2018

AUTOMOTIVE WARRANTY & RECALL REPORT

New Risks. New Remedies.
Bridging the Gap Between
What's Now and What's Next.

STOUT

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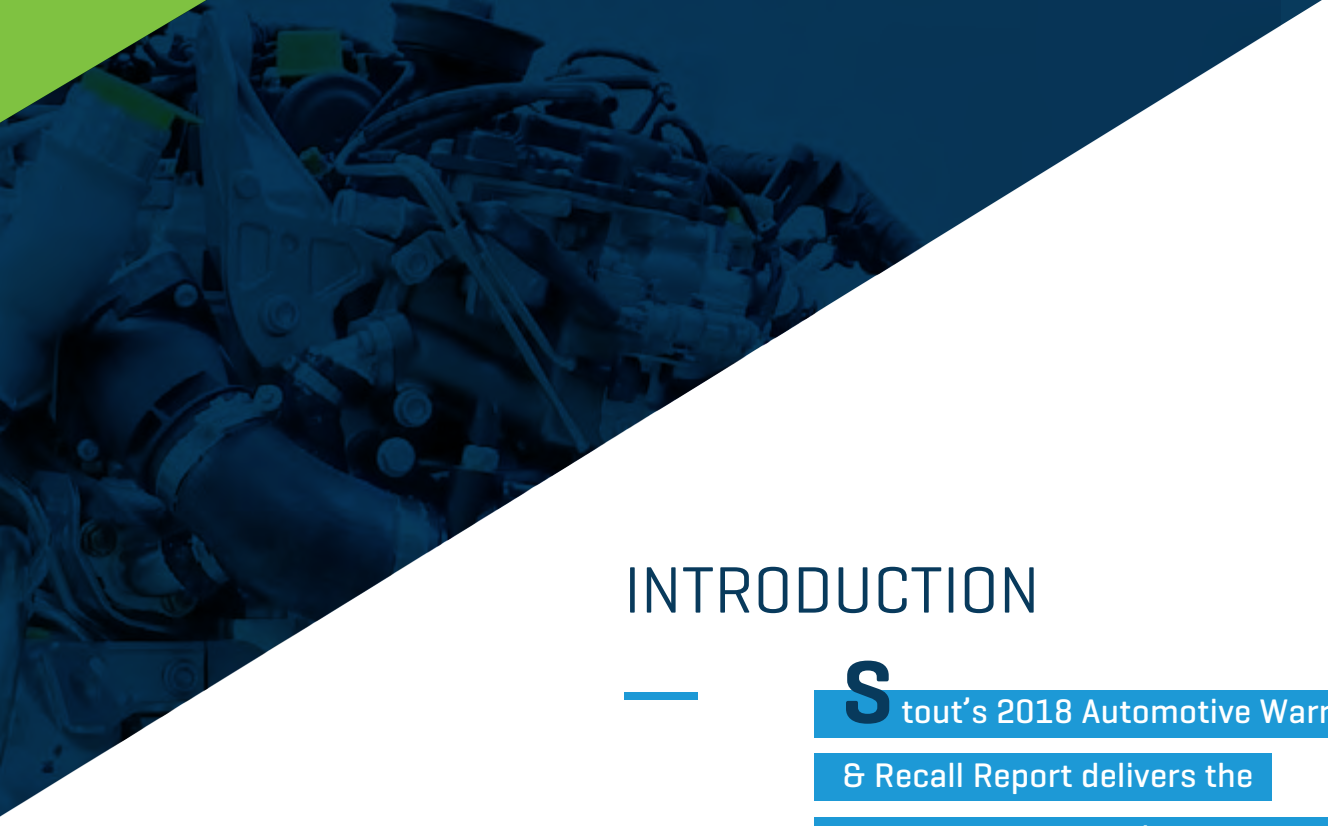
OF THE RECALLS IN 2017, FOUR AFFECTED 1 MILLION+ VEHICLES



INTRODUCTION

Stout's 2018 Automotive Warranty & Recall Report delivers the automotive industry's most thorough and comprehensive analysis of the recall activities, trends, and risks that revealed themselves in 2017.

Industry players can use the carefully cultivated data in this report — compiled from a multitude of sources domestically and abroad — to gain a better appreciation of the risks of particular components, recall completion percentage trends, and where and how recall risks might present themselves in the future.

Unlike previous years, 2017 offered the automotive industry some reason for recall optimism. After several years of elevated activity, created primarily by the massive Takata airbag recalls of 2015 and 2016, the number of recalled vehicles declined to levels similar to those observed earlier this decade. However, there were still hundreds of recall campaigns in 2017, including several in excess of 1 million vehicles.

As technologies, global platforms, and materials continue to evolve, and advanced components, software and systems are forced to interact with one another for the first time, new recall risks will emerge. Now is the time for members of the industry to identify those potential areas of concern and put processes and practices in place to navigate them.

THIS REPORT

Stout's fourth annual Automotive Warranty & Recall Report builds on the original research that Stout began in 2013. As in years past — in order to complete this report — Stout has compiled and analyzed prior-year data from a vast array of sources including National Highway Traffic Safety Administration (NHTSA), several international recall-related databases, financial reports, the Federal Register, and other sources.

This report leverages Stout's qualitative and quantitative approaches to understanding automotive industry recall trends and risks. Based on Stout's extensive experience serving automotive industry clients — from original equipment manufacturers (OEMs) and suppliers to insurance and risk-management professionals, lawyers and litigators, and other advisors to the automotive industry — the data and insights found in this report are meant to help inform and shape future recall risk-management strategies.

2017 IN REVIEW: A CHANGING DYNAMIC

THE NUMBER OF VEHICLES AFFECTED BY THOSE CAMPAIGNS DECLINED TO ITS LOWEST LEVEL SINCE 2013.

In 2017, even though the number of recall campaigns remained consistent with previous years, the number of vehicles affected by those campaigns declined to its lowest level since 2013.[1] This was primarily due to the limited expansion of the Takata recalls in 2017 relative to 2015 and 2016. A secondary cause, but one that shouldn't be discounted, is the efforts OEMs and suppliers may be taking to identify defects sooner.

As *Figure 1* indicates, 2017 saw fewer vehicles being affected by new recall campaigns. This is a trend that's likely to continue to impact recall volumes in the coming years.

Figure 2 goes one step further, showing that 2017 had the lowest number of unique recall campaigns involving more than 100,000 vehicles since 2009.

And *Figure 3* highlights the growing proportion of younger vehicles being recalled versus older models, which supports the notion that OEMs and suppliers are making a concerted effort to identify defects sooner.

The continued evolution of production management techniques, which includes effectively identifying root causes of component defects and utilizing advanced analytics, may have also contributed to OEMs' and suppliers' enhanced ability to prevent defects and respond to emerging issues sooner.

MORE SMALLER RECALLS

2017's elevated number of smaller recall campaigns has distinctive differences as compared to a lower number of larger campaigns for obvious reasons. Smaller campaigns are often easier to execute and manage, and cost less. Plus, as we'll explore later in this report, recalls involving newer vehicles have a far higher completion percentage than those involving older vehicles. For all these reasons, we should expect manufacturers and suppliers to continue their proactive approach to identifying defects and initiating recalls sooner, although the emergence of new technologies and software in the years ahead will make it an ongoing challenge.

