

Measuring and Managing Driving Behaviors Leads to Bottom Line Improvement

Introduction

Hard driving is a high risk, high cost behavior not easily tracked or managed. Hard acceleration or braking is a driving event when more force than normal is applied to the vehicle's brake or accelerator. Often referred to as 'lead foot' syndrome, and it can be an indicator of aggressive or unsafe driving. At the very least, this style of driving is wasteful and uneconomic.

Consider, hard driving is reported to reduce the lifespan of tires and brakes by 30-50%. Calculations show that harsh driving behaviors can cost a company more than \$3,600 in unnecessary tire and brake costs per 100k miles driven compared to a more controlled approach. In a recent study, RoadAware Safety Systems found that 1/3rd of the drivers had harsh driving behaviors compared to another third that demonstrated a controlled or 'light footed' driving behavior. That's \$3,600 for every third driver in a fleet and nearly \$120,000 for a fleet of 100 units! In addition, harsh driving behavior places strain on other critical vehicle parts such as suspension systems, transmission, and engine components causing them to wear out sooner than planned. This means fleet managers need to allocate more time and resources for frequent servicing, part replacements, and repairs, which lead to unplanned vehicle downtime and increased maintenance costs as well.

The Insurance Institute for Highway Safety (IIHS) produces research focused on highway safety, including the risks associated with large trucks and aggressive driving. Fatal large truck accidents can be linked to various factors, one of which is aggressive or "hard" driving, which includes behaviors like speeding, tailgating, and sudden lane changes. These behaviors increase the risk of serious accidents, particularly when operating large, heavy vehicles like trucks.

What else can be measured to improve drivers' performance and reduce costs? The **Road-Aware** large truck safety system is an in-cab safety application which dynamically calculates and displays safe speeds. It is the only application that provides location specific alerts and calculates safe speed based on the truck configuration, load, weight, engine braking HP, radius of curve and degree of slope. **Road-Aware** records detailed speed profiles (1 record per second) for the entire journey.

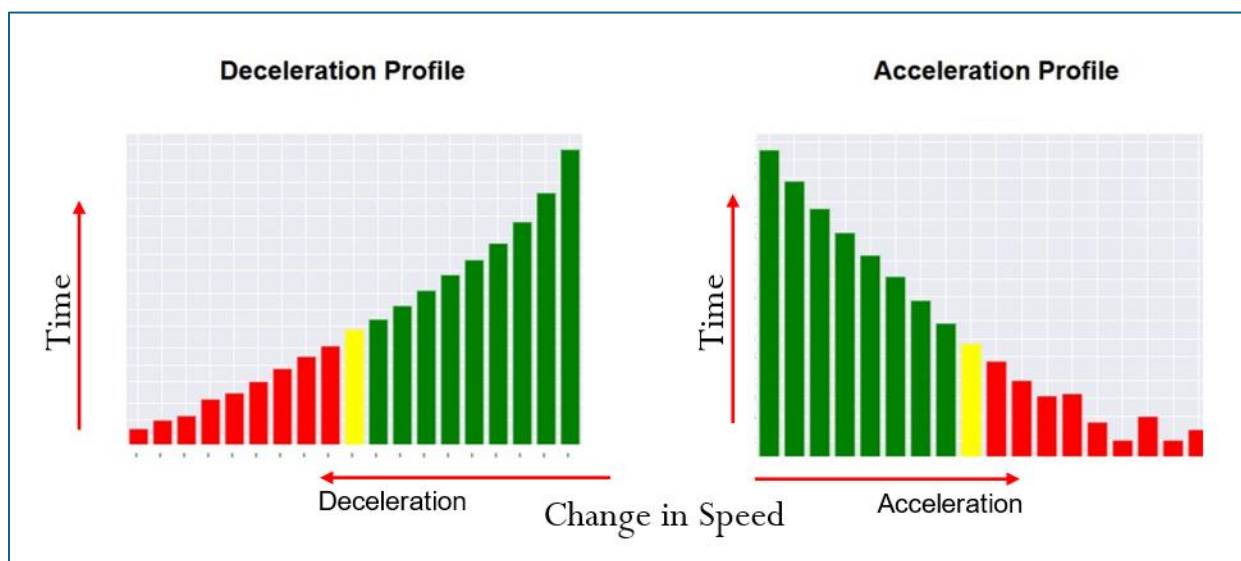
Moving beyond simple event monitoring, RoadAware Safety Systems, as part of its **Road-Aware** safety application, developed a proprietary approach to not only reporting hard driving events but also documenting the intensity and duration of these events as they relate to drivers and fleets of drivers. Such data provides focus for training needs, leading to behavioral change in



“at-risk” drivers. The outcome is a safer operating fleet, potential lives saved, direct cost savings and a positive ROI for the company.

