crash proportionally increases. In particular, excessive speeding (speeding that is significantly higher than the posted limit and/or for long durations) is a well-established indicator for unsafe driver behavior, even when accounting for highly congested contexts where speeding itself is infrequent. Further, many other key indicators of unsafe driving, such as **harsh braking[1], harsh cornering or close following,** are related to speed and are made more severe when speed and excessive speed are at play.

An organizational commitment to coaching and training is essential for telematics systems to deliver on safety and operational benefits. Operators should work to build organizational cultures that understand how to use telematics data to inform driver coaching and targeted training to improve safety performance. Telematics systems provide key data, insights, and information that should be used to augment on-going driver coaching and training programs. By combining telematics systems with robust and thoughtful driver coaching and training opportunities, operators can significantly improve and enhance safety in their fleets.

Lastly, as operators know well, different industries have different needs and use cases. When looking to purchase vehicles or add after-market technologies such as telematics, operators should carefully consider their industry contexts. For example, an organization in an urban area running a fleet of waste-hauling trucks may decide that telematics systems that include after-market AI-enhanced cameras with rear-facing near-miss detection are crucial, whereas an organization operating in a largely highway context may decide that telemetry-based telematics may suffice. Similarly, while drivers generally tend to appreciate the additional information and potential crash exoneration data that comes with forward-facing cameras, not all organizations will find value in driver-facing camera technologies. Understanding the benefits and trade-offs of the different telematics technologies is essential to improving safety.

As fleet operators launch, or enhance, their telematics programs, this report is designed to be a resource that can help them stay focused in a rapidly changing technological landscape. It outlines the benefits of telematics, identifies key safety metrics, and provides an overview of how telematics technologies work and what is needed to improve safety in different contexts. The report draws from the expertise of technology providers and technology users, i.e., fleets, and demonstrates the unique role that TSR plays in supporting the cross-sector partnerships that are critical to solving some of our most difficult and important road safety challenges. It is our hope that these insights and learnings can be shared widely across industries, supporting fleets of all sizes, public and private.

Image: Orion Fleet Intelligence

PRINCIPLES FOR USING TELEMATICS

Telematics provide fleet operators with significant opportunities for safety and financial benefits. While fleet operators will want to select their telematics provider and customize KPIs and metrics based on their needs, industry, and goals, our research finds consistent best practices that can help operators get the most out of their selected telematics system. Based on insights gathered through interviews with fleet operators and telematics providers, five key themes have emerged as best practices for effectively improving safety through implementing telematics:

Integrate Data with Driver Coaching Training - Collecting telematics data is only half of the equation, with transformative value laying in how fleet managers use the data to lead to meaningful behavior changes from drivers. The best telematics systems provide fleet operators with clear, user-friendly dashboards and driver reports that allow supervisors to easily see patterns, and communicate with drivers about how to change unsafe actions or behaviors.

Prioritize Speed Management - Across all industries and contexts, speeding and excessive speeding are essential metrics because speeding compounds the dangers posed by all other dangerous behaviors such as harsh braking, cornering and close following. While exact KPIs may differ by context - a flat speed threshold might provide less information in a highly congested area for example, significant durations of speeding above the anticipated speed are cause for concern.

Avoid Driver Overload - Not all data should trigger real-time alerts for drivers. Fleet managers need to clearly consider what requires a real-time alert and real-time action versus what can be addressed through later driver coaching to avoid driver fatigue. For example, excessive speeding should trigger a direct alert to the driver so they can take immediate action; general speeding (a few miles over the limit or for a short duration) should be addressed after the fact as part of on-going coaching.

Establish Company Safety Metrics - Setting company-wide metrics for Safety KPIs is essential to improve data comparison and to enable fleet managers to measure progress. These metrics are particularly important for larger fleets that operate across multiple facilities, or in many cities, states, or countries.

Account for Context and Calibration - Fleets should prioritize metrics that reflect the specific operating conditions for their drivers, such as the nuances of different industries or urban vs. rural environments. Similarly, metrics that rely on G-force measurements may be more challenging in industries like refuse hauling or beverage delivery, where the truck load weight can significantly change over the course of the day.

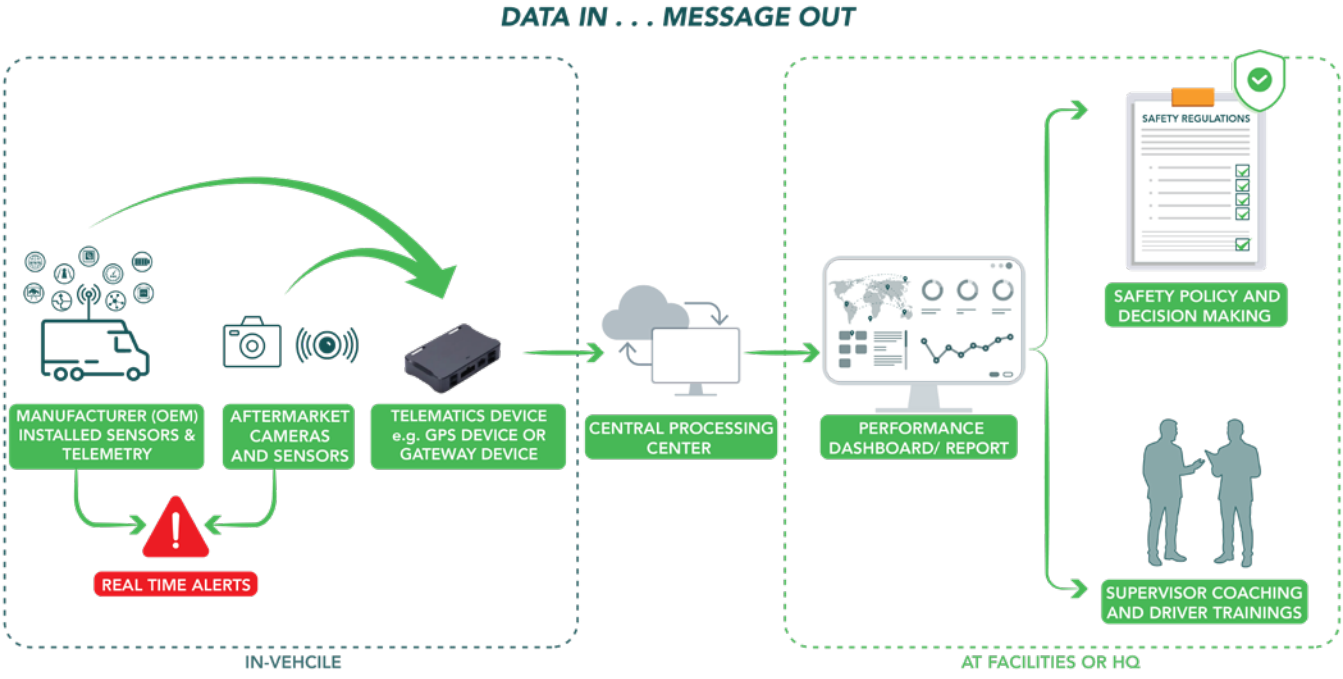
GETTING STARTED WITH TELEMATICS

WHAT IS TELEMATICS?

At the simplest level, the goal of telematics is to change behavior.