FIGURE 1 / UNIQUE CAMPAIGNS AND VEHICLES AFFECTED BY YEAR

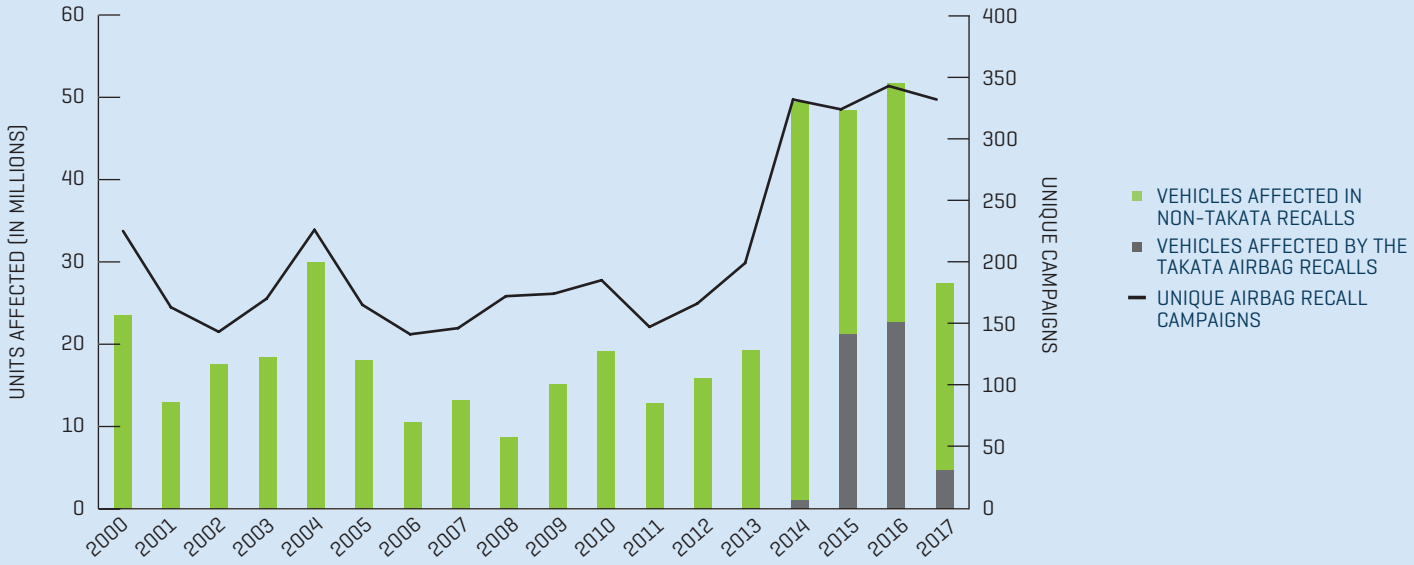


FIGURE 2 / PERCENT OF UNIQUE CAMPAIGNS BY SIZE OF RECALL

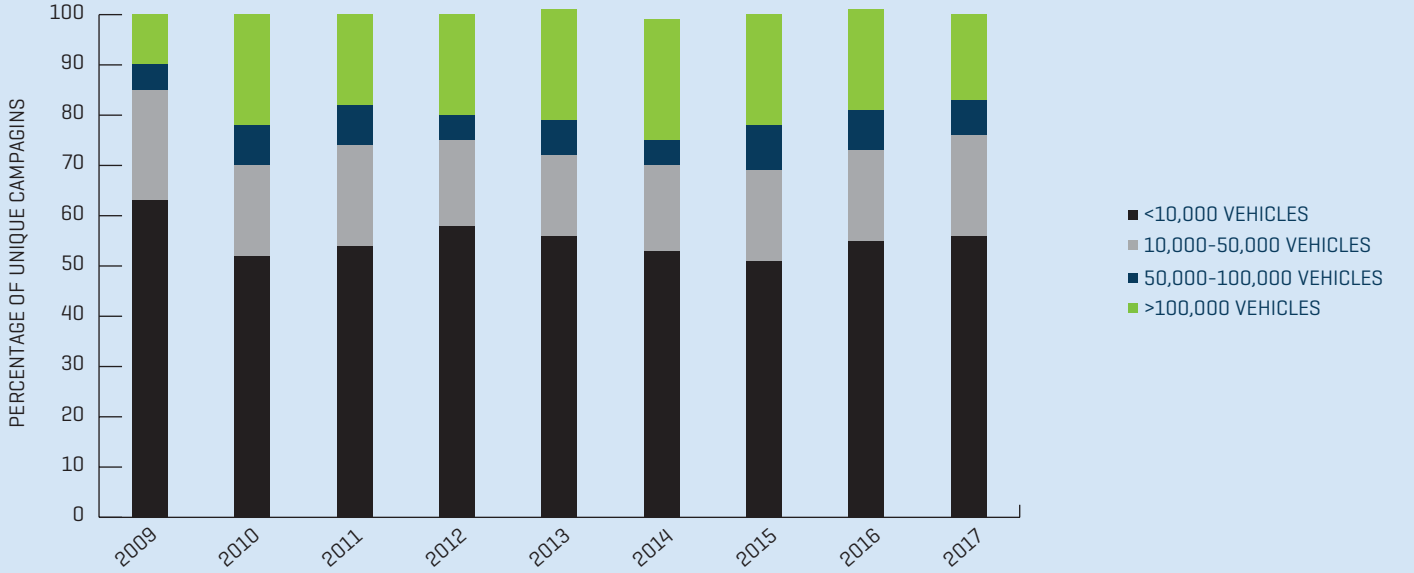
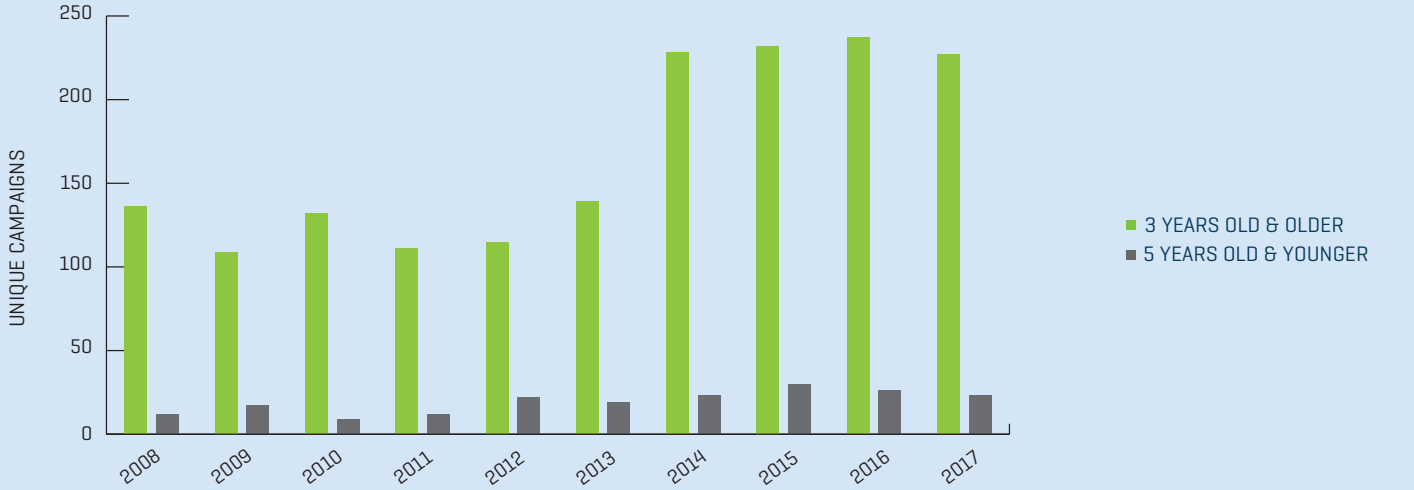


FIGURE 3 / UNIQUE CAMPAIGNS BY AGE AT TIME OF RECALL
EXCLUDES TAKATA & GM IGNITION SWITCH RECALLS



Despite the progress made in limiting large recall campaigns in 2017, there were still four recalls of more than 1 million vehicles each. Together, these four campaigns accounted for 21% of the non-Takata affected vehicle volumes in 2017. The silver lining is there were no recall campaigns involving more than 2 million vehicles last year, as there have been in years past.

RECALL CAMPAIGNS IMPACTING MORE THAN 1M VEHICLES IN 2017

FCA (DODGE) AIRBAGS

1 MILLION VEHICLES

Roll rate sensor may trigger a fault and cause the rollover side-curtain airbag or seatbelt pretensioner not to deploy.

FORD DOOR LATCHES

1.1 MILLION VEHICLES

Doors may open while driving due to kinked cable or frozen latches.

HONDA BATTERY

1.1 MILLION VEHICLES

The case for the battery sensor may allow water to enter and cause an electrical short.

FCA (DODGE) POWERTRAIN

1.5 MILLION VEHICLES

Transmission may shift out of park without pushing the brake pedal or having the key in the ignition.

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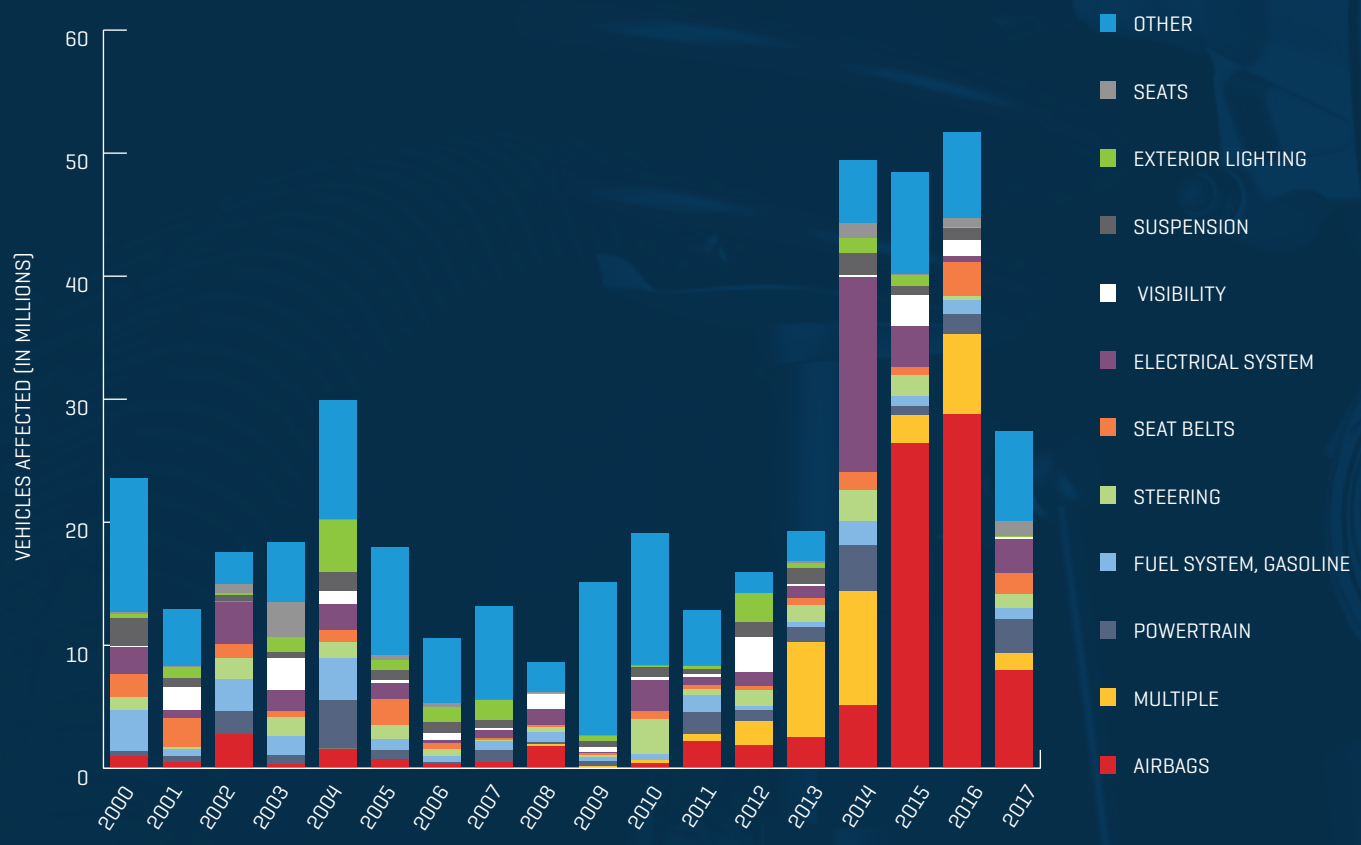
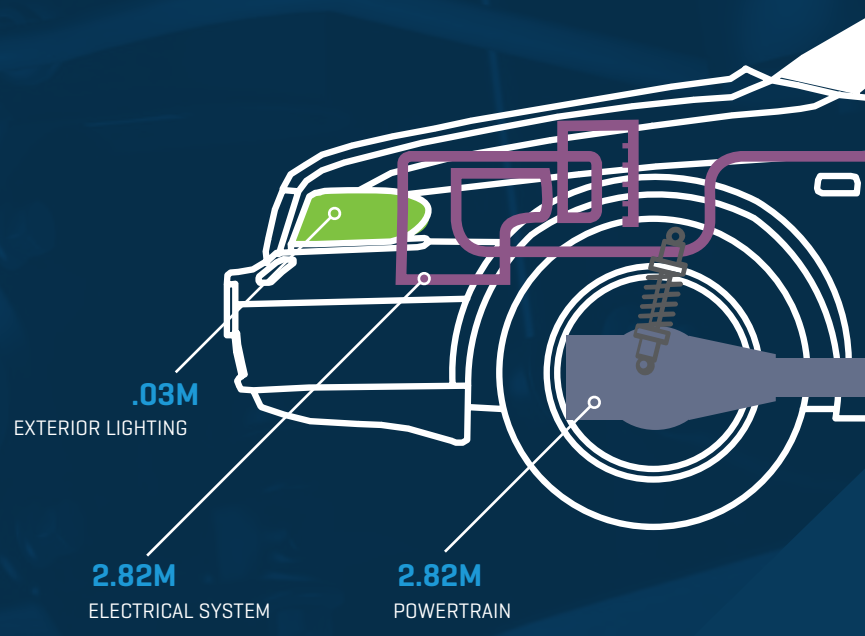
TOTAL RECALL CAMPAIGNS IN 2017

As *Figure 4* indicates, the number of electrical system recalls continued to increase in 2017 — as they have in recent years — a trend that will likely persist as software and new, technologically advanced components are introduced and forced to interact with one another for the first time in real-world environments. The risks of these electrical components will be a primary area of concern for the industry in the years ahead.

