THE FLEET SAFETY EQUATION

Part 1: Thinking Beyond a One-Step Solution to Safety

Bendix Commercial Vehicle Systems LLC
901 Cleveland Street • Elyria, Ohio 44035
1-800-247-2725
www.bendix.com • www.knowledge-dock.com
Recently, the National Transportation Safety Board (NTSB) published its 2017-2018 “Most Wanted List of Transportation Safety Improvements.” The list is useful for fleets, because it offers insight regarding the big issues NTSB has moved to the forefront, along with the board’s point of view on what approaches might help address these challenges. And it’s a credible list, because NTSB developed it from experience – the experience the agency gains through investigating thousands of crashes across all transportation modes, including aviation, marine, rail, and highway.

For the trucking industry, the 2017-2018 list cites:

- Increase implementation of collision avoidance technologies
- End alcohol and other drug impairment in transportation
- Reduce fatigue-related accidents
- Require medical fitness
- Eliminate distractions
- Strengthen occupant protection
- Expand recorder use to enhance safety

The list contains multiple items to help enhance safety, reinforcing the idea that there’s no one “golden solution” that will solve all the crash issues facing our transportation modes. It’s a combination of items that, together, make a difference. Just because you add electronic stability control to the trucks in your fleet doesn’t necessarily mean you’re going to fully eliminate rollovers and loss-of-control situations. If the driver falls asleep because of fatigue, or has a medical emergency that causes him or her to drive off an embankment, the technology may intervene but, in this case, may not eliminate the loss-of-control and rollover scenario. This concept of more than one approach – the “Most Wanted List” – reinforces the need to address a variety of factors in order to strengthen safety for the fleet and the owner-operator.

There has been great progress, but crashes involving heavy trucks are still an issue
Throughout 2016, media covered the positive news of a reduction – about 3 percent – in the number of fatal crashes involving heavy trucks from 2013 to 2014, as reported in the
Large Truck and Bus Crash Facts 2014* from the Federal Motor Carrier Safety Administration (FMCSA). But one also must note the negative statistics in the report as well:

- The large increase in overall crashes involving heavy trucks – 26 percent.
- Both property-damage-only (PDO) and injury crashes increased in the double digits, 28 percent and 19 percent, respectively.
- In 2014, 82,000 injury crashes occurred, compared to 69,000 in 2013 – or 13,000 more crashes.
- Injury crashes mean injuries, and 16,000 more people were hurt in 2014 than in 2013 – an increase of 17 percent.
- For PDO crashes, the increase is even more staggering: There were 28 percent more PDO crashes in 2014 than 2013 – an increase of 72,000 property-damage-only crashes. This, at a time when the number of miles traveled increased about 1.5 percent and the number of registered trucks increased about 3 percent.

*NOTE: At the time of publication, only the 2015 study preliminary figures were available. Bendix will update the applicable statistics pending distribution of the final 2015 Crash Facts data to ensure continued accuracy.

Interestingly, however, the average number of miles traveled per heavy truck actually went down – from an average of 25,951 miles traveled per registered truck in 2013 to 25,594 miles traveled per registered truck in 2014.

What does this mean? For every hour of every day in 2014, over nine injury crashes occurred and about 13 folks were injured in these crashes. And, for property-damage-only crashes, there were, on average, 37 crashes each hour. In total, 47 fatality, injury, and property-damage crashes occurred per hour in 2014. Too many crashes, too many injuries, and still, too many crash-related fatalities that may be preventable – with the right focus.

While the above represents the numbers of all large trucks – encompassing Class 3 through Class 8 – the numbers are still significant, especially when one considers that 78 percent of
the large trucks involved in crashes were Class 7 and 8 (26,001 lbs and heavier). In addition, the majority of trucks that were involved in fatal crashes – 77 percent – were Class 8 (33,001 lbs and over).

This is not to single out large trucks or lay the blame for crashes on the industry. After all, light vehicles (Class 1 and 2, 10,000 lbs or less) are the majority on the road – 22 times the number of large trucks. And these vehicles are involved in many more crashes than large trucks. Examining the facts, passenger vehicles were involved in almost eight times more fatal crashes, 19 times more injury crashes, and 13 times more PDO crashes than large trucks. And, of course, more people are injured or killed in passenger car crashes than in large truck crashes – 20 times more in injuries, seven times more in fatalities.