From safety to efficiency to operations, telematics systems provide drivers, managers, and companies with contextual, location-based performance information that they can use to make better decisions about what to do next.

When it comes to safety, the real-world data provided by telematics systems is invaluable. Real-time alerts give drivers immediate feedback to avoid a crash. Geo-located information on key metrics, like speed or harsh braking, gives fleet managers a clear view of where risky driver behavior is happening and how to target resources and training. Increasingly, camera-based telematics provide additional contextual information about why a crash or near-miss occurred, which can support driver training efforts, as well as provide information to inform insurance claims and payouts.



Telematics systems collect real-time, geo-located data from vehicles and transform it into actionable information for drivers, fleet managers, and fleet operators.

With telematics data, improvements to driver behavior can be more proactive and personal, leading to lasting positive change to driver behavior. Drivers can learn better driving habits and avoid dangerous situations caused by unsafe driving. At the same time, telematics offers safety managers a way to look beyond anecdote, to identify patterns - by driver, by facility, by vehicle type, by region, by work category - that can inform organization-wide safety improvements.

Telematics systems combine GPS location data with vehicle data to collect and analyze information about vehicle performance and driver actions. Telematics systems collect data that allows fleet operators to better understand and address the safety and maintenance needs of their fleets. Telematics devices (also known as GPS loggers or gateway devices) link these data points to specific geographic locations. The data is then transmitted to a centralized processing center where it can be analyzed and packaged into a format that is easy for operators and supervisors to understand and use for driver training and coaching.

Most telematics providers provide their clients with easily digestible dashboards, reports, and analytic tools that can help fleets - from drivers to line supervisors to management and policy makers - to understand and improve safety and fleet performance. Increasingly, a variety of telematics provider companies enhance telemetry-based data by adding aftermarket LIDAR sensors, cameras, and AI-enhanced cameras to fleet vehicles which can collect additional information, such as following distances, harsh-braking, and near-misses.

WHY TELEMATICS?

Telematics systems provide fleet operators with a variety of safety and operational benefits. These include safety benefits for employees and other road users, as well as associated financial benefits that come with reduced crashes and better information about what actually happened when crashes have occured. Telematics systems can also provide fleet operators with overview information to make more informed decisions about operating policies and practices.

SAFETY BENEFITS

While commonly used to manage fleet maintenance or fuel economy, especially in larger fleets, telematics are increasingly being used to help fleet operators improve safety performance. In 2023, 5,375 large trucks were involved in a fatal crash and 114,552 large trucks were involved in crashes resulting in an injury in the United States. The number of fatal crashes has increased steadily over the past decade; 2023 saw a 43% increase in truck-involved fatalities over 2013 numbers.[2] Telematic systems can provide real-time alerts to drivers to help them avoid these crashes as well as providing pattern-level information to fleet managers and supervisors who can then work directly with drivers to provide feedback and additional training. Using telematics systems to improve safety has immediate and clear benefits:

- A 2014 study of drivers of large (Class 8) trucks found that **using telematics systems resulted in a 56%-63% decrease in unsafe driving events** (sudden acceleration, harsh braking, sudden lane changes) and a 33% reduction in speeding when combined with training and coaching programs.[3]
- A 2025 Lytx Road Safety Report found that in 2024, their clients experienced an almost 9% reduction in time spent speeding per vehicle, **increasing safety and preventing poor gas mileage**.[4]
- A recent Samsara report, outlining their work with the City of Denver, **identified a 60% decrease in "moderate, major, or extensive" crashes** in the year following the deployment of Samsara software across their 1,900 vehicle fleet.[5]
- Speaking at the Fleet LatAm Conference in 2020, PepsiCo identified telematics as key to driving a **27% reduction in vehicle collision frequency** in their Mexico operations.[6]
- An IDC white paper, commissioned by Samsara, found that using telematics reduced vehicle crashes by 29% on average, and that companies saw a **51% reduction in unsafe driving** within 3 months.[7]

FINANCIAL BENEFITS

The safety benefits gained from the use of telematics systems are also tied to reduced crash related costs. These include reduced instances of vehicle repair and replacement and reduced administrative load. Additionally, a number of operators say that telematic systems that include externally-focused cameras (commonly called dash cams) have provided key video footage that has helped them reduce claims and insurance payouts.

- In an IDC white paper, commissioned by Samsara in 2025, researchers found that telematics reduced vehicle related crash costs, on average, by $363,700 annually per organization, and that operators saw a **36% reduction in insurance costs**.[8]
- In a case study highlighting their work with the city of Denver, Samsara found that the City of Denver was able to **reduce the number of false claims filed against them by 50%** in the year following the Samsara rollout.[9]
- Similarly, Motive found that companies using their AI-enabled Dash Cam saw a 21% reduction in insurance costs and **30% reduction in crash-related costs.**[10]

AI-enabled cameras allow drivers to see objects in blindzones to the side, rear, and front of their truck.

Image: Rosco Vision

TELEMATICS AS A POLICY-INFORMING AND OPERATIONS TOOL

Telematics systems can also provide information to help improve an organization's safety policies and practices. Telematics systems can show patterns of events or alerts across multiple drivers or vehicles can indicate that larger safety improvements are needed. For example, repeated speed or harsh braking alerts could indicate to route planners that a schedule is too tight and additional resources are needed. Similarly, repeated harsh braking or forward collision warnings (FCW) could suggest visibility issues and indicate that higher-vision trucks are needed. In 2004, UPS formalized a routing practice that limits left turns whenever possible, as internal data showed that the company could save gas and reduce dangerous turning movements.[11] By combining these data insights with driver training and coaching and using findings to make updates to company policy and practice as necessary, fleet operators can make significant improvements in safety and operations.