How long drivers spend in hard (yellow) and in harsh (red) zones is important! The charts following show combined Deceleration /Acceleration profiles for 24 drivers. By analyzing the profiles for time spent in hard and harsh zones over multiple hours, driving multiple road types and geometries, fleet managers can assess driver behavior across an entire fleet. For this group of drivers, the summary profile shows they recorded nearly 9 minutes under hard braking conditions plus another 1.6 minutes under harsh braking! The group also spent 3.2minutes in hard acceleration, with an additional 17 seconds in harsh acceleration!

Composite Driving Profile of 24 Company Drivers



Truck driving requires extensive training, certifications, and skills. Drivers must master vehicle control, logistics, and safety protocols. Obtaining a Commercial Driver’s License (CDL) involves rigorous testing and training, making it a highly skilled profession.

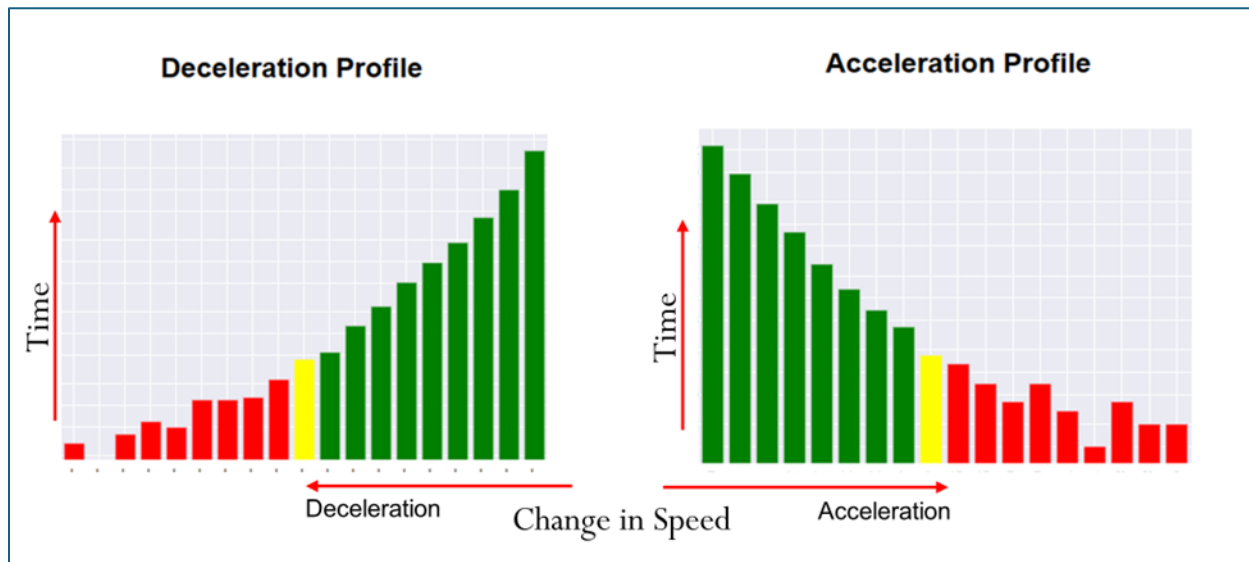
Measuring a “professional” driver’s skills has always been a challenge. The Federal Motor Carrier Safety Administration’s (FMCSA), CSA (Compliance, Safety, Accountability) program is a way to hold carriers and drivers accountable for compliance and safety on the roads. Think of a CSA scorecard as a safety report card indicating a carrier's collective driver safety performance over time. It's a rating metric used to indicate how much risk a fleet may pose, based on their individual driver's performance. However, CSA driver performance is only based on “event” reporting such as a speeding ticket, a crash event, a failed drug test, a failed inspection etc.