Also, the per-100-million-mile crash rates for light vehicles in PDO and injury crashes are much higher than for large trucks – 157.4 for cars vs. 116.6 for heavy trucks in PDO crashes, and 58.5 for cars vs. 29.4 for large trucks in injury crashes. Regrettably, however, the same can’t be said for the fatality rate. Large trucks have a higher fatality rate (1.23) vs. light vehicles (0.96) when it comes to fatality crash rates per 100 million miles.

But few car crashes are covered to the extent that large truck crashes are in the media. If you find your fleet on the 6:00 p.m. news, it’s most likely due to a crash. It’s almost sure to get you exposure – of course, not the positive kind.

And, while trucks and their drivers are frequently singled out for news, regulation, citations, and lawsuits, history shows that it’s often the other vehicle that instigates the crash. Easy access to distractions is increasingly a contributing factor. For most truck drivers, this is their livelihood – their goal is to drive safely and make it home for dinner each night.

But the numbers are the numbers and, as an industry, we can’t ignore them or their impact. We need to continue taking prudent steps to reduce crashes involving large trucks.
Safety is not one-dimensional

Across the industry, many claims are made about how fleets and owner-operators can best promote safety. The claims mostly serve to muddy the issue. For example, some groups tout the importance of driver training, while others pronounce the superiority of technology. Is crash worthiness or crash avoidance/mitigation more important? There are studies favoring one technology over another, while acknowledging that the findings may be impacted by factors beyond the study’s scope. Fleets report varying experiences when using the same technologies. Even with technology-equipped vehicles, insurance companies often review a fleet’s risk profile to determine rate charges, or if they will insure. And, of course, the FMCSA’s Compliance, Safety, Accountability (CSA) program is ever present – today a series of scores in “BASIC” categories, tomorrow a fleet safety rating. Finally, there is an abundance of articles, advertisements, and agendas that point out what is useful and what is not – often doing more to confuse than to clarify.

It’s not one quick fix, but a combination of elements that, when combined, may add up to a safer fleet. And a safer fleet can mean a positive ROI through fewer crashes, better driver retention, and other benefits.

Safety is multidimensional

From our perspective, a fleet’s true safety measure is a factor of what can be termed the Fleet Safety Equation (FSE). Whether you operate one vehicle or 100,000, this equation applies. The FSE is a multidimensional approach that captures aspects related to a fleet’s safety efforts. It also covers what should be considered when evaluating a fleet’s safety performance.

The framework provides a starting point for thinking about fleet safety in its entirety, enabling an open conversation to develop an optimal solution that fits the needs or operating profile of a particular fleet. It also provides an opportunity to quantify a number of variables not considered in other approaches. This leads to a potential total Fleet Safety Score, which may be a way for a fleet to consider its progress in improving safety.
**The Fleet Safety Equation**

*To achieve maximum fleet safety performance, a combination of factors/approaches must be considered, implemented, and optimized.*

The following statement forms the basis of the hypothesis for the concept of a Fleet Safety Equation:

Maximum fleet safety performance is driven by optimizing the combination of technology, drivers, culture, maintenance, monitoring, and regulatory adherence over a period of time less the cost of crashes, or

\[
S_{fleet} = \text{SUM} (w_T + w_D + w_C + w_{M1} + w_{M2} + w_R + w_A + w_{SI}) - w_{CoC}
\]

where:

- \(S_{fleet}\) = Safety of the fleet
  As determined by the sum of key variables and their impact (weighting)

- \(w_T\) = Technology
  Crash avoidance/mitigation and crash worthiness

- \(w_D\) = Drivers
  Selection, training, health, and support

- \(w_C\) = Culture of Safety
  Top down and bottom up

- \(w_{M1}\) = Maintenance
  Preventive, responsive, pre-, and post-trip

- \(w_{M2}\) = Monitoring
  Driver, vehicle

- \(w_R\) = Regulatory Adherence
  Does the fleet adhere to all rules or only some?