CASE STUDY: BEYOND TRUCKS– AB InBev ADDS TELEMATICS TO TWO-WHEELED FLEETS

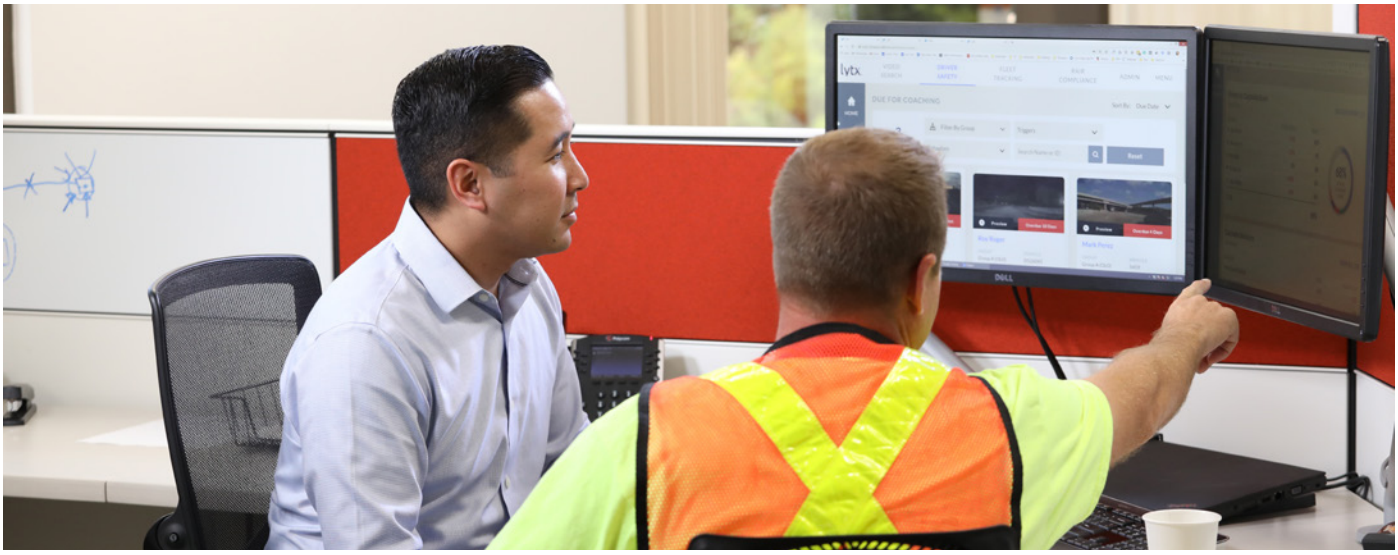
In their Brazilian and Columbian operations, AB InBev is expanding the use of telematics in non-traditional fleet vehicles - motorcyles. In response to high crash rates, especially for their more than 3,000 sales representatives who get around by motorcyle, AB InBev wanted ways to ensure safety and hold drivers to safety standards like their truck drivers. The first steps taken to install telematics technology into motorcycles were telemetry devices on the drivers' cell phones to collect very basic GPS information to track speed and location. In the case that fleet operators own, not lease, the individual motorcycles, like AB In Bev does in Brazil, they can install telematic hardware in the motorcycles to track more detailed safety metrics and develop their motorcycle driver training programs. Brazil's iFood, a food delivery service, utilizes telemetry to understand their drivers current driving patterns and identify where improvement is needed.

TELEMATICS & TRAINING

Key to the efficacy of telematic systems is their connection to driver coaching and training. At first, telematics are often thought of as providing the most value in real-time alerts that provide immediate feedback to the driver, which allows them to take action to avoid an imminent collision. However, drivers and operators alike emphasize the biggest value of telematics comes as part of longer term coaching and training.

Telematics systems allow supervisors to recognize patterns of unsafe behaviors and provide direct coaching and instruction to drivers to make necessary changes – for example, repeated instances of low-moderate speeding, harsh braking, or close-following. This trend or pattern information is sent to supervisors or line managers who then work with the driver to discuss why issues are occurring and retrain them as needed.

The consistent coaching and training from line managers or safety trainers is key to helping drivers recognize unsafe patterns in their driving and make changes. For example, 93% of drivers agree that seeing interior-facing dash cam footage of themselves has increased their awareness of being distracted while driving and after seeing their dash cam footage, 60% of drivers changed their driving habits.[12] Similarly, in a recent report from Chalk Mountain Services, which uses Samsara's Vehicle Gateways and Video-Based Safety solutions, credited AI dash cams and the associated data-driven rewards program with an 86% reduction in crash costs, 43% decrease in worker compensation costs, and 15% improvement in driver retention.[13] In contrast, drivers and operators alike caution that the overuse of immediate intervention tools (e.g. noise alerts or lights) can desensitize drivers and lead to reduced compliance over time.



Consistent coaching and training essential to improving safety performance.

Image: Lytx

To help analyze and communicate trends to drivers and supervisors, telematics system providers collect and display safety metrics in dashboards and safety scorecards. These tools track behaviors at an individual driver level to help supervisors identify where additional training is needed. These systems are typically customizable to the needs of the fleet operator and provide information on key metrics the operator wishes to track. Ensuring that dashboards clearly display actionable information on priority metrics is key to effectiveness. For example, Motive uses driver scorecards to improve driver behavior, enhance fleet safety and control operational costs. Their scorecards aggregate data into a simple rating system to identify drivers that need additional coaching or correction. The metrics that Motive tracks include: speeding, harsh braking and acceleration, distraction, idling time, seatbelt usage, and collision and near-miss rates.[14]

GeoTab also uses driver scorecards, focusing on three main metrics: speeding, aggressive driving, and seat belt usage.[15]

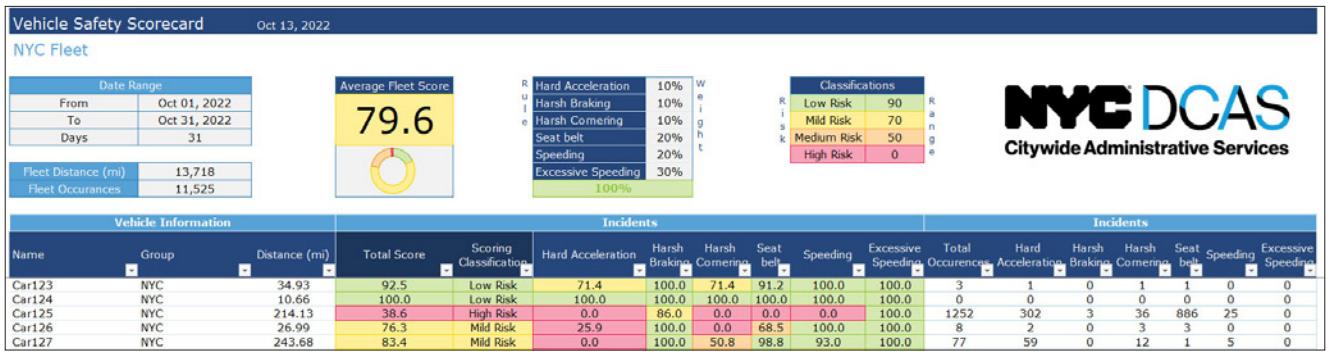
Lytx found that highlighting driver achievements can strengthen company culture and safety programs; they issued over 250,000 safety recognition certificates to drivers in 2024, up 29% from the previous year.[16]

Feedback that Drives Change

Enhancing driver training and improving safety depends on having accessible and actionable data. When fleet managers receive clear findings, they can identify which risky driving behaviors are prevalent in their fleet and identify the drivers who may require additional training. When The New York City Department of City Administrative Services (DCAS) began using telematics, they found that they were overwhelming their fleet managers with large spreadsheets that they weren't sure how to use. As one DCAS safety specialist noted, "when we started, we were sending large excel files to people who didn't know how to use excel."[17] Fleet managers struggled to access the file and determine next steps for the training programs.

Through improved communication and more back-end analysis, NYC DCAS now provides their fleet managers with effective, streamlined charts and tables in email format that highlight risky driving behaviors and identify the drivers that need support.[18] The emails and reports now include a summary first page with trend lines and bar chart, a simple list of drivers whose performance needs attention, and specific actions to address. The refined approach allows fleet managers to use data to make quick decisions that have more impact.

Implementing safety programs not only improve driver safety, but also can lead to decreased turnover rates and save operators time and money. Dohrn Transfer Company, a local delivery trucking service, introduced the gamification of driver safety by using the safety program by Samsara, the Samsara Safety Scores, which reduced driver turnover by 10%, saving $8,000 in recruitment and replacement costs per driver.[19]



Monitoring Safety Risk: DCAS Vehicle Safety Scorecard

Image: NYC DCAS

TSR'S FOCUS ON FLEET SAFETY PROGRAM

FOCUS on Fleet Safety is TSR's signature workforce development program, created specifically for small to mid-size fleets and grounded in industry best practices and peer mentorship.