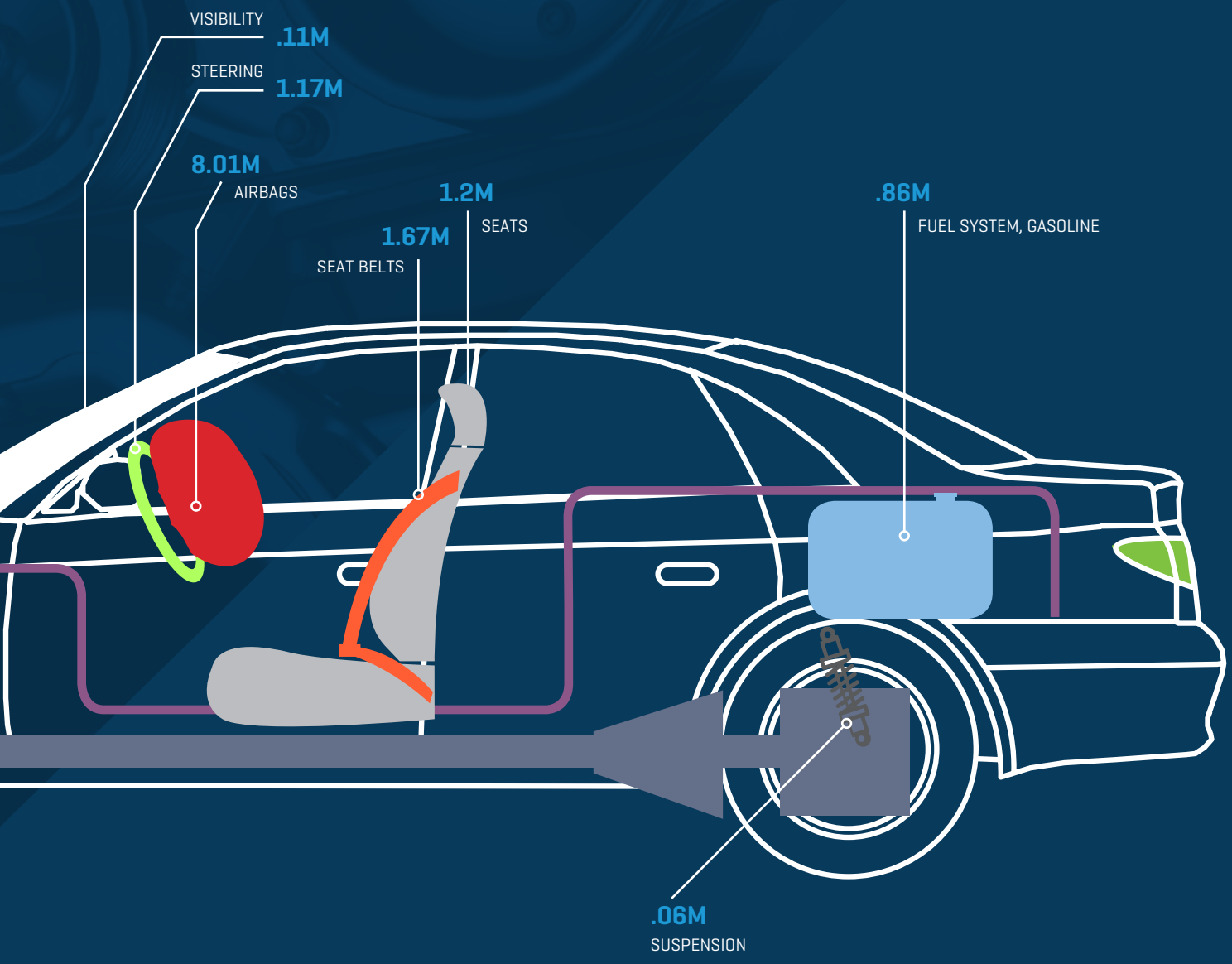
FIGURE 4 / VEHICLES AFFECTED BY COMPONENT & YEAR



Contains data for BMW, Daimler AG, FCA, Ford, General Motors, Honda, Isuzu, Kia, Mazda, Mitsubishi, Nissan, Subaru, Jaguar, Land Rover, Tesla, Toyota, Volkswagen, and Volvo. Identified from dataset updated through 2017.



2017 VEHICLES AFFECTED BY COMPONENT



THERE WERE APPROXIMATELY **23 MILLION** VEHICLES RECALLED IN NON-TAKATA CAMPAIGNS IN 2017.

REASON FOR (CAUTIOUS) OPTIMISM

2017 showed signs that a focused, proactive approach to defect identification and response may result in smaller campaigns impacting fewer, and younger cars. However, 2017 also continued to demonstrate that the introduction of new technologies and software — while certainly helping to inspire vehicle sales — will likely create new areas of risk moving forward as well as new opportunities for remedy.

Suppliers will need to adapt to what could be the start of a new era of risk management by updating their processes, implementing new checks and balances, and taking advantage of new production management tools and data that are becoming available. Taking the necessary precautions now is essential to laying the foundation for a successful financial and operational future.

THE TAKATA TAKE-AWAY

AN UPDATE ON THE TAKATA AIRBAG RECALLS

The Takata airbag recalls contributed fewer additional vehicles to total recall activity in 2017 than in previous years (*Figure 5*). However, there were still significant happenings to report, led by TK Holdings Inc. and 11 of its U.S. and Mexican affiliates filing for Chapter 11 bankruptcy protection on June 25, 2017.[2]

"In the multi-district, class-action litigation against them, Toyota, Mazda, BMW, Honda, and Subaru agreed to settlements in excess of 1.2 billion dollars, including the creation of an outreach fund to target vehicle owners who have not had the repair completed."[4]

beasleyallen.com

"In July 2017, Takata issued a defect information report (DIR) recalling certain desiccated inflators contained in approximately 3 million vehicles."[3]

nhtsa.gov

OTHER RECENT TAKATA HEADLINES

"On February 12, 2018, Ford and Mazda expanded a "Do Not Drive" warning to include 33,000 MY 2006 Rangers and B Series trucks after a July 2017 death in a 2006 Ford Ranger."[5]

reuters.com

"In March of 2018, Senators Markey and Blumenthal issued the Automaker Report Card, urging OEMs to offer loaner cars to owners of vehicles affected by recalls."[6]

blumenthal.senate.gov

"On March 20, 2018, a Senate Commerce subcommittee overseeing NHTSA held a hearing regarding the pace of recall repairs."[7]

wsj.com

"More than 40 states and the District of Columbia have reached a settlement with Takata."[8]

mlive.com

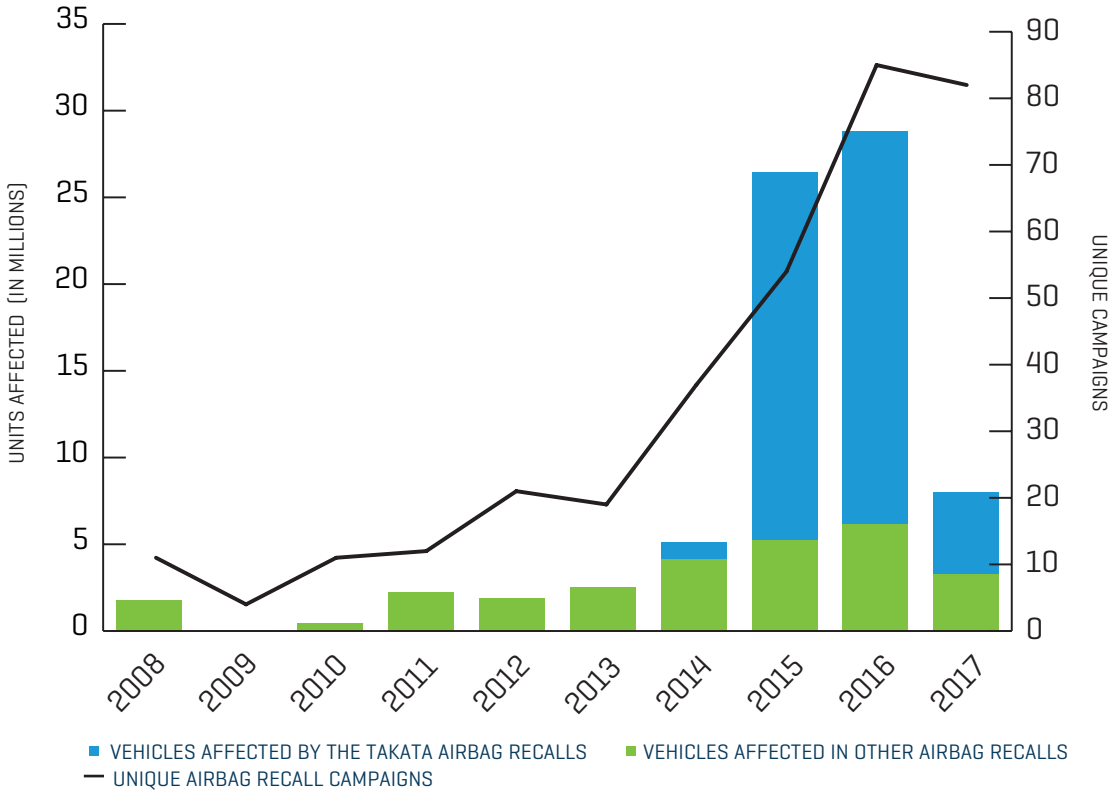
THE TAKATA RECALL CAMPAIGNS HAVE A

60%

COMPLETION PERCENTAGE

AS OF THIS WRITING,[10] AND HAVE ACCOUNTED FOR 15 FATALITIES IN THE U.S.,[11] 23 WORLDWIDE,[12] AND HUNDREDS OF SERIOUS INJURIES.

FIGURE 5
UNIQUE AIRBAG CAMPAIGNS AND VEHICLES AFFECTED BY YEAR



Contains data for BMW, Daimler AG, FCA, Ford, General Motors, Honda, Isuzu, Kia, Mazda, Mitsubishi, Nissan, Subaru, Jaguar, Land Rover, Tesla, Toyota, Volkswagen, and Volvo. Identified from dataset updated through 2017.

In November 2017, The Independent Monitor of Takata and the Coordinated Remedy Program issued *The State of the Takata Airbag Recalls*.[9] The report outlined the initiatives that have been implemented to repair affected vehicles during the Takata recalls.

The findings of The Independent Monitor are consistent with Stout's research and recommendations in regard to what's required to execute a successful recall: a combination of strategic planning, varied and targeted communication tactics, and analysis.

The Monitor's observations for positively influencing higher completion percentages included the following activities being pursued by the industry:

COORDINATED COMMUNICATIONS

Frequent, multi-channel outreach that clearly describes the dangers of the defect and a clear path to action.

SEGMENTED ANALYSIS

Segment unrepaired-vehicle owner populations and employ different strategies based upon the needs of each.

STRATEGIC FORECASTING

Measure the success of the different initiatives and tactics employed in executing recall plans.

ENGAGING DEALERS AND INDEPENDENT REPAIR SHOPS

Manufacturers should engage and motivate dealers by ensuring dealer recognition and accountability, expanding dealer reimbursement policies, evaluating technician training requirements, and hosting dealer roundtables.

SCALE AND RESOURCES

Transition from local to national strategies after identifying successful initiatives.

CROSS-FUNCTIONAL EXPERTISE

Leverage personnel with more diverse skill sets, experience, and expertise.

CANVASSING

Door-to-door canvassing initiatives later in recall campaigns to proactively encourage vehicle owners to schedule repairs, verify contact information, and understand barriers to completing repairs.

ENHANCED OUTREACH BASED ON RISK

Address heightened risk posed by certain defect types with enhanced outreach strategies, including canvassing and multi-touch, multi-node communications tailored to affected vehicle owners.

The Takata airbag inflator recalls are expected to continue to expand through the end of 2020 and possibly beyond. Although it represents an undeniably challenging period for the automotive industry, there are lessons to be learned from the Takata recalls and insights and strategies that can be extrapolated to enable more successful recall campaigns in the future.

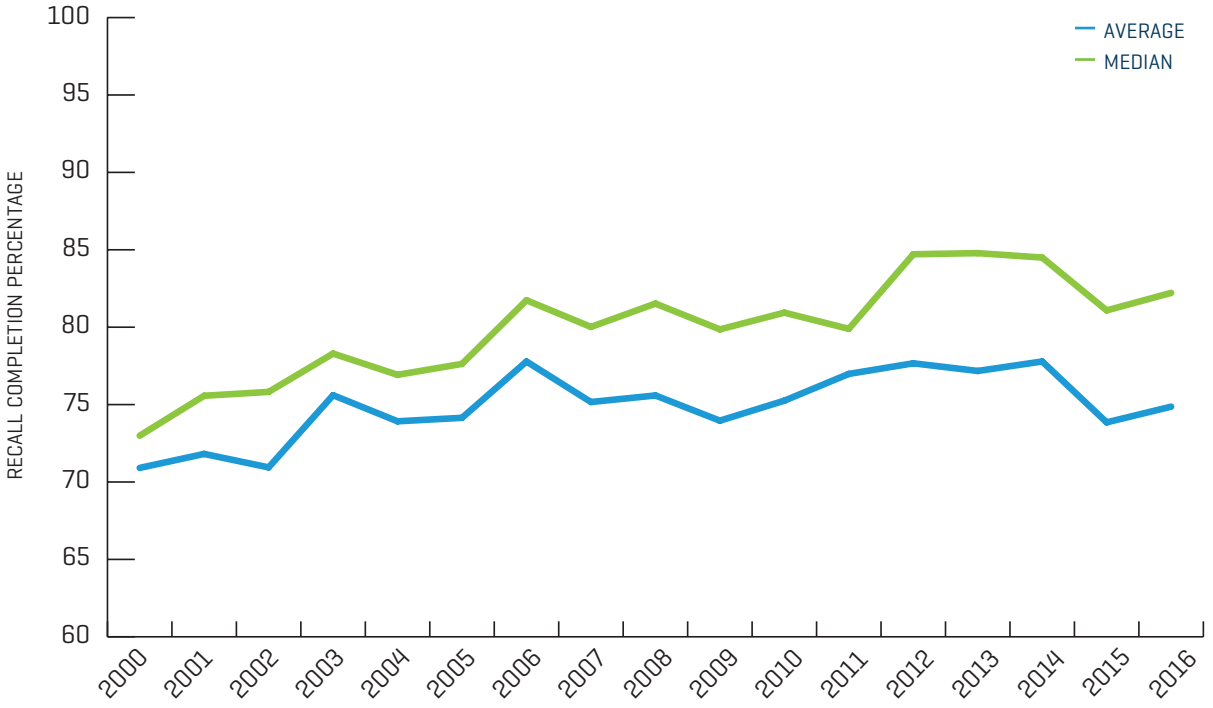
RECALL COMPLETION PERCENTAGE

The most recent recall data shown in *Figure 6* illustrates that the industry experienced a small increase in its median rate of recall completion related to recalls initiated in 2016. The completion percentage data for the first four quarters of data related to recalls initiated in 2017 indicates enhanced completion for those recalls, both in terms of average and median completion percentage.