If you measure it, you can manage it.

Hard/Harsh driving can be broadly described as any sudden change in direction or velocity of a truck moving at a steady rate. It is often characterized by abrupt changes in g-forces, which can be monitored using the rate of change in speed (often expressed in miles per hour per second, mph/s) or with accelerometers. Rapid increases in speed, sudden braking and cornering at a high speed are all examples of hard driving and indicate unsafe or aggressive driving habits. Both hard braking and hard acceleration can impact safety, fuel efficiency, vehicle maintenance and costs.

RoadAware defined **Hard Braking** as a decrease in speed below what the best drivers were using and **Harsh Braking** using the industry standard of below -7.0 mph/s. RoadAware defines **Hard Acceleration** as a positive change in speed above what the best drivers were doing and **Harsh Acceleration** as above +7.0 mph/s.

Hard Driving Profile of a Single Driver

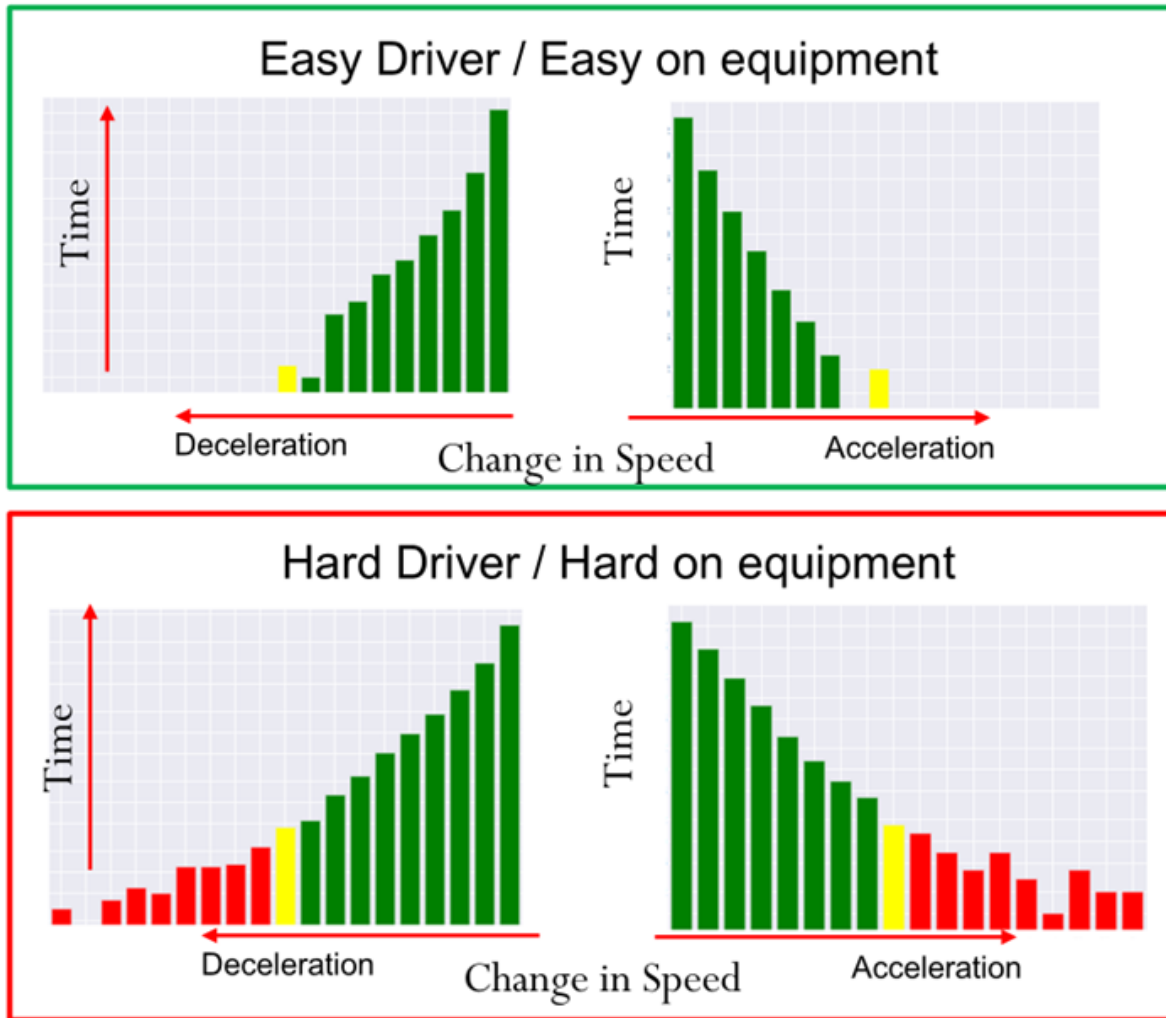


Reviewing driver braking and acceleration profiles will flag unsafe driver behaviors, allow better coaching of drivers and help facilitate and enforce programs around safe driving standards all while reducing maintenance costs. The less time a driver is in the hard and harsh zones the less risky that driver is and, the less strain they are putting on the equipment. In the driver profile above, the driver spends 60 seconds, a full minute, in the hard braking zone and another 18 seconds in the harsh braking zone. They spend almost equal time in hard and harsh acceleration.

Comparing driver profiles provides an opportunity to sort driver behavior within a fleet so that drivers that need more coaching and direction can receive the attention needed. In the profiles below, in addition to the high number of 'events' in the profile on the left, the driver is also

braking and accelerating in the hard and harsh zones. Compare this with the driver on the right's minimal hard braking and no hard acceleration. We find that drivers with a hard braking profile also have a similar hard acceleration profile.

Hard Driving Profiles Showing Good Driver at top vs Risky Driver on bottom



Impact of Hard Braking

Hard braking can cause significant wear and tear on a semi-truck's components. It can strain brake components, cause tire wear, and affect overall vehicle stability. When talking about drivers of big rig trucks, hard braking becomes particularly precarious, considering that a loaded 18-wheeler can weigh up to 80,000 lbs. and can't stop on a dime.