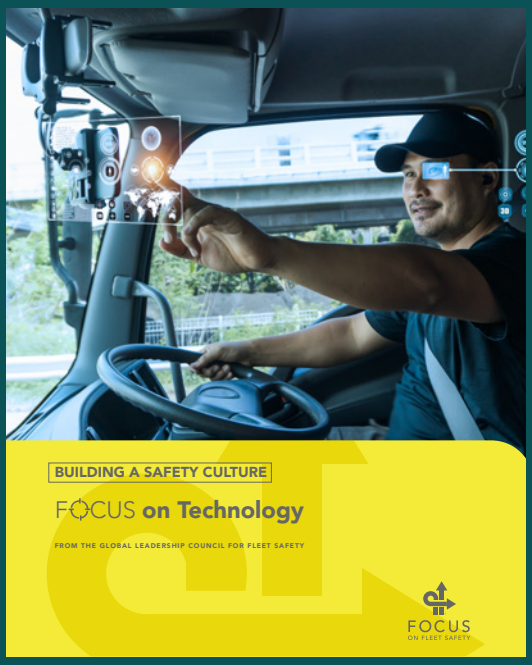
The program supports companies in building programs that sustain a strong culture of safety—benefiting employees, the organization, and the greater community.

Participants gain access to a robust curriculum, best practice guides, benchmarking tools, and peer learning to build stronger safety cultures, enhance operations, and achieve measurable results. The FOCUS program is structured around three foundational pillars of fleet safety: Safety Leadership, Training and Development, and Technology.

As part of the Vehicle Technology and Telematics Pillar of FOCUS, TSR provides fleets with a comprehensive resource guide that includes a three-tiered analysis framework, providing fleets with a clear roadmap to assess different types of vehicle technology and telematic solutions to strengthen their safety operations:

- Tier 1: Viewed as an industry standard by fleets. E.g.: Speeding, harsh braking, and harsh acceleration
- Tier 2: Best practices recommended by fleets. E.g.: Seatbelt use, camera- and sensor-enabled tracking and warnings
- Tier 3: Good practices for specific risks and emerging technologies. E.g.: Lane departure warnings, alcohol touch ignition interlock, distracted driving prevention

Participation in the FOCUS on Fleet Safety program will provide readers of this report with concrete, specific action steps tailored to their fleet on how best to understand and implement a telematics system.



TSR Focus on Fleet Safety, Focus on Technology
Image: Together for Safer Roads

CASE STUDY: TELEMATICS & THE NEW YORK CITY FLEET TRANSITION PLAN

Telematics plays a key role in New York City's efforts to improve safety, sustainability, and efficiency in the City's 29,000 vehicle municipal fleet. As outlined in the 2025 NYC Safe Fleet Transition Plan Update (SFTP), telematics is mandated as a Tier 1 requirement. This requirement is also codified in Mayoral Executive Order 41 of 2019. Telematics use has allowed DCAS to track risky driving behaviors including legal requirements such as speeding, excessive speeding, and seatbelt use; and safety indicators including hard braking, accelerating and cornering. DCAS has used this monitoring and follow-ups to achieve major (50% and greater) reductions in high and moderate risk driving and excessive speeding. Telematics has also allowed DCAS to reduce the size of the overall City fleet by identifying inefficiencies. DCAS tracks 29,000 vehicles in real-time at its Fleet Office of Real Time Tracking (FORT).

The telematics initiative is also a key building block to DCAS's nation-leading intelligent speed assistance (ISA) program, where 700 vehicles to date are kept within the speed limit wherever they are operating. When a vehicle exceeds the speed limit at any location, as tracked through telematics, the ISA system prevents further acceleration of the vehicle. DCAS recently announced that it would transition all civilian vehicles, over 7,000, to ISA.

The 2025 NYC Safe Fleet Transition Plan Update, which outlines the scope of the City's telematics program, is the New York City Department of Citywide Administrative Services' (DCAS) strategy to enhance vehicle safety in the City's municipal fleet. The SFTP, which was first adopted in 2017, identifies best practices for vehicle safety and technology for the municipal fleet, with a goal of preventing crashes. It divides potential technologies into three categories to help prioritize implementation in keeping with technology readiness and availability.

- Tier 1: Required for implementation
- Tier 2: Best Practice Technologies encouraged for adoption
- Tier 3: Exploratory Technologies for future study

Since the original SFTP report was published, DCAS has surpassed 100,000 safety improvements and the City has seen a 29% decrease in preventable collisions involving municipal vehicles from 2019 to 2024[20]. The 2025 update incorporates feedback from city agencies and recent policy mandates to guide future fleet procurement and upgrades. DCAS has received multiple national recognitions for these efforts including the 2025 Green Cross for Safety Excellence Award from the National Safety Council.