This data was analyzed both including and then excluding Takata recalls. Excluding Takata recalls, the median fourth-quarter completion percentage in 2017 was greater than 81%, which was 2.5%-5% greater than the fourth-quarter completion percentages in each of the previous five years.

This improvement can be partially attributed to an increase in the number of recalls involving newer vehicles, which are more likely to be owned by original buyers and by people with active dealer-service relationships.

FIGURE 6 / OVERALL MEDIAN & AVERAGE RECALL COMPLETION PERCENTAGE BY YEAR
INCLUDING ONLY RECALLS WITH SIX OR MORE REPORTED QUARTERS



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As previously discussed, the ability of OEMs and suppliers to identify component defects quickly, limiting the number of older vehicles involved in a recall, should help positively influence higher completion percentages. However, it is worth noting that achieving a high completion percentage with a recall that includes a significant population of older vehicles is still certainly possible, as evidenced by the following campaigns:

LARGER CAMPAIGNS INVOLVING OLDER VEHICLES THAT HAVE ACHIEVED

85% COMPLETION PERCENTAGE

GM / IGNITION SWITCH

14V047

OLDEST VEHICLE
13 YEARS OLD
AT TIME OF RECALL

92% COMPLETION
2,190,934 VEHICLES

TOYOTA / FRICTION LEVER

10V017

OLDEST VEHICLE
5 YEARS OLD
AT TIME OF RECALL

87.5% COMPLETION
2,230,661 VEHICLES

GM / AIR BAGS

14V118

OLDEST VEHICLE
6 YEARS OLD
AT TIME OF RECALL

91% COMPLETION
1,176,407 VEHICLES

89.5% COMPLETION
262,559 VEHICLES

OLDEST VEHICLE
5 YEARS OLD
AT TIME OF RECALL

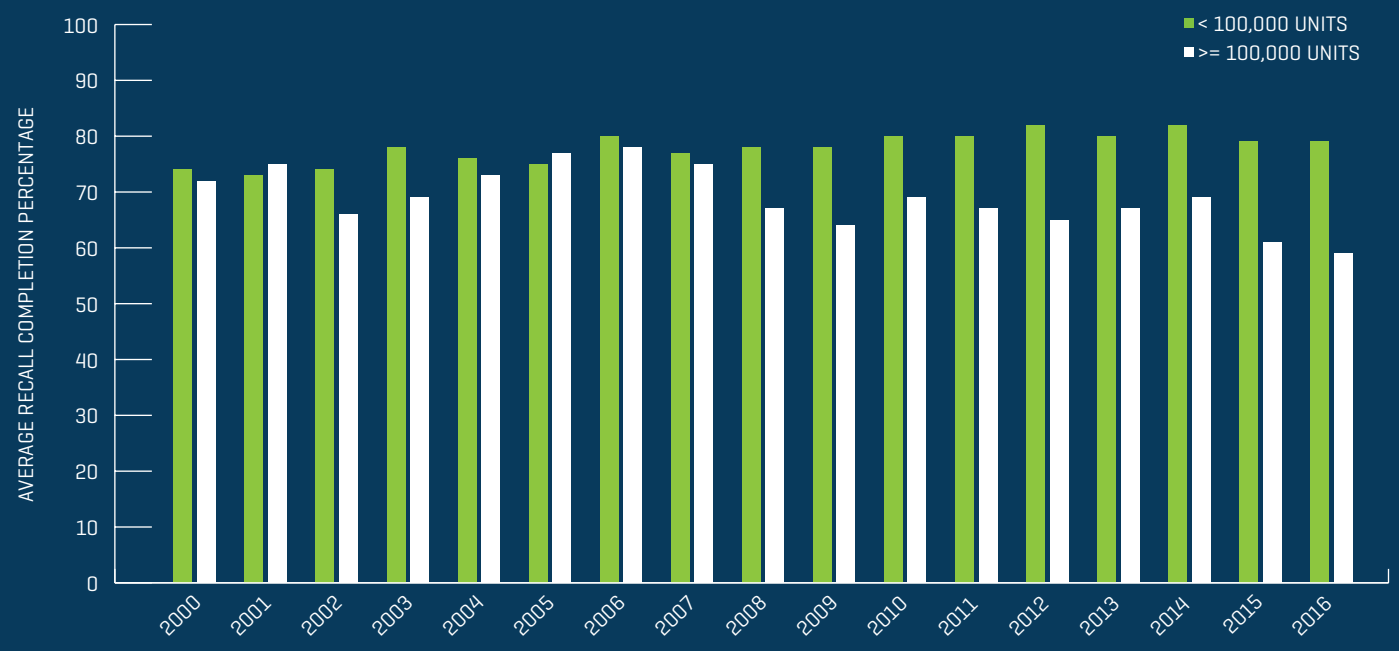
00V367

STOUT ANALYSIS: RECALL COMPLETION PERCENTAGE DATA

After years of tracking and analysis, Stout has identified several key variables that can have a significant influence on the completion percentage of a recall campaign.

FACTORS AFFECTING RECALL COMPLETION PERCENTAGE

FIGURE 7 / SUMMARY OF AVERAGE COMPLETION PERCENTAGE BY RECALL SIZE (SINCE 2000)



Contains data for BMW, Daimler AG, FCA, Ford, General Motors, Honda, Isuzu, Kia, Mazda, Mitsubishi, Nissan, Subaru, Jaguar, Land Rover, Tesla, Toyota, Volkswagen, and Volvo. Identified from dataset updated through 2017.

COMPONENT TYPE

Completion percentages are likely to be higher among vehicle owners if they consider the component to be crucial to their vehicle's operation or safety. The other side of that coin for OEMs and suppliers is the lack of urgency on the part of vehicle owners when they don't perceive a component to be safety or operation critical.

RECALL SIZE

As *Figure 7* reveals, the completion percentage for recalls involving more than 100,000 vehicles has not improved significantly in recent years. Completion percentages for recalls with more than 100,000 units affected are often approximately 5%-10% lower than for smaller-sized recalls. The difference was 20% in 2017.

VEHICLE AGE

Completion percentages for recalls involving older vehicles are, on the whole, significantly lower than newer vehicles (*Figure 8*). The older the vehicle, the more pronounced the impact. The good news is that overall, the size of both the older vehicle recall population and the average campaign size is shrinking (*Figure 9*).

FIGURE 8 / SUMMARY OF AVERAGE COMPLETION PERCENTAGE BY AGE AT TIME OF RECALL (SINCE 2000)
INCLUDING ONLY RECALLS WITH 6 QUARTERS REPORTED

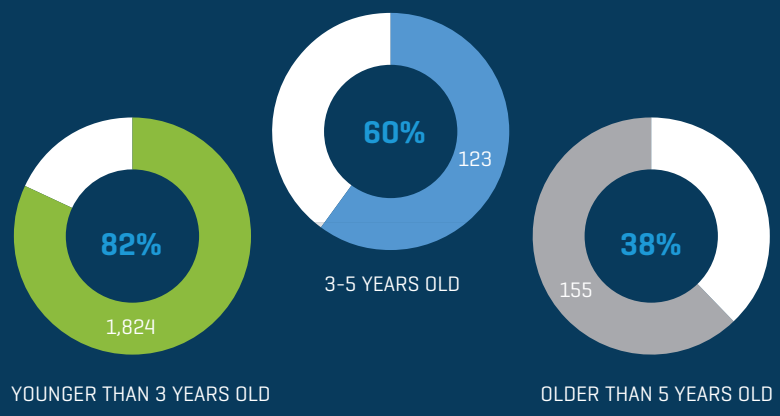
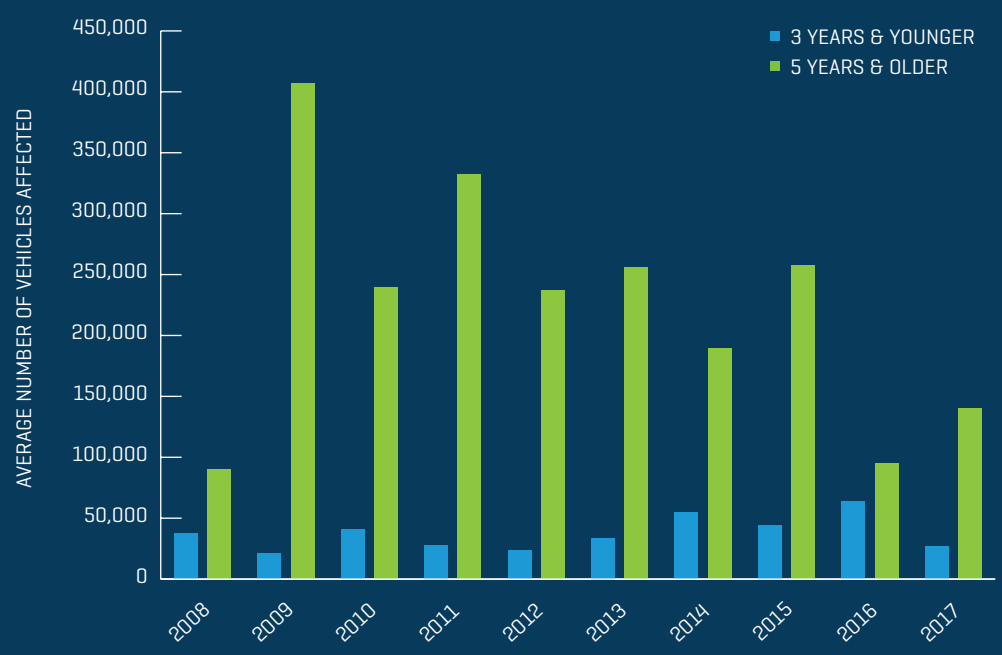


FIGURE 9 / AVERAGE RECALL CAMPAIGN SIZE BY AGE AT TIME OF RECALL
EXCLUDES TAKATA AND GM IGNITION SWITCH RECALLS



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EFFECTIVE OUTREACH

Motivating busy car owners to comply with recall notifications has been a challenge for many years, especially so in today's world of multi-media touchpoints. Gone are the days when a standard-issue form letter might be sufficient to compel all vehicle owners to make an appointment at their local dealership. Those types of letters don't resonate with all vehicle owners today, and increasingly don't reflect the way most people communicate.

In acknowledgement of this, NHTSA has encouraged OEMs to find new ways to alert car owners about vehicle recalls, including a proposal rule that would require OEMs to send notifications electronically in addition to first-class mail.[13] In response to NHTSA, OEMs have started to embrace new recall outreach strategies including emails, social media messaging, and phone calls.