There is published evidence supporting the statement that "tires wear out more quickly with harsh driving compared to regular driving." Research has shown that aggressive driving behaviors—such as hard braking, rapid acceleration, and cornering at high speeds—significantly

accelerate tire wear. This is primarily due to the increased friction and heat generated during these maneuvers, which causes the tire material to degrade more rapidly.

https://link.springer.com/chapter/10.1007/12_2022_118

A study in the journal *Wear* highlighted that aggressive driving significantly increases tire abrasion, thereby reducing tire lifespan. The study explains that hard driving, characterized by rapid acceleration, sharp cornering, and sudden braking, places additional mechanical stresses on the tires, leading to faster tread wear and overall degradation.

<https://shop.elsevier.com/journals/wear/0043-1648>

Additionally, research published in *Rubber Chemistry and Technology* noted that the increased mechanical stresses and higher temperatures associated with hard driving contribute to accelerated wear. These conditions cause the rubber compound of the tire to break down more quickly, which can lead to a shorter overall tire lifespan.

There are some natural instances where hard braking cannot really be avoided, such as stopping short to prevent an accident or getting out of the way of an accident that has just occurred. However, unnecessary hard braking typically occurs when a driver needs to stop short because they were not paying attention to the flow of traffic. This is a big sign of aggressive driving; if drivers are doing it, it is dangerous and a money drain.

[Why You Should Monitor Hard Braking and Acceleration for Your Fleet \(rastrac.com\)](https://info.rastrac.com/blog/monitor-hard-braking-and-acceleration)

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Cost Estimation of Hard Driving on Tires

A general overview of the costs associated with truck maintenance and tire replacement, emphasizing the cost difference caused by hard driving, are provided by The Truckers Report <https://www.thetruckersreport.com/> The typical lifespan of semi-truck tires can range from 70,000 to 150,000 miles under normal conditions, but hard driving can reduce this lifespan by 30-50%, depending on the severity and frequency of such behaviors. This means that instead of lasting an average 100,000 miles, tires may need replacement after just 50,000-70,000 miles.