City Staff Participating in DCAS Safe Driver Training

Image: NYC DCAS

CASE STUDY: METRICS THAT MATTER – HOW SAFETY SCORECARDS IMPROVED DRIVER PERFORMANCE AT PEPSICO

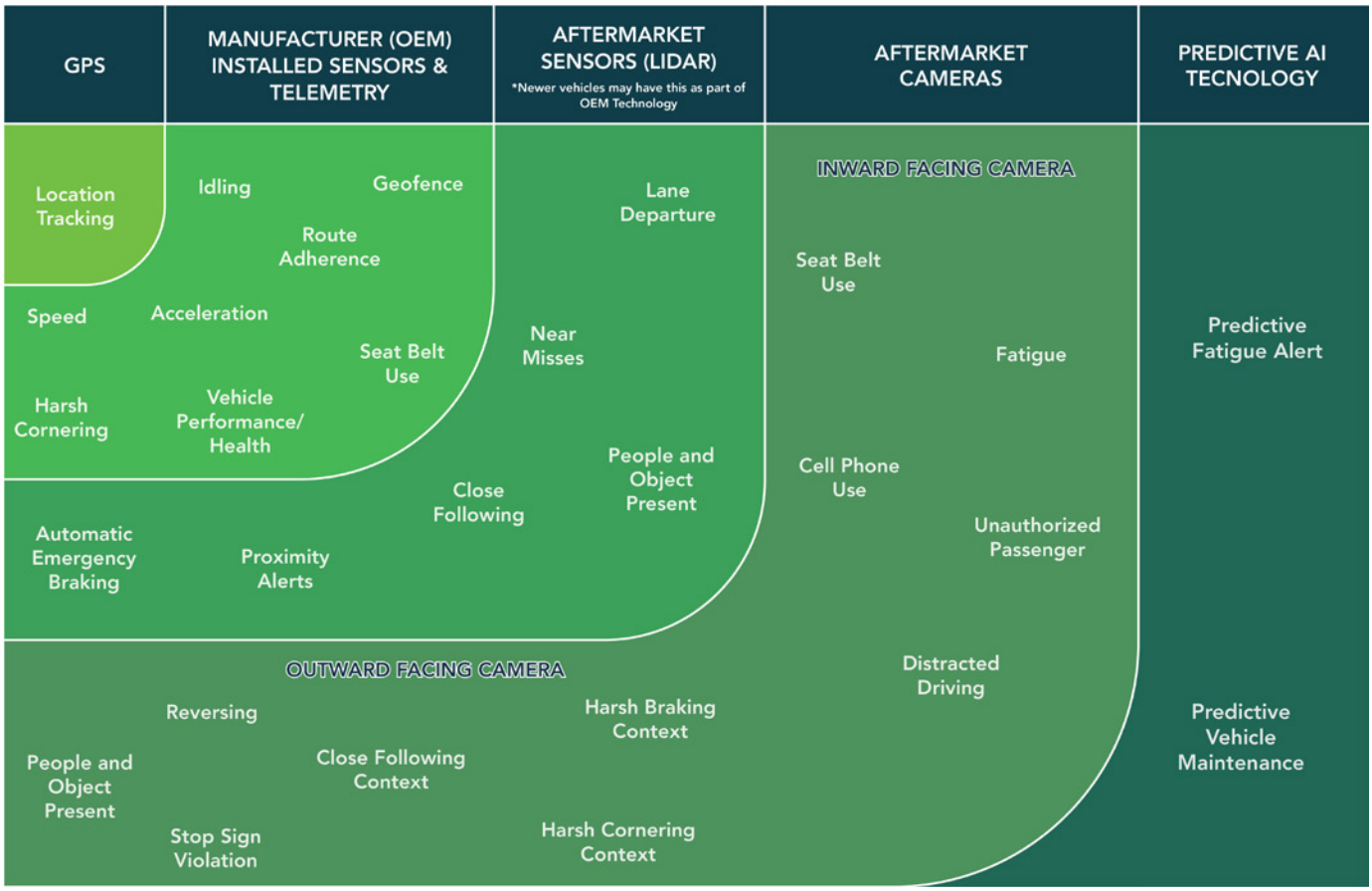
PepsiCo uses telematics across its 80,000-vehicle fleet to monitor performance, promote efficiency, and most importantly improve driver safety[21]. PepsiCo uses Safety Scorecards to reward safe driving and guide corrective actions through coaching and training programs. PepsiCo follows regional telematics guidelines while pursuing global standardization for their fleet. Certain regions have different safety issues that are more prevalent, so PepsiCo collects baseline data for three months before activating alerts to understand natural driver behavior and identify trends. PepsiCo attributes the improvements in safety to its use of telematics, their Safe Drive Index increased from 30% in 2018 to 97% in 2020, and their Vehicle Collision Frequency Rate by Distance decreased from 7.4 crashes per 1 million kilometers in 2018 to 5.8 crashes per 1 million kilometers in 2020[22].

HOW DO TELEMATICS WORK?

Telematics systems combine GPS location data with vehicle data to collect and analyze location-based data about vehicle performance and driver actions. The data is then interpreted and analyzed by a third-party software system and finally displayed through fleet management dashboard software[23]. Managers use the dashboard to see and understand patterns in driving behavior and coach drivers to drive safely. Increasingly, advances in AI technologies have further enhanced telematics systems, speeding up processes and allowing them to provide a wider array of alerts with increasing accuracy.

Most vehicles currently on US roads today have internal sensors installed at the time of manufacture (OEM-installed) which track vehicle telemetry (e.g. speed, acceleration, and positioning). Telematics systems take this data further, using a third-party device and software system to collect and analyze that information, communicating it back to fleet operators and drivers.

Safety Metrics and Telematics Technologies



The range of technologies - from GPS to cameras to AI - allow telematics technologies to measure different things. Matching desired metrics to technology capabilities can help operators decide what tools are needed.

STANDARD & ENHANCED TELEMATICS SYSTEMS

While the technology is constantly evolving, in broad terms, telematics systems can be divided into two categories:

STANDARD TELEMATICS

Definition:

Standard Telematics collect telemetry data from sensors and diagnostics systems installed in the vehicle at the time of manufacture that provide information about what a vehicle is doing at any given location or time.

What it Does:

Standard telematics systems typically focus on information about what the vehicle is doing, including telemetry information like speed, brake activation, and G-forces applied, as well as performance and maintenance metrics like engine temperature and fuel usage.

In more recent vehicles (post-2014), standard telematics systems can provide real-time alerts to drivers such as blindspot alerts, turn warnings, seatbelt use, and speeds above the posted limit. Camera and LIDAR functions are increasingly included at the time of manufacture in passenger vehicles, but there is typically a lag in these technologies for most commercial vehicles.

ENHANCED TELEMATICS

Definition:

Enhanced Telematics additionally integrate after-market technology such as cameras, LIDAR/sensors that can provide more information about why the driver is taking a particular action as well as more information about the vehicle's position in relation to other vehicles, objects, and people on the roadway.

What it Does:

Enhanced systems provide additional information about driver actions and the actions of other drivers on the roadway that can help operators understand why a driver has made a decision. This information can add key context to coaching, training, and insurance claims.

As with Standard Telematics, the data is collected, analyzed and packaged into formats that support training and coaching. Enhanced Telematics systems often include real-time and AI-based analytics to provide a wider array of real-time alerts to drivers, such as near-miss alerts or close following, etc.

STANDARD TELEMATICS

How it works:

- In Standard Telematics systems, data collected by internal sensors and diagnostics systems is linked to either an in-vehicle GPS tracking device or a gateway device, which is effectively a mini-computer or black box that is installed in the vehicle aftermarket via the onboard diagnostics (OBD-II) or CAN bus port.
- The collected data is then transmitted via the GPS tracking device or gateway device to a centralized data center where it is cleaned, analyzed, and displayed via the dashboard or scorecard.

ENHANCED TELEMATICS

How it works:

- In Enhanced Telematics systems, after-market technologies such as cameras, LIDAR and other sensors are added to the vehicle to collect further data, in addition to what is provided via OEM-installed devices.
- As in Standard systems, this data is then transmitted to a centralized data center where it is packaged for easy analysis and consumption by operators.
- Simultaneously, Enhanced Telematics systems typically include real-time and AI-based analytics to provide a wider array of real-time alerts to drivers, such as near-miss alerts or close following, etc.

DATA INPUTS

Standard and Enhanced Telematics Systems use and combine a variety of data inputs. These include LIDAR sensors, a range of in-vehicle diagnostic instruments, and internal and external cameras:

LIDAR AND EXTERNAL SENSORS:

LIDAR (Light Detection & Ranging) sensors provide information about the vehicle relative to other vehicles and objects on the road.

- **How it works:** LIDAR sensors bounce lasers off nearby objects and record the time it takes to bounce back to determine the distance from the vehicle to surrounding objects.
- **How it is used:** In Standard Telematics to measure things like lane departure, Pedestrian Automatic Emergency Braking (P-AEB), Automatic Emergency Braking (AEB), Forward/ Backward Collision Warnings (FCW), temperature and road conditions. In Enhanced Telematics, LIDAR is often used to measure close following and near-miss.
- **Considerations:** Proper placement and maintenance are essential to ensure reliable data collection and avoid false readings[24]. Integration with the broader telematics system should be evaluated to ensure compatibility and maximize benefits of external sensor data.