Finding new ways to target specific consumer segments will continue to be a critical component of recall strategies moving forward. Through our analysis, Stout has observed several key objectives when crafting driver outreach. They include the following:

CLEAR COURSE OF ACTION THROUGH MESSAGING

Presenting a clear message to car owners through more than one medium and giving them a definitive course of action.

CORRECTLY ADDRESSING THE AUDIENCE

Understanding the owner population in question, selecting a communication medium(s) that fits the population, and customizing a message that will help diminish barriers to having the repair completed.

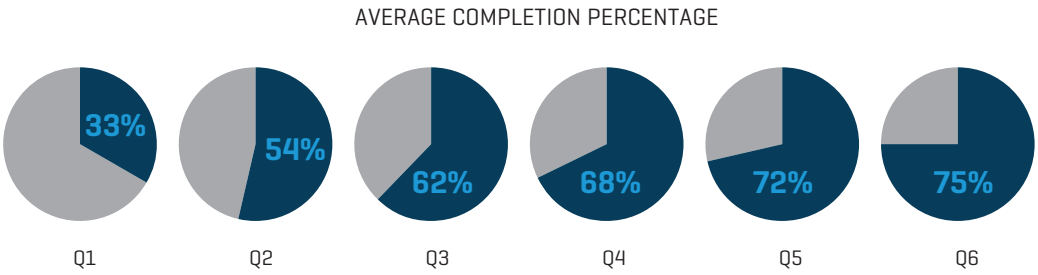
UP-TO-DATE INFORMATION

Utilizing comprehensive data strategies to identify vehicle owner contact information. Potential sources of information include non-DMV sources of vehicle addresses, vehicle maintenance history reports from external sources, online postings, export records, and scrap and salvage inventories.

As Stout's analysis has revealed, a strong initial communications push is crucial to encourage owner engagement and compliance. As *Figure 10* indicates, most of the owner compliance and repair activity in a recall happens early in the process. If one can drive higher compliance in the first and second quarters, there will be less ground to make up in the latter quarters when diminishing returns become more evident and the data and engagement challenges become more significant.

In today's automotive industry, there is no cookie-cutter approach to implementing an effective recall strategy. Much like automakers do with consumer sales, OEMs and suppliers must be diligent in targeting specific demographic groups with customized tactics and messaging in order to compel owners to take action and have recall repairs completed.

FIGURE 10 / SUMMARY OF AVERAGE COMPLETION PERCENTAGE BY QUARTER (SINCE 2000)
INCLUDING ONLY RECALLS WITH 6 QUARTERS REPORTED



RECALLS DEFECTS INVOLVING ELECTRONICS & SOFTWARE

BY 2030, ELECTRONICS ARE EXPECTED TO REPRESENT 50% OF THE TOTAL COST OF A VEHICLE.[14]

Electronic components and software will continue to be an increasingly important element of vehicle safety and customer satisfaction. The irony is that as more sophisticated driver-convenience and safety technologies are introduced — innovations like forward-collision detection, emergency braking, and self-parking — the more complicated the interactions within a vehicle's internal network become, increasing the possibility of defects.

Technologies and systems that have been developed and tested prior to vehicle integration may have risks associated with that integration that will not be understood or observed until after vehicle production has begun. This is a critical consideration for OEMs and suppliers when conducting risk analysis and benchmarking associated with vehicle defects and recalls.

As a matter of risk mitigation, OEMs and suppliers should consider potential component and integration failure modes and analyze patterns and relationships in testing and production data, as well as external data (such as recall and defect information observed in similar vehicles for similar components). Suppliers in particular should be sure to understand — and clearly document — the intended use of their products and, to whatever extent possible, clarify the limits of their responsibility.

STOUT ANALYSIS: ELECTRONIC COMPONENTS

Stout's analysis of automotive electronic defects for 2017 highlights the role of software in the failure and remedy of electronic defects. Our analysis focuses on the following categories:

INTEGRATED ELECTRICAL COMPONENTS (IECS)

Failure of electrical components due to physical defect. This includes defects related to water intrusion, wiring failure, etc.

SOFTWARE INTEGRATION

Failure results from software interfacing with other components or systems in the vehicle.

SOFTWARE DEFECT

Failure of components related to defect in operating software.

SOFTWARE REMEDY

Software flash or replacement is identified as the appropriate defect remedy.

FIGURE 11 / RECALLS OF ELECTRONIC COMPONENTS BY YEAR*

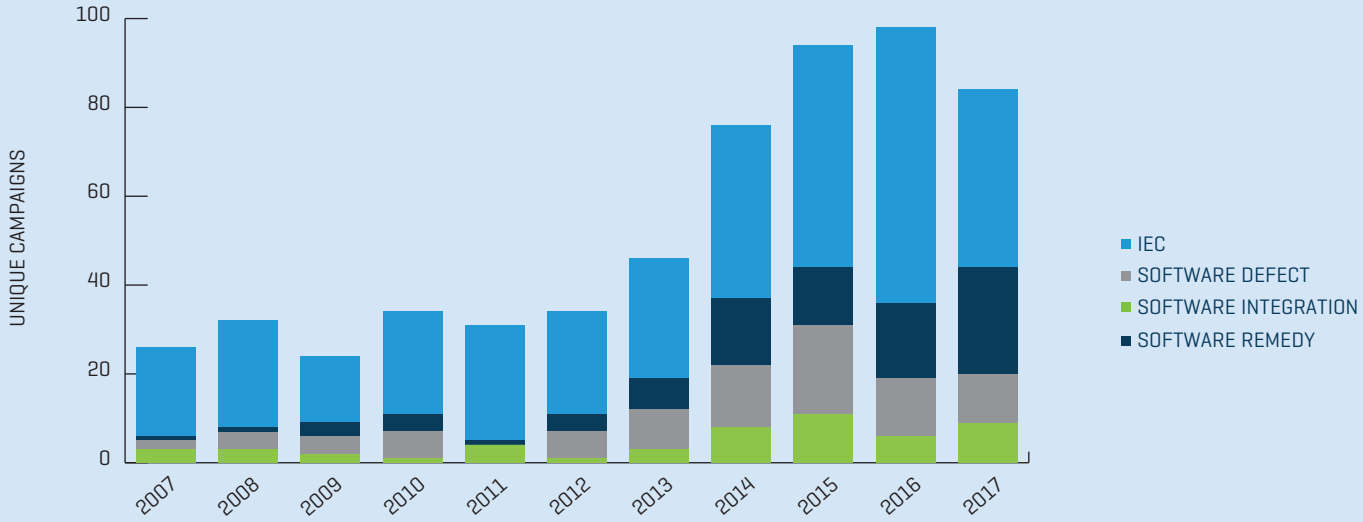


FIGURE 12 / RECALLS OF ELECTRONIC COMPONENTS BY YEAR*

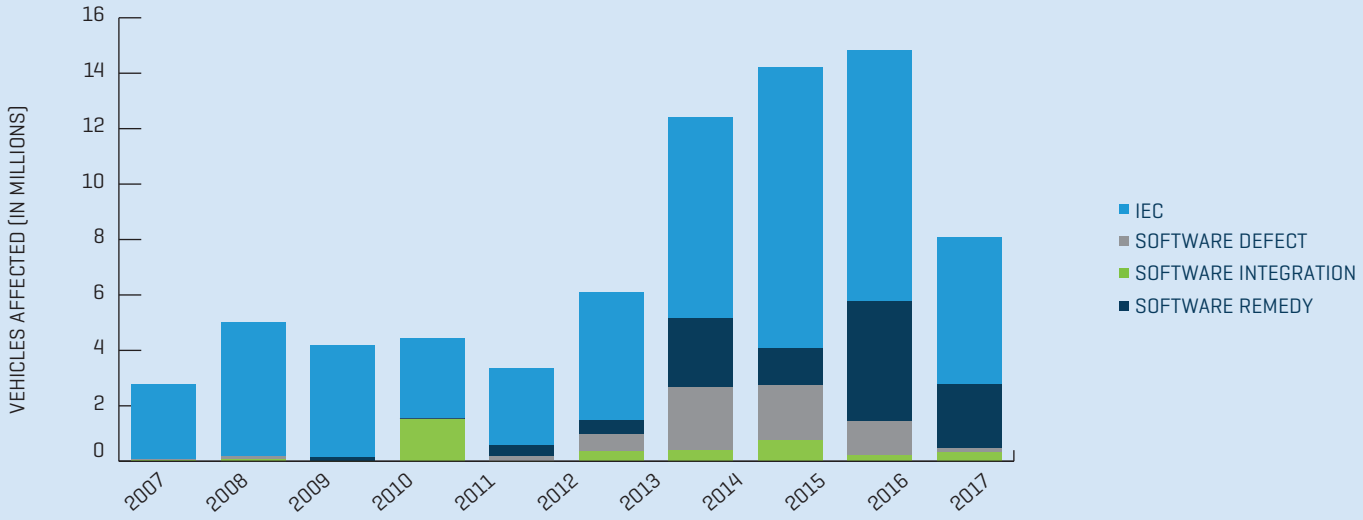
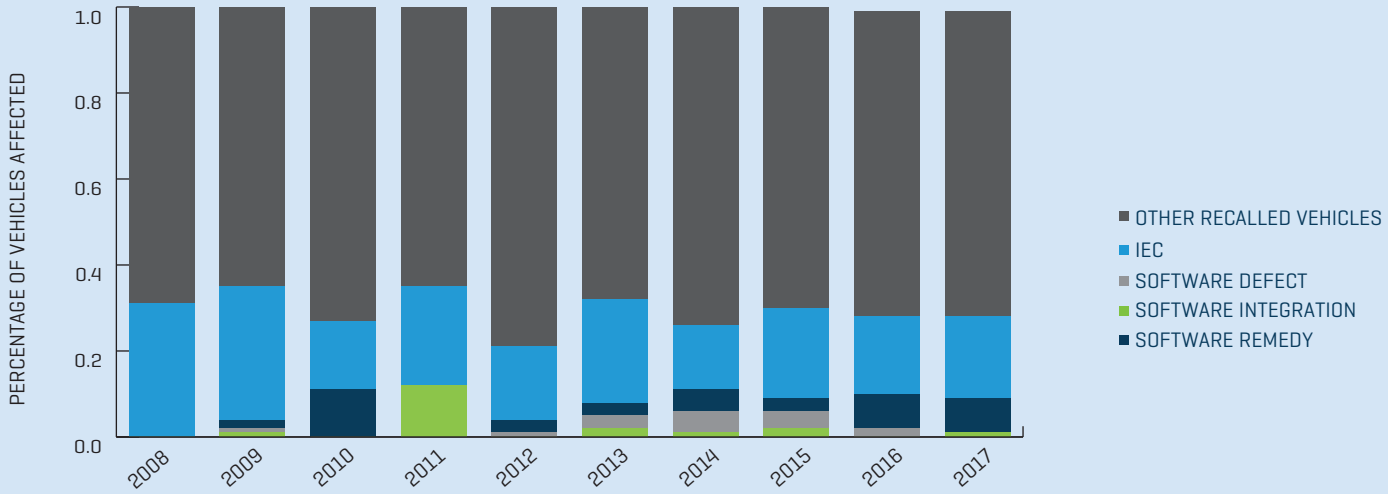


FIGURE 13 / RECALLS OF ELECTRONIC COMPONENTS BY YEAR



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**Excludes Takata inflator recall campaigns.*

Recalls involving integrated electronic components and software have consistently increased since 2012. However, as *Figures 11* and *12* illustrate, we observed a decrease in electronics-related recall campaigns in 2017, and a significant decrease in the number of vehicles affected by recalls involving electronic components, reflecting 2017's industrywide reduction in recall activity.

Figures 11 and *12* also show that defects related to IECs are most prevalent within the electronic components category, which may be related to the pervasiveness of these components in vehicles.