- \(w_A\) = Age of the Fleet
  Newer trucks typically mean newer technology and less maintenance

- \(w_{SI}\) = Cost of Safety Incentives
  A fleet may provide safe drivers additional incentives for safe performance – e.g., 1 million accident-free miles; winning the Bendix National Truck Driving Championships Grand Champion Award; being an ATA Road Captain, etc.

- \(w_{CoC}\) = Cost of Crashes
  What the fleet spends on crashes

\(w\) = Weighting

Some elements may do more to help safety in a particular fleet situation than others, and it may be beneficial to give these added weight in consideration. It might be possible in the future to actually weight the importance of each area in arriving at a total quantitative score for measurement, comparison, or as an additive to a fleet safety score based on CSA BASICs.
These variables should be addressed over a period of time, say a typical operating year for the fleet, which then enables the fleet to track performance over time.

Let’s discuss each factor in a little more detail.

**T = Technology**

When considering technology, there are two perspectives to keep in mind: crash avoidance/mitigation and crash worthiness. Crash avoidance covers those technologies designed to help mitigate accidents through warnings and active interventions. At Bendix, we refer to these as active and supportive safety systems, such as stability control, collision mitigation, trailer roll stability, Reduced Stopping Distance (RSD) brakes, air disc brakes (ADB), lane departure warning, side object detection, etc. They are designed to help drivers in various situations.

Crash worthiness, on the other hand, involves technologies designed to help the commercial vehicle driver survive a crash. Technologies such as air bags, stronger cab structures, and crumple zones fit into this area.

The question that often arises, from a fleet investment perspective, is where to put the money. Investments in both areas, while making sense, come with a cost. For example, adding structure to increase cab crash worthiness can increase weight, which may reduce fuel economy and decrease payback potential, while using lighter materials to increase strength may add additional cost to the vehicle.

Along the same lines, safety technologies are designed to address particular circumstances. If the fleet is not having that particular issue, why make the investment?

Given our contention that technology – both crash avoidance and crash worthiness – is important in assessing overall fleet safety, investments in both areas should be regarded as...
supportive to delivering an overall improvement to fleet safety. However, a case can be made that the value of crash avoidance technologies is actually higher and should be weighted as such in the Fleet Safety Equation.

It’s not difficult in our world to know the result when cars and trucks collide. The physics of an 80,000-lb vehicle hitting a 3,000- to 4,000-lb vehicle are stark. Crash statistics bear this out – 94 percent of those killed and 85 percent of those injured in heavy truck and other vehicle accidents are in the other vehicle, not the heavy truck. Technologies that help the driver avoid the accident do more than those designed to help the driver survive the crash – if you avoid the crash in the first place, you don’t have to worry about survival. To this end, in our view, crash avoidance technologies should count for 90 percent of the weighting of the technology factor.

**D = Drivers**

Bendix has long maintained that technology alone does not replace the need for safe drivers, safe driving habits, and comprehensive driver training. Today, and in the foreseeable future, the driver remains in control of the vehicle and is integral to the success of the fleet in preventing accidents. It’s also why CSA places unique focus on the driver by having the PSP (Pre-Employment Screening Program), which enables fleets to check out a driver’s record before hiring.

Key driver considerations begin with the basics:

- **Credentials** – Does the driver have an appropriate CDL, an acceptable score in the PSP, and an overall safe driving record?
- **Selection** – How does the fleet hire drivers? What verifications and factors are considered?
- **Experience** – How long has the driver been driving commercial vehicles? How much experience does the driver have on the road and with the particular load being hauled? How long has the driver been at your fleet – is he or she new behind the wheel or an old pro, knowledgeable about your fleet’s operating practices, customers, loads, policies, and procedures?

Today, and in the foreseeable future, the driver remains in control of the vehicle and is integral to the success of the fleet in preventing accidents.
• Training – What type of initial and ongoing training and coaching does the fleet provide? How frequent is the training, and who conducts it? What about training on safety technologies?
• Health – How healthy is the driver? What habits does the driver practice to maintain health? (As folks know, sleep apnea is a major concern in the industry, as are issues around weight.)

Drivers are like roses in the garden – you just can’t plant ‘em and expect they will prosper. Along the same lines, drivers need nurturing to grow into the safest skilled professionals possible.