TSR's Truck of the Future project showcases a variety telematics and telematics-related technologies that can be used to improve safety performance. For more information, visit https://togetherforsaferroads.org/our-work/truck-of-the-future/

Image: Together for Safer Roads

IN-VEHICLE DIAGNOSTICS:

In-vehicle diagnostic systems are installed in the vehicle at the time of manufacture and can provide information about the vehicle at a particular moment in time and, increasingly, issue driver alerts as needed. While there are many in-vehicle diagnostic tools, the main ones used for safety metrics are:

- **Speedometer**
  - » **How it works:** Measures rotation of the vehicle's driveshaft, axle or wheel
  - » **How it is used:** Tracks vehicle speed
- **Accelerometer**
  - » **How it works:** Measures forward/backward g-force changes. Sudden acceleration would be measured by increasing backward g-force. Harsh braking would be measured by sudden increases in forward g-force. Experts note that accelerometer measurements are impacted by vehicle weight and need careful calibration. Accelerometer measurements may also be less accurate in cases where vehicle weight changes throughout the day (e.g. the waste truck that starts the day lighter and ends fuller and heavier or, conversely, the delivery truck that starts the day heavier and ends the day lighter and empty.)
  - » **How it is used:** Tracks harsh braking, sudden acceleration

- **Odometer**
  - » **How it works:** Uses a computer chip and sensors to track vehicle miles travelled, storing data in the engine control module.
  - » **How it is used:** Tracks miles traveled
- **Gyroscope**
  - » **How it works:** Measure lateral g-force changes
  - » **How it is used:** Lane changes, harsh cornering
- **Other indicators**
  - » In-vehicle diagnostics also cover a wide variety of other metrics, such as engine health and fuel efficiency, headlight activation, seatbelt use, and windshield wiper use, that may impact safety.
- **Considerations:** Regular calibration and maintenance are essential to ensure accuracy and prevent false alerts[25]. Integration with external sensors and AI-driven analytics can enhance their effectiveness for fleet management.

CASE STUDY: PUTTING IT ALL TOGETHER IN DENVER

The City and County of Denver has introduced Samsara's Connected Operations Cloud into their fleets, **allowing the transportation department's fleet division to see consolidated data and continuous high-definition interior-facing dash cam video footage of driver behaviors**, which has contributed to their 99% decrease in harsh driving, 98% drop in distracted driving, and a 94% reduction in safety incidents across its fleet[26]. This recent adoption supports Denver's proactive fleet management, so the department can get ahead of crashes and maintenance, helping Denver achieve its sustainability goal of a 65% reduction in emissions by 2030[27].

CAMERAS:

In telematics systems, cameras capture a continuous video feed that can provide additional context to the other telematics data. This footage can support driver training and can help operators and insurance companies better evaluate insurance claims[28]. Advances in AI-technologies also allow camera footage to be analyzed in real-time, feeding alerts to drivers. Telematics systems can integrate with externally-focused and driver-focused cameras.

- **Externally-facing cameras** (also known as dash cams) provide continuous video footage of things happening outside of the vehicle. External cameras can provide some real time alerts, thanks to advances in AI technologies and provide additional context on harsh braking or abrupt lane departures, which can be used for insurance claims.
- **Driver-facing cameras** provide video footage of the driver's actions. Driver-facing cameras can be used to monitor a variety of behaviors such as phone and seatbelt use or the presence of unauthorized passengers and provide proxy indicators for other driver activities such as distraction (typically measured by eye movements or head position). Introducing driver-facing cameras, especially into unionized workforces, requires additional discussion and buy-in with employees although industry studies suggest that individual drivers recognize the value of driver-facing video for training purposes. A recent Samsara report found that 93% of drivers agree that seeing dash cam footage of themselves has increased their awareness of habits that lead to being distracted while driving and after seeing their dash cam footage, 60% of drivers changed their driving habits[29].
- **Considerations:** Proper positioning and regular lens cleaning are crucial for clear footage. AI-powered features, such as object detection, can enhance their effectiveness. Implementing front-facing cameras requires discussions with employees, as they must be informed about recording policies.

Cameras and other diagnostic tools help drivers drive safely in the Volterra refuse truck.

Image: Stantec

AI ENHANCEMENTS AND PREDICTIVE TECHNOLOGIES

AI camera technologies further augment regular camera technology by providing additional real-time alerts for risky driver behaviors. These include unsafe following distances, near-misses, phone use, fatigue, and seatbelt use[30]. While regular cameras provide information that can be reviewed to provide invaluable insights into what happened, AI-enhanced cameras can provide that information as alerts to drivers to help them avoid a crash. This technology augments alerts that can be issued via LIDAR sensors.

As with regular cameras, AI enhanced cameras provide a visual record that can be reviewed after the fact for training or insurance claims purposes. For example, Dohrn Transfer Systems used Samsara's AI-based cameras to quickly analyze data after a harsh driving event, including harsh braking, accelerating, or turning, and provide drivers with feedback within 24 hours. Using this system, Dohrn achieved an 88% decrease in harsh driving events in one year[31].

CASE STUDY: AI SOFTWARE FOR PREDICTIVE ALERTS

AI software can also provide opportunities for predictive alerts, for example for fatigue or distraction. Using driver-facing AI-enhanced cameras, AB InBev utilizes Argus Solutions to leverage artificial intelligence for predictive machine learning to track driver behaviors in order to predict when drivers may experience fatigue[32]. Driver-facing cameras monitor driver behaviors such as body position, blink speed and eye movement, and reaction times, and provide real-time alerts such as seat vibrations and buzzers. At the same time, predictive machine learning tools overlay driver actions with analyses of a buzz or beel, actual driving time and downtime. Combining these two types of data helps drivers and managers predict when drivers will be fatigued, allowing them to issue alerts or modify schedules to help avoid dangerous situations.

The integration of AI with telematics has also helped companies improve sustainability efforts by tracking fuel usage and recommending adjustments to reduce waste. Beyond individual vehicle monitoring, AI enables automation in fleet-wide operations, optimizing routes based on traffic conditions, weather patterns, and fuel consumption to maximize efficiency[33]. One of AI's key advantages is predictive maintenance, which identifies patterns in vehicle diagnostics to anticipate mechanical issues before they escalate, reducing downtime and repair costs[34]. As telematics adoption grows, AI can continue to support enhanced data security, real-time edge computing for faster processing, and greater integration with electric vehicle (EV) fleet management[35].

USING TELEMATICS FOR FLEET SAFETY

USING TELEMATICS FOR FLEET SAFETY

Across all industry and vehicle types, excessive speeding, harsh braking, and harsh cornering are most correlated with crashes. Furthermore, these metrics are typically easily understood by drivers and supervisors, which can support coaching and training efforts. All three metrics are based in telemetry and can be captured using Standard Telematics. Enhanced Telematics may be required for some real-time alerts, or for additional video footage that can help contextualize incidents for training or insurance claims purposes.