SOFTWARE REMEDIES ON THE RISE

As *Figure 13* indicates, software remedy continues to be a viable recourse for vehicles with electronic component defects. This is a noteworthy trend for manufacturers and suppliers because an over-the-air software remedy (OTA) could greatly reduce the costs associated with a recall campaign, specifically in regard to materials and labor.

While the vast majority of software updates are still likely taking place in a traditional dealership setting — outside of Tesla vehicles, which have had the ability to use remote over-the-air (OTA) remedies to update certain systems since 2012[15]– remote updates for nonsafety features like changing satellite radio stations and updating navigation maps are not uncommon.

FORD AND GM HAVE ANNOUNCED THAT CERTAIN 2020 VEHICLES WILL HAVE OTA CAPABILITIES THAT ADDRESS UPGRADES AND FAULTY SOFTWARE FIXES.[16]

PERHAPS THE BIGGEST RISK ASSOCIATED WITH OTA UPDATES IS THE NEW SOFTWARE ITSELF, AND HOW IT RESPONDS WHEN INTRODUCED INTO THE COMPLEX MATRIX OF A VEHICLE'S EXISTING NETWORK.

WITH REMEDY COMES RISK

In 2015, after researchers successfully "hacked" into a moving Jeep Cherokee, (which, it should be noted, was being driven by a consenting journalist),[17] FCA initiated a 1.4 million vehicle recall to fix the vulnerability.

While there have been no similar documented security breaches in the industry since then, this episode highlighted the increased exposure to cyber-risk that OEMs and suppliers face as their vehicles become more reliant on computer-based technologies and software.

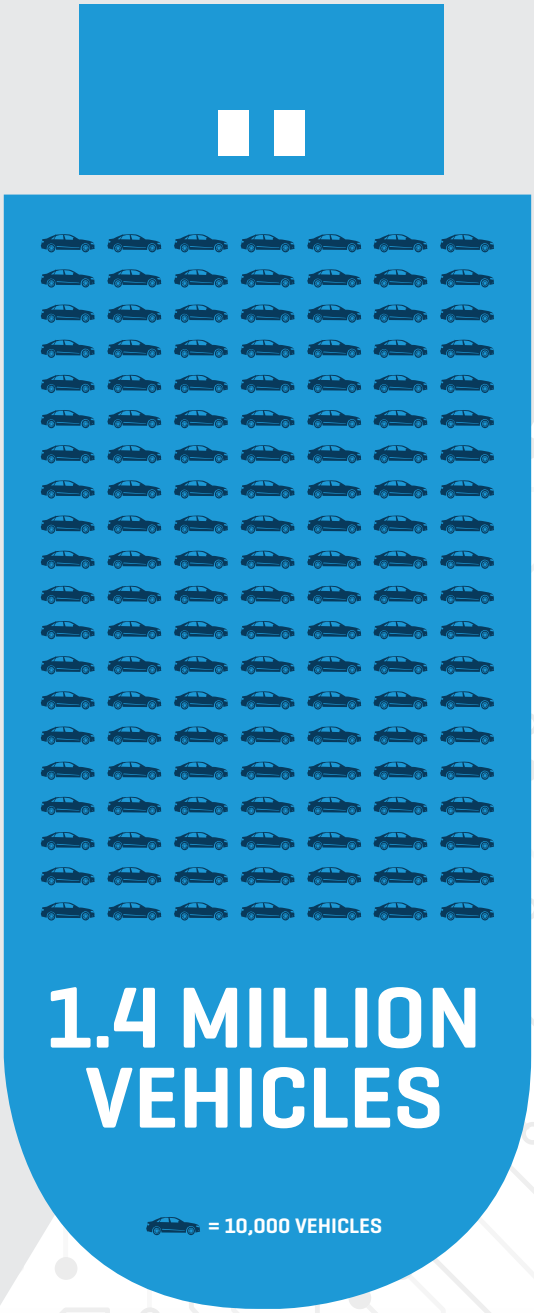
Perhaps the biggest risk associated with OTA updates is the new software itself, and how it responds when introduced into the complex matrix of a vehicle's existing network. Suppliers and OEMs will have to collaborate to ensure that software updates not only remedy the potential defect they were designed for, but also integrate seamlessly with the existing technologies in a vehicle.

SOFTWARE REMEDY & RECALL COMPLETION PERCENTAGE

An OTA remedy presents an opportunity for increased recall completion since it will almost always be more convenient for consumers than a trip to the dealership. OEMs can leverage this convenience in their outreach to vehicle owners as a means to generate more compliance. The FCA recall referenced earlier is a good example, as it achieved an unusually high completion percentage for a recall of its size, most likely due to the convenience of the software remedy presented to consumers.

FCA CYBER SECURITY RECALL

99% COMPLETION PERCENTAGE



Owners had the option to receive a USB drive in the mail and perform a vehicle update themselves, download software to a USB and initiate the update, or take their vehicle to the dealer.

ADVANCED DRIVER ASSISTANCE SYSTEMS (ADAS)

ADAS continue to garner significant attention from the public, NHTSA, and Congress. Even though many ADAS components are still early in the product lifecycle and have yet to be widely adopted, NHTSA has proactively created Forward Collision Avoidance and Lane Departure component designations across various datasets. This is an indication that NHTSA recognizes the increase in upcoming ADAS activity and is putting measures in place to ensure it can be adequately monitored.

As Stout continues to assess ADAS components, we are beginning to observe indications of ADAS-related component defects, although there have been a limited number of recalls, service bulletins, and investigations thus far.

Despite limited available data at this time, there was meaningful legislative, regulatory, and policy activity regarding ADAS in 2017:

ON SEPTEMBER 6, 2017, THE HOUSE PASSED THE SAFELY ENSURING LIVES FUTURE DEPLOYMENT AND RESEARCH IN VEHICLE EVOLUTION ("SELF DRIVE") ACT.[18]

Included in the SELF DRIVE Act are provisions that do the following:

1. Expand NHTSA's authority and state preemption for autonomous vehicles.
2. Update the Federal Motor Vehicle Safety Standards for highly automated vehicles.
3. Establish a requirement that OEMs develop a cybersecurity plan.
4. Amend general exemptions and testing requirements in FMVSS.
5. Require the Secretary of Transportation to perform a study and initiate a rule-making proceeding to require manufacturers to inform consumers of the capabilities and limitations of autonomous vehicles.
6. Establish a Highly Automated Vehicle Advisory Council in NHTSA.

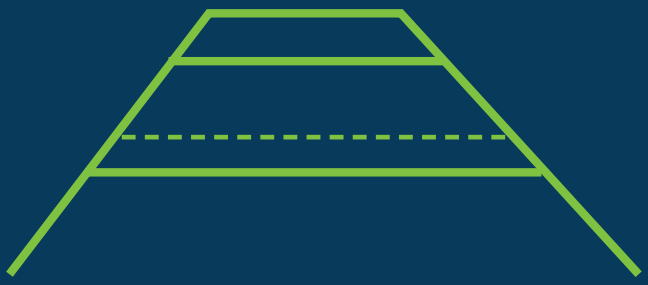
A SIMILAR BILL, CALLED THE AV START ACT, WAS INTRODUCED IN THE SENATE.

On September 12, 2017, the U.S. Department of Transportation released the federal government's policies related to autonomous vehicles, titled *Automated Driving Systems 2.0: A Vision for Safety.* The document is an update to the previously issued Federal Automated Vehicle Policy Statement. The nonbinding policy statement includes the following:[19]

» **Voluntary Guidance for Automated Driving Systems (ADS)**
Details 12 priority safety design elements for the testing and deployment of Automated Driving Systems, including cybersecurity, human machine interface, crashworthiness, consumer education and training, and post-crash ADS behavior.

» **Technical Assistance to States, Best Practices for Legislatures Regarding Automated Driving Systems**
Clarifies and delineates federal and state roles in the regulation of ADAS.

IN MAY 2018, NHTSA MADE IT MANDATORY FOR **ALL NEW VEHICLES TO BE EQUIPPED WITH BACKUP CAMERAS,** REINFORCING THE NOTION THAT DRIVER ASSISTANCE EQUIPMENT IS BECOMING INCREASINGLY STANDARDIZED.[20]

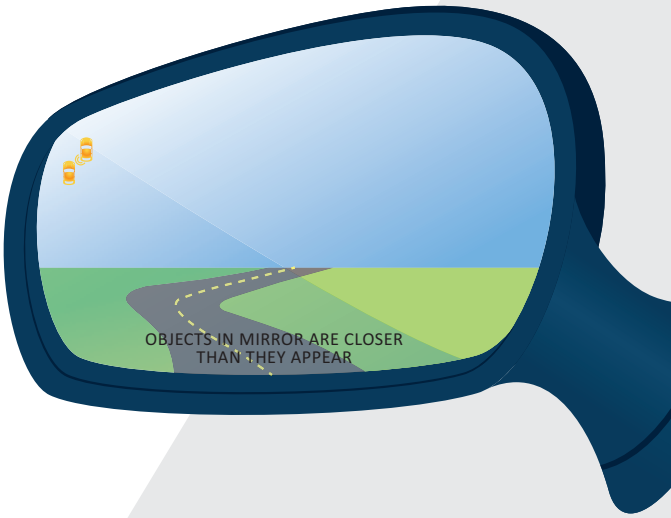


NHTSA ADDED A COMPONENT DESIGNATION FOR LANE DEPARTURE SYSTEMS IN 2017 ASSOCIATED WITH TWO RECALLS:

2016-2017 MERCEDES-BENZ METRIS VAN

37 VEHICLES AFFECTED

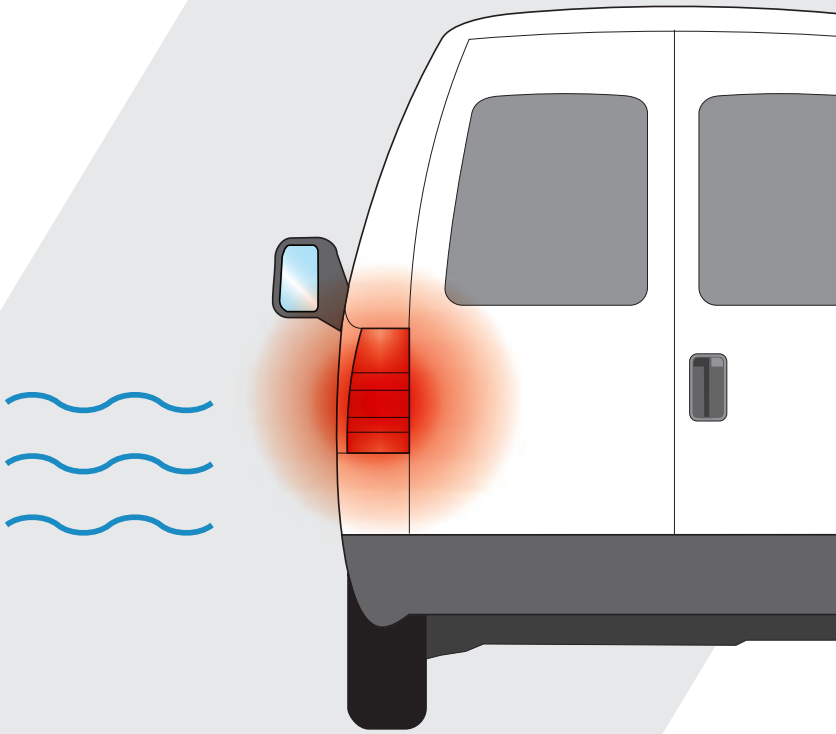
Instrument panel installed does not support Blind Spot Monitoring function equipment.



2017 MERCEDES-BENZ & FREIGHTLINER SPRINTER 3500 VANS

2,177 VEHICLES AFFECTED

Automatic brake interventions might not be activated in strong crosswinds.