Also important: How does the driver react to coaching – from both a driver trainer or from a system on the vehicle? Receptivity to change is important. A driver not willing to listen to his or her coach, whether human or the safety system, is a problem waiting to happen.

Driver Assistance Systems (DAS) can be an important part of coaching. Drivers often find safety systems help improve their driving habits. (At least those drivers that want to improve.) If the alert doesn’t go off or the system doesn’t hit the brakes, the driver is doing something right. Building on eliminating alerts and interventions from driver assistance systems can result in better, safer drivers.

C = Culture of Safety

Every fleet talks safety. If you look at a fleet’s website or values statement, safety is typically always mentioned. But when a fleet says “safety is everyone’s business,” how do you know it is? Talking the talk and walking the walk are often two different things. It is important that management truly embraces and actively engages in a safety culture – not just for drivers, but for the organization as a whole.

What are the initiatives that the fleet implements around the company? Safety initiatives that are supported by company leadership, and that truly drive safety as the number one value or priority of the company – even over financial – go a long way. Fleet leaders who listen to the
concerns of drivers and act on those concerns can reinforce a safety culture. A top-down, bottom-up approach to safety can help cement it as a part of the company culture.

**M1 = Maintenance**

Maintenance is ensuring that vehicles are kept in top operating condition – this entails proactive preventive maintenance actions, along with responsive repairs when issues arise on the field. Poor or inconsistent maintenance practices can have an impact on driver and safety system performance.

As you think of safety system maintenance, think of it as a hierarchy (see Figure 1). Higher-level systems – like stability and collision mitigation – are near the top, and the lower-level systems, like tires and brakes, form the foundation at the bottom. Just as you don’t run a marathon in worn-out shoes, maintaining tires and brakes is critical. For the higher-level systems to perform, the foundational systems need to be taken care of first.

Problems at the lower levels will impact the functionality at the higher levels. For example, camera- and radar-based collision mitigation technology (such as the Bendix® Wingman® Fusion™ system) builds on the radar-based collision mitigation technology. If the camera goes out, you still have radar-based collision mitigation to support a driver. If the radar goes out, you still have the camera for other functions such as lane departure warning, but not collision mitigation.

Similarly, the collision mitigation technologies build on the stability system. So if the stability system has a fault, this will knock out the collision mitigation technology. Stability builds on ABS – if ABS goes out, then stability and collision mitigation also go out. (Keep in mind, however, that if ABS goes out, you still have braking – just without ABS.) If the braking system is in disrepair, this will impact the ability of the other systems to perform optimally. The same is true for tires.

**M2 = Monitoring**

Monitoring involves a number of areas, including:

- Monitoring the performance of drivers on the road to ensure that training efforts are focused on individual needs.
• Monitoring vehicle condition to ensure optimal performance and prognostics for repairs.
• Monitoring dispatch-to-driver communications to ensure that these communications are helpful, not harassing.
• Tracking the performance of vehicle inspections (pre-trip, post-trip, and during trip) to ensure problem areas are being addressed.

Is your fleet doing any of this? Are you capturing data from the road? Most importantly – are you doing something with the data you capture to help enhance and improve these areas? Monitoring is pretty worthless if you don’t act on the data you collect.

**R = Regulatory Adherence**

Regulations are a reality in the industry. How well does the fleet adhere to the intent of the regulation, not just the letter of the law? How well is the fleet doing with CSA scores? Passing inspections or causing crashes? Areas to cover include: ensuring that replacement linings on RSD brakes will continue to make sure that the expected stopping distance performance is delivered; watching hours of service to ensure rules are being met; and helping drivers understand what is expected (and why) and help them in meeting the required regulations.

**A = Age of the Fleet**

As with cars, the newer the trucks in the fleet, the more likely certain mandated safety equipment is included or could have been purchased as an option. For example, all new trucks have ABS and can be outfitted with a variety of optional safety technologies, such as stability and collision mitigation. Airbags are an optional accessory or standard on some new trucks. The newer the fleet, the higher the likelihood that safety technologies are on the vehicle – either installed as an option or required by a mandate.