<https://appletruckandtrailer.com/how-many-miles-do-semi-truck-tires-last>

New semi-truck tires can range from \$400 to \$1,000 each, with a full set for an 18-wheeler costing upwards of \$10,000 or more. Additionally, using premium tires or opting for frequent replacements due to increased wear can further drive up costs. Retreaded tires are a more economical option, ranging from \$200 to \$300 per tire, but they still require proper maintenance to be cost-effective. <https://thetruckhow.com/how-much-does-semi-truck-tires-cost/>

A study of fleet operating costs was published by the American Transportation Research Institute (ATRI) in 2023. An extensive survey of operating costs across the United States found



that average tire wear costs are \$0.046 per mile. Thus, for a semi-truck that runs a hundred thousand miles per year, the average tire wear cost is \$4,600.

Given other sources that cite harsh driving can double tire wear, the best drivers in a fleet are likely experiencing a cost of \$3,000 per year for tires while the harsh drivers cause increased tire wear resulting in a cost of \$6,000 per year. In the driver behavior data summarized in the first graphs, it was found that about 1/3rd of the drivers had harsh driving behavior compared to another third that had gentle or 'light footed' driving behavior. The other third fell in between harsh and gentle.

This information translates into a significant cost saving opportunity. For a fleet with a hundred semi-trucks, running a hundred thousand miles each on average, the cost saving opportunity is about \$120,000 per year if harsh drivers are measured and coached to better driving behavior.

	National Average	Light Foot Driver	Lead Foot Driver	Cost of Hard
Tires	\$ 4,600	\$ 3,000	\$ 6,000	\$ 3,000
Brake System	\$ 980	\$ 670	\$ 1,330	\$ 660
Cost/100k Miles	\$ 5,580	\$ 3,670	\$ 7,330	\$ 3,660

In summary, the cost of tire wear on a semi-truck due to hard driving can be significant, potentially doubling the annual tire replacement expenses compared to regular driving. The exact cost will vary based on specific circumstances and the quality of the tires used.

Factors Influencing Brake System Wear and Cost

In similar fashion, the frequency of brake replacement due to hard braking can vary depending on several factors, including driving habits, road conditions, and the type of braking system. Some general guidelines include:

- **Commercial Vehicle Research:** According to a study by the Commercial Vehicle Safety Alliance (CVSA), brake pads in commercial trucks generally last between 30,000 to 60,000 miles under normal conditions. Fleet Owner Magazine notes that brake shoes and drums should be inspected regularly, with replacements often required every 30,000 to 50,000 miles under aggressive driving conditions.
- **Maintenance Manuals:** Many truck manufacturers suggest a range of 25,000 to 50,000 miles for brake pad replacement depending on driving habits and conditions.

Hard Braking Impact: With aggressive driving and frequent hard braking, brake shoe linings and brake pads can wear out much faster, often needing replacement every 15,000 to 25,000 miles.



Unfortunately, the study sponsored by ATRI did not separate brake wear costs as a line item. Rather brake wear was included in the overall maintenance costs with a note that brake wear represented about 5% of total maintenance costs. Total maintenance costs were reported as \$0.196 per mile or \$19,600 for a semi-truck that runs 100,000 miles. Using the 5% value reported in the study, brake wear results in a cost of \$980 per year. Once again, these are national averages so costs for fleets operating in mountainous areas are likely higher. The average fleet includes drivers that use light footed driving behavior which reduce brake wear costs to \$670 per year in contrast to drivers with harsh behavior which would cost \$1,330 per year.

What About Hard Acceleration?

Harsh or hard acceleration occurs when a driver uses more power than necessary to pull off from a dead stop. Hard acceleration leads to increased tire wear, a variety of maintenance issues, and sometimes costly insurance claims. Harsh acceleration is a common result of drivers not paying attention to the pace of traffic and needing to speed away from a stop line. This is both a road safety issue and a fuel efficiency problem. Hard acceleration wastes fuel as the throttle is opened more than necessary. Also, speeding through intersections increases the risk of car collisions when vehicles run red lights.

It should be obvious when thinking of driving habits that affect tires, aggressive acceleration and sudden braking put a lot of excessive stress on the tires. When accelerating rapidly, the force exerted on the tires can cause them to lose traction and result in tire spin, leading to accelerated wear. Slow and smooth acceleration from a complete stop is always the best practice.

What about the Trailer?