In addition to these metrics, other outward-facing metrics, such as near-miss, and close-following, as well as driver-facing metrics like seatbelt use and distraction, are commonly used to assess driver performance. For example, in near-miss alerts, sensor and camera systems allow operators to track instances of close following to the front, side, and rear and provide real-time driver alerts when the vehicle is too close to an object or person. Many operators say that tracking and analyzing instances of near-misses is particularly valuable as a tool to inform driver coaching[37]. In addition to these metrics, some operators also include driver-facing metrics, such as phone use, presence of unauthorized passengers, and eye motion that focus on driver distraction, or metrics like seatbelt use that focus on driver safety in the event of a crash. These metrics can provide valuable information about driver safety and safe decision making, but are less correlated with safety for people outside the vehicle[38].

To monitor and improve safety performance, fleet operators should focus on three key safety metrics that are most strongly correlated with crashes, injuries, and costs[36]. By focusing on these three safety metrics, operators can reduce crashes and costs.

- Excessive speeding
- Harsh braking/ sudden stops
- Harsh Cornering

TOP 3 SAFETY METRICS

SPEED

Speeding is one of the leading factors in US traffic crashes, injuries, and fatalities, including for large trucks and fleet vehicles[39, 40]. In 2023, NHTSA found that speed was a contributing factor in 29% of all traffic fatalities[41]. A 2007 FMCSA Large Truck Crash Causation Study that looked at over 1,100 large truck crashes found that speeding (defined as driving too fast for conditions) was an associated factor in 23% of all large truck crashes.[42]

Recognizing the realities of "going the speed of traffic" and the occasional need to speed up quickly for some passing maneuvers, most fleet managers program their telematics systems to recognize a difference between General Speeding and Excessive Speeding. General Speeding reports are sent to supervisors or line managers to be used as part of coaching and training conversations, while Excessive Speeding reports become real-time in-cab alerts for drivers, as well as getting sent to supervisors or line managers.

- **Excessive Speeding** - typically defined as driving 25 mph over the posted speed limit or driving over 80 mph for any amount of time[43].
- **General Speeding** - typically defined as driving over the posted speed limit for more than a limited amount of time[44].
    - Speed above the posted limit is typically defined as 6-11 mph over the posted limit.
    - Time above the posted limit varies widely, but is commonly defined as greater than 60 seconds.

HARSH BRAKING

Harsh braking is a particularly strong indicator of the likelihood of a crash. A 2018 study focusing on emergency services vehicles found that harsh braking was one of the strongest risk indicators for a crash[45]. A 2015 report from Progressive, analyzing 12 billion miles of driving data, found that harsh braking, an indicator of tailgating, is the most likely predictor of future crashes[46].

Harsh braking is a measurement of how suddenly a vehicle stops and is indicative of dangerous driving maneuvers like close following and tailgating, and to a lesser degree inattention, and distraction. Harsh braking is calculated based on lateral G-force recorded by an accelerometer. For example, very hard braking can be defined as the change from a starting speed of 40 mph to an ending speed of 0 mph within 3 seconds, creating a G-force of 0.51[47]. Adversely, quick acceleration can be defined as going from a starting speed of 0 mpg to an ending speed of 60 mph within 6 seconds, producing a G-force of -0.38[48].

Harsh braking is measured using an accelerometer which looks at forward/backward G-force. However, for fleets, especially those with large trucks, harsh braking can be a useful, but complicated, metric because stopping distance increases with vehicle weight. Some experts mention that extreme changes in vehicle weight throughout the day could impact the accuracy of the alert. This would impact some delivery trucks who typically start the day with a full load and then decrease weight over the course of their deliveries, and trash haulers who typically start empty and end their day fuller and heavier.

In addition, when using the harsh braking metric, many fleet operators have found that externally facing camera footage can provide valuable contextual information because the video footage can also show if a harsh braking incident is due to driver error (following to close), a sudden lane change, or action by another driver.

HARSH CORNERING

Harsh cornering puts vehicles at risk of tilting and overturning, or the driver losing control of the vehicle. A 2018 study focusing on emergency services vehicles found that harsh cornering was associated with increased likelihood of a crash[49].

The harsh cornering metric provides information on how drivers encounter turns on their routes, and if drivers are driving at a safe speed while turning. It is calculated based on lateral G-force recorded by an accelerometer when a driver takes a turn or curve, and is measured by the radius of the corner and the driver's speed[50]. If drivers obey posted speed limits while taking sharp turns, G-force should not exceed the set threshold, which is set by a telematics device. A very lenient threshold would be 0.47 Gs[51], but a vehicle following the speed limits of sharp turns should not exceed 0.28 Gs on those curves[52].

As with harsh braking, the harsh cornering metric, which is based on lateral g-forces, can be a complicated metric for fleets where the weight of the vehicle changes throughout the day. Some experts mention that extreme changes in vehicle weight throughout the day could impact the accuracy of the alert.

OTHER METRICS

Depending on the industry and use-case, additional metrics such as rear near-miss, can also provide valuable information. OSHA defines a near-miss as a potential hazard or incident in which no property was damaged, and no personal injury was sustained, but where, given a slight shift in time or position, damage or injury easily could have occurred[53]. For example, rear and side near-miss metrics are typically emphasized in fleets with a large number of large trucks and vehicles with large blind spots, or in industries that backing up is a typical driving maneuver (e.g. waste collection and delivery).

Other metrics include:

- **Seat Belt Usage:** Identifies if a seatbelt is in use
- **Close Following:** Records distance to the vehicle ahead in relationship to actual vehicle speed
- **Lane Departure:** Records vehicle position vs lane markers
- **Unsafe Lane Change:** Records object in vehicle path while turn action is in progress
- **Idling:** Engine is running, but speed remains at 0 mph and GPS location does not change
- **Distraction:** Records driver behavior and distraction, such as phone use
- **Fatigue:** Records driver's eye motion, head position, and reaction times, and rest times compared to active driving time
- **Rear Near-Miss:** Records object within certain distance of vehicle reversing
- **Side Near-Miss:** Records object within certain distance to the side of vehicle
- **Stop Sign Violation:** Records when driver fails to stop at a stop sign
- **Route Adherence:** Monitors route adherence to avoid deviations and wasteful fuel consumption

CASE STUDY: ELEVATING SAFETY THROUGH TELEMATICS INTEGRATION – REPUBLIC SERVICES

Republic Services has integrated Samsara's vehicle telematics and computer vision (AI-based cameras) to create a safer, more efficient work environment across its extensive waste management fleet. The integrated telematics and camera system measures key safety metrics including speed, close following, and seatbelt usage. Through the use of real-time alerts, the Samsara system allows drivers to self-correct before supervisor intervention. Cameras are strategically calibrated to minimize inaccuracies, ensuring alerts are reliable and actionable. Safety improvements are further driven by features like fatigue monitoring and reverse maneuver tracking, addressing common risks such as backing incidents.

Republic also tracks maintenance metrics like engine hours and vehicle reversals, allowing fleet managers to anticipate issues before they occur. Republic has built a comprehensive safety ecosystem that protects drivers, reduces incidents, and enhances fleet-wide performance.

Republic Services uses a variety of measures to improve safety. These include telematics, AI technologies, and high-vision truck
Image: Republic Services

ALL SAFETY METRICS

The table below lists safety metrics tracked by telematics hardware, including the capture device, telematics level, and whether each metric aligns with industry standards or best practices. It also notes tracking context and real-time alert availability.