THE CHALLENGES AND BENEFITS OF PROGRESS

The proliferation of computer-based electronic components and software in passenger vehicles has made integration a necessary point of emphasis for OEMs and suppliers. Considering not just whether a component will work, but how it will work alongside other components should be a baseline expectation for OEMs and suppliers moving forward.

The same technological advancements that are making risk assessment more challenging for OEMs and suppliers are also providing them with more progressive recall solutions like software remedy and OTA updates. Although not without risk, the use of software remedy continued to increase in 2017, a trend that should continue well into the future.

AIRBAG COMPONENT DEFECTS

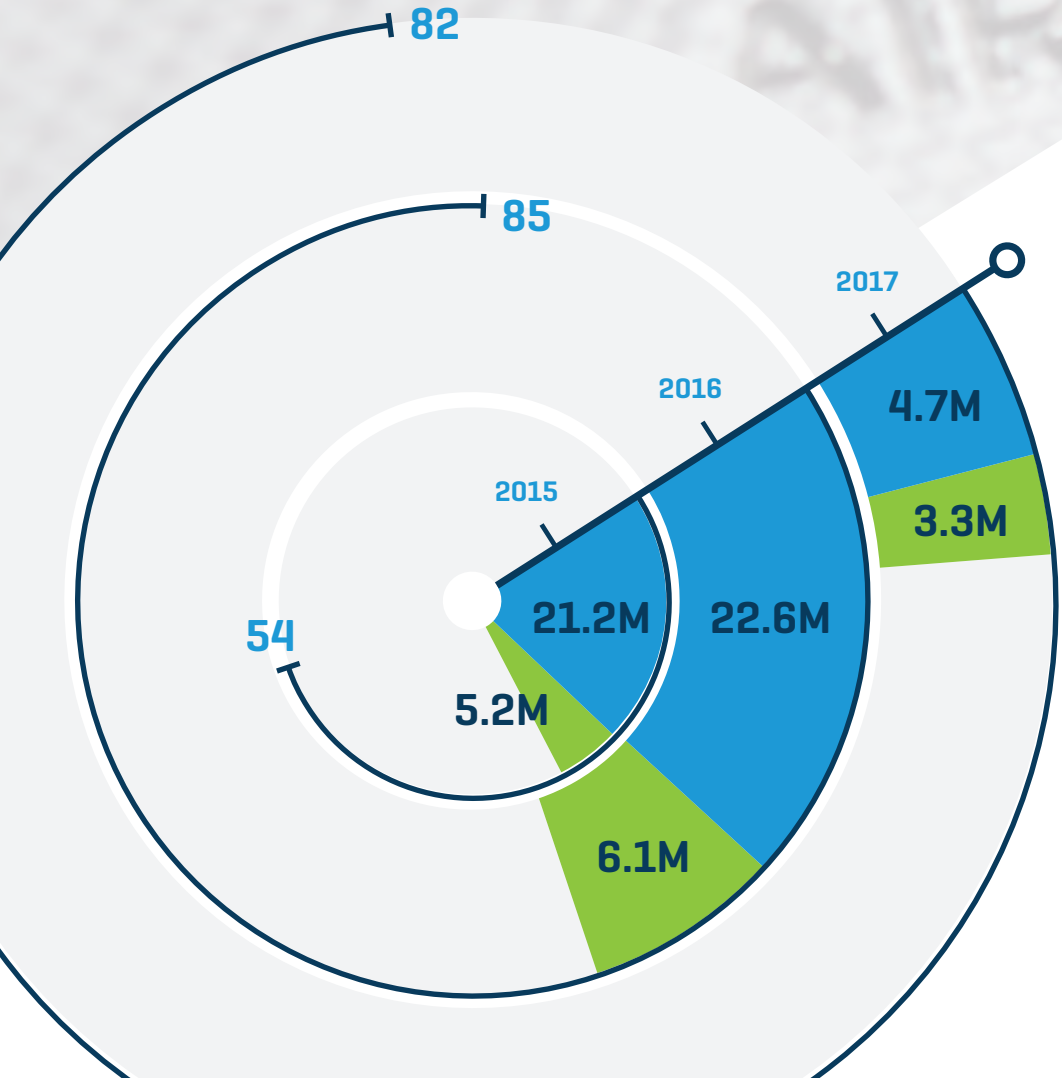


FIGURE 14 / UNIQUE AIRBAG CAMPAIGNS AND VEHICLES AFFECTED BY YEAR

- VEHICLES AFFECTED BY THE TAKATA AIRBAG RECALLS
- VEHICLES AFFECTED IN OTHER AIRBAG RECALLS
- UNIQUE AIRBAG RECALL CAMPAIGNS

NHTSA ESTIMATES THAT OVER **47,000 LIVES WERE SAVED** BY FRONTAL AIRBAGS FROM 1987 THROUGH 2016, INCLUDING **2,700 LIVES SAVED IN 2016 ALONE**.

Frontal airbags have been standard equipment in all cars since model year 1998, and in all SUVs, pickup trucks, and vans since 1999.[21] Since that time, manufacturers have introduced additional airbags throughout the vehicle (side, knee, etc.). As discussed further below, airbag defects are an increasing global trend as well.

The successful deployment of an airbag is the result of a split-second chemical reaction created by the interaction of multiple components. The components, including an inflator with chemical compounds, an accelerometer, numerous sensors, circuits, a heating element, and the cushion, work in concert to slow and disperse the forward momentum of a passenger involved in a vehicle collision. The entire life-saving process, from collision to full deployment, takes approximately 1/20th of a second.[22]

NHTSA estimates that over 47,000 lives were saved by frontal airbags from 1987 through 2016, including 2,700 lives saved in 2016 alone.[23]

The Takata airbag recalls have dominated industry headlines for the past several years. In 2017, as part of the scheduled expansion of the Takata recalls, the number of additional vehicles affected by the Takata recalls declined for the first time since the campaigns began (*Figure 14*).

IN 2017, EVEN EXCLUDING THE VEHICLES AFFECTED BY THE TAKATA RECALLS, THERE WERE STILL OVER

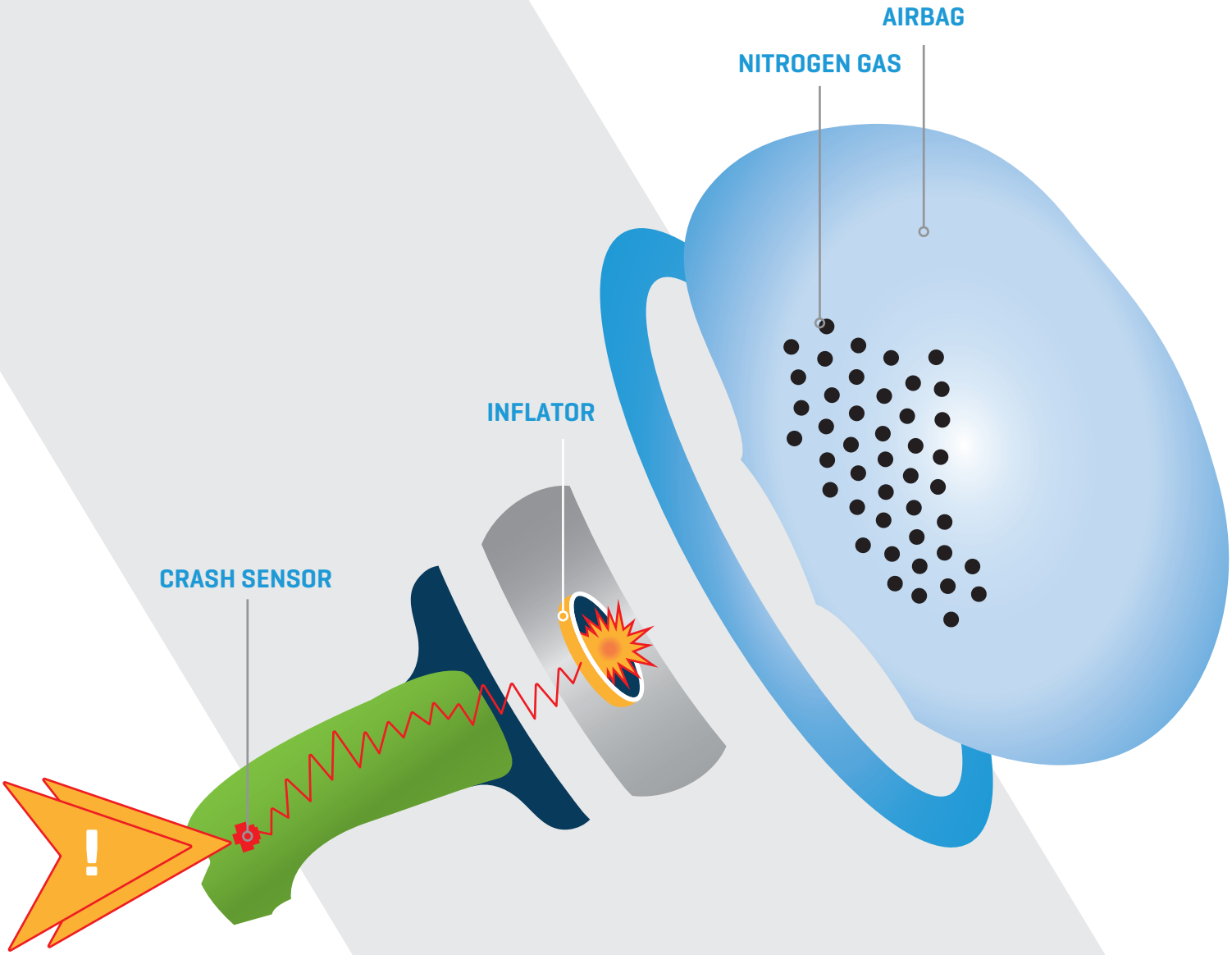
3 MILLION **VEHICLES AFFECTED BY AIRBAG RECALLS**

THAT'S NEARLY

15% **OF ALL THE NON-TAKATA VEHICLES FOR THE ENTIRE YEAR**

This highlights the fact that historically airbag components have been among the most frequently recalled, which may be due in large part to the complexity of the airbag "system."

THE ENTIRE LIFE-SAVING PROCESS, FROM COLLISION TO FULL DEPLOYMENT, TAKES APPROXIMATELY 1/20TH OF A SECOND.[22]



AIRBAG COMPONENTS

Continuing the trend from years past, a variety of airbag components prompted recalls in 2017. *Figure 15* shows the component distribution for 2017, as well as the past several years.

Figure 16 demonstrates the significant decrease in the number of vehicles affected by non-Takata airbag recalls in 2017, (although that number was still over 3 million). It also shows how cushions continued to affect a significant number of the vehicles represented, and the notable activity that has occurred with occupant classification systems (OCS) in the past three years.

While *Figure 17* notes that the overall average completion percentage for vehicles recalled in non-Takata airbag campaigns is 77%, similar to the overall industry average for all recalls, there is a significant difference in the completion percentage after six quarters for vehicles recalled in non-Takata airbag campaigns involving older vehicles (32.5%) and newer vehicles (81.6%).

Also notable in *Figure 17* is the completion percentage disparity among airbag components. Defects affecting the driver's side have a far higher completion percentage than those affecting the passenger's. Drivers may consider the risk to passengers to be less imminent, especially as studies have shown that vehicles have passengers less than 30% of the time.

DEFECTS AFFECTING THE DRIVER'S SIDE HAVE A FAR HIGHER COMPLETION PERCENTAGE THAN THOSE AFFECTING THE PASSENGER'S.