But it’s not only safety technologies that are a part of the new truck. Newer trucks may be subject to fewer maintenance issues than older trucks. Bob Costello, chief economist at ATA (American Trucking Associations), often talks about how much maintenance costs increase as trucks age. As maintenance is a part of the Fleet Safety Equation, reducing maintenance issues by virtue of operating new trucks is a factor to consider in the overall equation.
**w = Weighting**

You’ll note, with the exception of the “Technology” variable, that this paper doesn’t discuss weightings around the variables. It’s not that the weightings have no value in these variables – they do. However, there is a question in our mind regarding how best to determine the appropriate weightings for each, and, most importantly, how to defend the value chosen. At Bendix, our extensive expertise and demonstrated legacy of developing practical applications enable us to make a strong case for the differences between crash worthiness and crash avoidance technologies; we deal with these daily in our development of crash avoidance systems and solutions. (Of course, you may disagree with our selection of the higher weight for crash avoidance and may feel that we have a bias because of our expertise. That is fair, which leads to the point of the weightings – a lot may be dependent on individual fleet experience in each of these areas and, therefore, the actual values can vary by fleet.) For now, consider the weightings in the Technology element as an example of how to apply the values. We’ll discuss this concept in more detail in Part 2 of this paper.

**A few areas to consider**

Keep in mind that interrelationships exist for each of the factors we discussed. Obviously, safety investment crosses all the categories, as one does not add technology for free on their vehicles, nor is driver training a no-cost endeavor. The value of evaluating the interrelationships between these factors is that it provides a potential cross-check. It is difficult for a fleet to claim that it is doing a variety of things to improve safety if the investment isn’t there. Likewise, it’s difficult to prove a strong safety culture if regulations are being violated.

Does one factor have more impact than another? Weightings on each of these factors may vary. In other words, does more driver training mean less need for technology? It’s a good question and one we should not attempt to answer, because the answer requires a high level of empirical research comparing a variety of fleets and a variety of factors.

Of importance at this point, however, is the hypothesis – that maximizing fleet safety involves optimizing some combination of these factors. For different fleets operating in various areas
and situations – for example, bulk transporters in the Midwest vs. dry van carriers in the Southwest – the weightings likely vary. Stability technology may have a higher weighting for fleets operating in North Dakota than fleets operating in Arizona. What is important is that fleets consider and work on all these factors.

Does this impact CSA? With CSA still being critical to a fleet’s overall wherewithal, all these factors are going to be important and may actually reflect where a fleet rates on select BASICs. Overall, the expectation would be that a fleet that is working in all these areas to improve safety would likely see better fleet safety scores than those that are doing little in any of these aspects.

The same could be said for insurance rates – insurance companies are going to look to a fleet’s risk profile and what they are doing to reduce the risk of crashes. Fleets that are implementing in all these areas are going to potentially look better than those that don’t.

Integrating the equation could be a means for validating “beyond compliance” – where fleets may get CSA improvement scores that reflect various aspects in the equation. A model for beyond compliance could be built on scoring a fleet in each of these areas. Fleets doing more in each factor could see improvements in CSA score vs. fleets that are not.

Combining variables to form an approach for improving safety is not a new concept. Look at the insurance industry. Insurers examine a variety of factors to assess the risk of a fleet. Of course, they have their factors and we have ours.

The basic idea behind the Fleet Safety Equation is to first think about the safety factors and where, perhaps, your fleet has room for improvement. Then, look at how these areas might be enhanced and what impact this will have on safety.

The more your fleet does to optimize each of the variables in the Fleet Safety Equation, the higher the likelihood that your fleet becomes safer – especially compared to those fleets that do not take the opportunity.
What's next?
Quantifying the factors is our next step. Considering the numbers in the Fleet Safety Equation and how it might be used to quantify safety will be the topic of Part 2: Putting the Fleet Safety Equation to Work.

We welcome your thoughts on the Fleet Safety Equation. Please share them at FSE@bendix.com.

About the author
Fred Andersky is director of government & industry affairs, and director of customer solutions – Controls, at Bendix Commercial Vehicle Systems LLC. He has been involved with safety technologies at Bendix for over 10 years and presents to government, industry, and media about current and future technologies. Fred holds a Class A CDL and often drives demonstrations of Bendix technologies. He is also a frequent contributor to podcasts, blogs, and videos at www.knowledge-dock.com.