METRIC	DESCRIPTION	CAPTURE DEVICE	TELEMATICS TYPE	INDUSTRY STANDARD	RECOMMENDED BEST PRACTICE	ALERTS AND BEST PRACTICE	REAL TIME ALERTS RECOMMENDED	CONTEXTS & INDUSTRIES
SPEEDING	Defined as driving over the posted speed limit for more than a limited amount of time. Typically defined as 6-11 mph over the posted speed limit for greater than 60 seconds.	Speedometer	Standard	✓		Monitor and log to inform driver coaching	No	May be less applicable in deeply congested areas; speeding thresholds can be set in the vehicle settings by operators.
EXCESSIVE SPEEDING	Driving 25 mph over the posted speed limit for 60 seconds or driving over 80 mph at anytime.	Speedometer	Standard	✓		Immediate alert to driver and supervisor; monitor and log to inform driver coaching	Yes	May be less applicable in deeply congested areas; speeding thresholds can be set in the vehicle settings by operators.
HARSH ACCELERATION OR BRAKING	Sudden braking or acceleration and change in velocity of a vehicle moving at a steady rate	Accelerometer	Standard	✓		Record events and analyze cause of breaking patterns (distraction, close following distance) to inform driver coaching	No	May require re-calibration for delivery or waste hauling vehicles where vehicle weight can change significantly over the course of the day
HARSH CORNERING	Sudden change in velocity of a vehicle moving at a steady rate	Gyroscope	Standard	✓		Record events and analyze cause of breaking patterns (distraction, speeding) to inform driver coaching	No	May require re-calibration for delivery or waste hauling vehicles where vehicle weight can change significantly over the course of the day
SEAT BELT USAGE	Identifies if a seatbelt is in use	Other in-vehicle sensor and/or inward facing camera	Both	✓		Real-time alerts if seat belt is not being used, if using cameras, may require additional driver consent	Yes	
CLOSE FOLLOWING	Records distance to the vehicle ahead in relationship to actual vehicle speed	Front-facing camera and/or LIDAR	Enhanced		✓	Analyze proximity data and alerts to inform defensive driving coaching and discourage aggressive driving; requires AI for real-time alerts	Yes	
LANE DEPARTURE	Records vehicle position vs lane markers	Front-facing camera & side-facing cameras	Enhanced		✓	Notify drivers of a lane departure and encourages rest breaks; requires AI for real-time alerts	Yes	

METRIC	DESCRIPTION	CAPTURE DEVICE	TELEMATICS TYPE	INDUSTRY STANDARD	RECOMMENDED BEST PRACTICE	ALERTS AND BEST PRACTICE	REAL TIME ALERTS RECOMMENDED	CONTEXTS & INDUSTRIES
UNSAFE LANE CHANGE	Records object in vehicle path while turn action is in progress	Front-facing camera & side-facing cameras	Enhanced		✓	Record events and analyze surrounding events to inform driver coaching; requires AI for real-time alerts	Yes	
IDLING	Engine is running, but speed remains at 0 mph and GPS location does not change	Other in-vehicle sensor	Standard	✓		Monitor and log to inform coaching to decrease wasted fuel consumption and increase driver efficiency	No	
DISTRACTION	Records driver behavior and distraction, such as phone use	Inward facing camera	Enhanced		✓	Requires AI for real-time alerts to notify driver of distraction; record and analyze frequency to inform driver coaching; may require additional driver consent	Yes	
FATIGUE	Records driver's eye motion, head position, and reaction times, and rest times compared to active driving time	Inward facing camera	Enhanced		✓	Requires AI for real-time alerts to notify driver of fatigue; record and analyze frequency to inform driver coaching; may require additional driver consent	Yes	
REAR NEAR-MISS	Records object within certain distance of vehicle reversing	Rear-facing cameras and/or sensors	Enhanced		✓	Record events and analyze event to inform driver coaching; requires AI for real-time alerts	Yes	May be most applicable in industries with large trucks and frequent backup maneuvers
SIDE NEAR-MISS	Records object within certain distance to the side of vehicle	Side-facing cameras and/or sensors	Enhanced		✓	Record events and analyze event to inform driver coaching; requires AI for real-time alerts	Yes	May be most applicable in industries with large trucks and frequent backup maneuvers
STOP SIGN VIOLATION	Records when driver fails to stop at a stop sign	Front-facing camera	Enhanced		✓	Record frequency and surrounding events to inform driver coaching; requires AI for real-time alerts	No	
ROUTE ADHERENCE	Monitors route adherence to avoid deviations and wasteful fuel consumption	GPS	Standard	✓		Record route adherence and identify deviations	No	

“SOMETHING IN MY CAB IS BEEPING!” – AVOIDING ALERT OVERLOAD FOR DRIVERS

Drivers and fleet safety experts agree that an excess of in-cab alerts can lead to alert fatigue, overwhelming drivers with constant alerts and notifications. This overload can lead to physical fatigue, but also decision fatigue when drivers need to quickly decide which behaviors need immediate correction.

All vehicles have beeps and buzzes. There is always something going off. However, real-time coaching is effective when implemented correctly. Drivers need to clearly understand which behaviors are most critical to address in the moment to prevent dangerous situations. Real-time alerts should prioritize situations where action can be taken, including excessive speeding or unsafe lane departure, which also may be signs of driver fatigue. When alerts are targeted to a small amount of behaviors, drivers can immediately respond and take corrective actions.

Patterns of general speeding or close following are behaviors that may be better corrected through ongoing driver training. These types of behaviours typically do not require immediate intervention but still should be captured and discussed with the driver to support long term safety improvements.

Image: Orion Fleet Intelligence

NEXT STEPS IN FLEET SAFETY TELEMATICS

NEXT STEPS IN FLEET SAFETY TELEMATICS

From a simple speedometer to telemetry to AI-enhanced cameras and predictive machine learning technologies, telematics systems continue to evolve, offering new information and data to parse, consider, and use. This astounding pace of telematics technology growth is providing fleet operators with new and powerful ways to better understand and improve the safety of their fleets. In the face of a potentially overwhelming array of information, keeping track of the core safety metrics, and matching the opportunities that arise from advanced analytics with direct face-to-face driver coaching and training, will be essential for continued safety enhancements.

At the same time, fleet vehicles themselves are also evolving. Especially in urban areas, operators now routinely deploy fleets of smaller and two-wheeled vehicles such as e-bikes, e-quads, and motorcycles for freight and delivery. Developing telematics tools and systems for these in-demand fleet vehicles is an important new avenue for exploration. Simultaneously, autonomous technologies - from drones to bots - will require even more sophistication from the LIDAR, camera, and AI technologies that underpin current telematics systems.

As fleet operators launch, or enhance, their telematics programs, we hope this report will serve as a resource for fleets of all sizes operating in a diversity of environments, outlining key safety metrics and providing an overview of telematics technologies and data inputs that can help them stay focused in a rapidly changing technological landscape.

- **For more information on driver training programs and best practices**, visit TSR's Focus on Technology Report and FOCUS program website or contact TSR directly for more information.
- **If you are an operator interested in introducing telematics to your organization**, or enhancing your existing program, please reach out directly to TSR so we can facilitate introductions to telematics providers and provide further information to you.

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