In addition, hard braking or acceleration in a semi-truck can cause several issues related to the trailer including:

- **Uneven Load Stress:** If the trailer is unevenly loaded, it can lead to improper weight distribution. This affects braking performance and may make it more difficult to stop effectively.
- **Tire Wear:** Abrupt stops put strain on the trailer tires. Excessive wear or flat spots can occur, impacting tire lifespan and safety.
- **Suspension Strain:** The sudden deceleration transfers force to the trailer's suspension system. Components like shocks and bushings may wear out faster.
- **Frame and Chassis Impact:** The trailer frame and chassis endure additional stress during hard stops. Over time, this can weaken welds and structural integrity.
- **Cargo Shift:** Hard braking can cause cargo to shift within the trailer. Unsecured items may collide, potentially damaging both the cargo and the trailer.



Each of these issues cost the company money over time. Knowing which hard braking or acceleration profiles exist among drivers, allows management to make knowledgeable decisions on driver coaching or discipline.

How does hard braking or hard acceleration impact fleet safety?

Fleet managers should be thinking about safety and its impact on their business and staff. When drivers are out on public roads, there is a corporate responsibility to the public in general. If the drivers are practicing reckless behaviors or unsafe habits, they aren't just putting themselves, their vehicles, and inventory at risk. These drivers are also endangering other drivers, passengers, and pedestrians on and around the road.

Drivers who frequently brake hard as part of their driving routine are jeopardizing their own safety as well as others. Not only is an established profile of hard braking dangerous, increasing the likelihood of tickets and accidents, the fleet's reputation is put at risk for unsafe driving citations and investigations by the FMCSA. Too often, however, hard braking is the result of drivers not allowing enough space between vehicles to react in time if the vehicle ahead suddenly stops. Traveling speed is an important factor when determining total stopping distance: the faster the speed of the truck, the more stopping distance will be needed.

Hard braking and hard acceleration negatively impact both fleet safety and fuel consumption. That's why it's essential for fleet managers to monitor these driving behaviors as part of any comprehensive fleet driver safety and training program. Doing so can help companies save money and help mitigate accidents or injuries

Harsh braking and acceleration can increase the risk of accident or injury to fleet drivers and others sharing the road. Consistent hard braking may indicate the driver is following traffic too closely, increasing the chances of rear-end collisions and injury to those involved. It can also lead to dangerous situations, such as trucks 'jackknifing', resulting in potentially severe incidents.

Safety is an investment that should never be undervalued. It's not just part of a company's responsibility to its staff, but also part of its corporate responsibility to the public. Advancements in technology such as RoadAware's **Road-Aware** larger truck safety application, now make it economical and easy for fleet managers to detect unsafe driver behaviors like hard braking and acceleration, effectively coach drivers through analyzing driver profiles and by implementing safety programs around safe driving standards.

Summary & Conclusion:

Why is detecting and measuring hard driving important? Because all studies report that hard driving doubles the normal wear on tires and the brake system, which in turn, doubles the repair and maintenance cost for those systems. Based on the ATRI research this equates to \$3,600 (or more) in cost savings per 100,000 miles driven by turning a 'lead footed' driver into a



'light footed' one. Measuring the number and intensity of hard driving events allows the management of this costly driver behavior. Getting hard driving under control will save money and put safer drivers on the road.

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Sources for the Cost of Trucking

1. Truckers Report

Annual tire cost \$4,000

Annual Maintenance cost \$15,000

[The Real Cost of Trucking - Per Mile Operating Cost of a Commercial Truck \(thetruckersreport.com\)](http://www.thetruckersreport.com)

<https://www.thetruckersreport.com/infographics/cost-of-trucking/>

2. ATRI 2023 Cost Study

Tire cost per mile - \$0.045 or \$4,500 per year assuming 100,000 miles

Maintenance cost per mile - \$0.196 or \$19,600 per year assuming 100,000 miles

Brake System costs 5% of maintenance costs.

[ATRI-Operational-Cost-of-Trucking-06-2023.pdf \(cdn-website.com\)](https://irp.cdn-website.com/7bc682fd/files/uploaded/ATRI-Operational-Cost-of-Trucking-06-2023.pdf)

<https://irp.cdn-website.com/7bc682fd/files/uploaded/ATRI-Operational-Cost-of-Trucking-06-2023.pdf>