FIGURE 15 / UNIQUE AIRBAG CAMPAIGNS BY COMPONENT & YEAR (EXCLUDING TAKATA RECALLS)

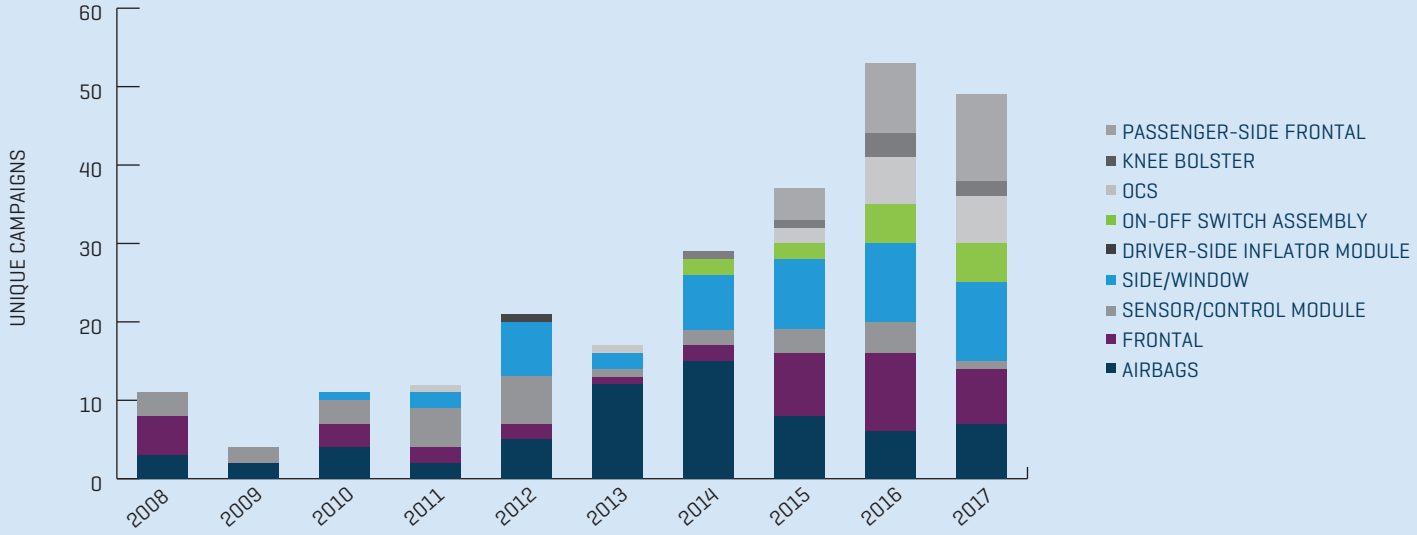


FIGURE 16 / VEHICLES AFFECTED BY AIRBAG COMPONENT & YEAR (EXCLUDING TAKATA RECALLS)

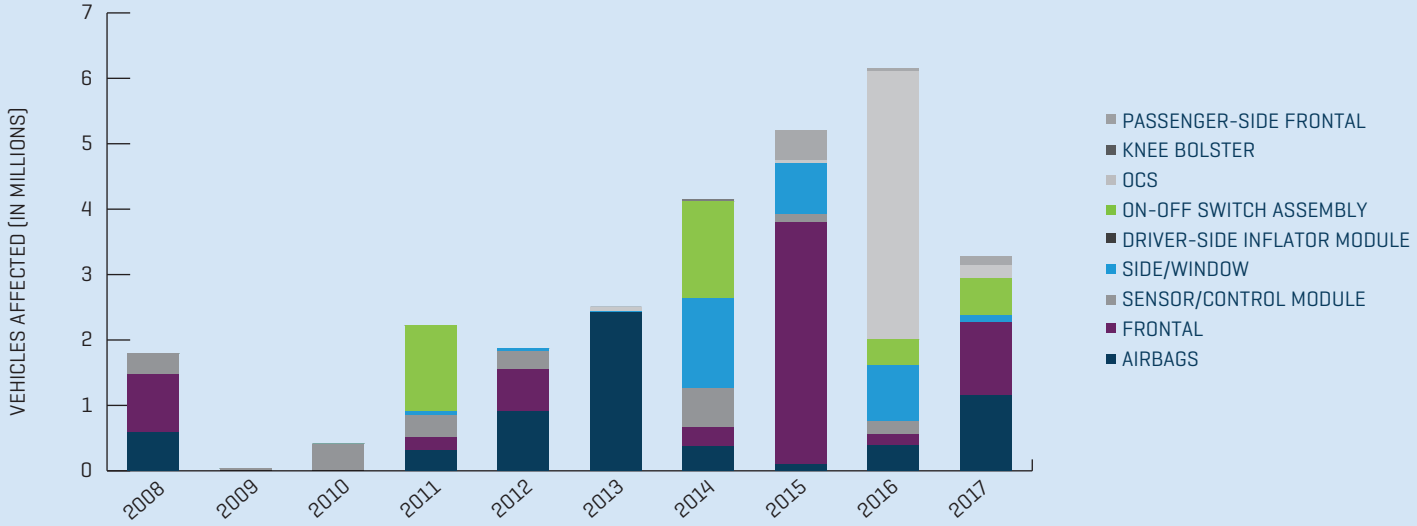
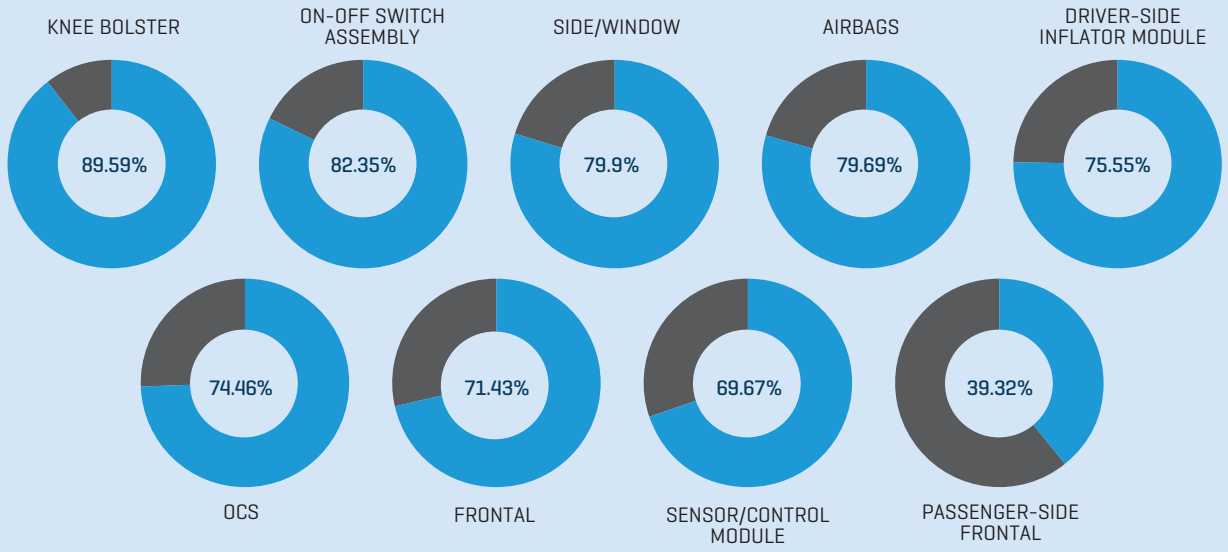


FIGURE 17 / SUMMARY OF AVERAGE COMPLETION PERCENTAGE BY AIRBAG COMPONENT (SINCE 2008)



Contains data for BMW, Daimler AG, FCA, Ford, General Motors, Honda, Isuzu, Kia, Mazda, Mitsubishi, Nissan, Subaru, Jaguar, Land Rover, Tesla, Toyota, Volkswagen, and Volvo. Identified from dataset updated through 2017.

A FOCAL POINT FOR RISK ASSESSMENT

As new technologies and software continue to be introduced into today's vehicles, OEMs and suppliers must be wary of how airbag systems could be affected by these new technologies. The efficacy of the airbag system is only one part of the modern-day equation; how it integrates into the overall ecosystem of a vehicle is another. Airbags are also susceptible to environmental factors, as the Takata recalls have demonstrated.

Airbags present OEMs and suppliers with a number of different risk scenarios to consider, including how the airbag system will behave on its own, how it will interact within the vehicle, and how it will respond in the midst of potentially challenging environmental factors. In the case of the GM unintended key-rotation recall, GM personnel identified the vehicle-stall condition resulting from the unintended rotation as a customer-convenience issue and failed to appreciate the interaction between the ignition switch failure and airbag deployments. As a result, more than a dozen deaths were caused by incidents that involved an airbag that failed to deploy as a result of the ignition-switch defect.[24]

ENVIRONMENTAL CONDITIONS & MATERIALS

In 2017, up to 1 million vehicles are estimated to have been damaged or destroyed by flooding related to Hurricanes Harvey and Irma.[25]

Motor vehicles are designed and built to function in a variety of climates and conditions, whether it's the dry heat in Arizona, a windswept winter in Chicago, the frigid conditions of Alaska, or the heat and humidity of Texas, Florida, and Puerto Rico. However, despite the best efforts and intentions of OEMs and suppliers to continually fortify their vehicles against the elements, Stout has observed a significant number of component defects in the past decade that can be attributed to environmental conditions.

Environmental factors have been the cause of 144 unique campaigns in the past 10 years, impacting approximately 25 million vehicles (excluding Takata recalls).

Any number of environmental factors can trigger a component defect, from more obvious natural phenomena like extreme temperatures and moisture to exposure to elements like dust, debris, and de-icing salts and solutions.

As we witnessed in 2017, environmental factors can have a significant impact on vehicle components:

» HONDA recalled 1.1 million vehicles as a result of water entering the battery sensor case and potentially causing an electrical short.

» FORD recalled 1.5 million vehicles due to frozen door latches.

As part of the design, engineering, and production processes, it's vital for OEMs and suppliers to consider how their components are going to be used, and in what environment, so they can put the necessary protections in place. A control module built to spec is ideal, but only if it resides in a compartment that's designed to protect it from the rigors of the environment where it will be used.

IN 2017, UP TO 1 MILLION VEHICLES ARE ESTIMATED TO HAVE BEEN DAMAGED OR DESTROYED BY FLOODING RELATED TO HURRICANES HARVEY AND IRMA.[25]

STOUT'S ANALYSIS: MEASURING HOW EXPOSURE TO THE ENVIRONMENT INFLUENCES COMPONENT FAILURES

Stout's analysis of component failures related to environmental exposure and corrosion (EEC) examines recalls where various environmental conditions are identified in the defect descriptions. We have isolated these defects with descriptions including the following:

CLIMATE | **ENVIRONMENTAL** | **CORROSION** | **DEBRIS**

ACCORDING TO AAA, 70% OF AMERICAN DRIVERS HAVE BEEN AFFECTED BY ISSUES ASSOCIATED WITH DE-ICING SALTS AND SOLUTIONS, SPENDING $3 BILLION ANNUALLY TO REPAIR DAMAGE CAUSED BY RUST.[26]

SALT

MOISTURE INTRUSION

Stout reviewed the defect and remedy descriptions in these EEC recalls to derive a unique data set, and extrapolate key features including the frequency and scale of recalls, components affected, and the ages of affected vehicles.

As *Figure 18* indicates, we observed a decline in the number of unique recall campaigns related to environmental conditions in 2017, but a significant increase in the number of vehicles affected.

As *Figures 19* and *20* demonstrate, there were far more unique campaigns affecting vehicles three-years-old and under than there were campaigns affecting older vehicles, which continues a trend that began in 2014.

These findings highlight one of the more significant themes of 2017, and one we touched on earlier in this report — the ability of OEMs and suppliers to identify component defects early, initiate recalls quickly, and limit the number of older vehicles involved.

ENGINEERING FOR POSSIBILITIES

In light of the emerging data from Stout's analysis, OEMs and suppliers need to continue to think strategically about how components will be used and where. While there will always be an unknown element in predicting the effect of weather and other environmental factors, 2017 showed the importance of taking all possibilities into consideration.

FIGURE 18 / UNIQUE EEC CAMPAIGNS AND VEHICLES AFFECTED BY YEAR (EXCLUDING TAKATA RECALLS)

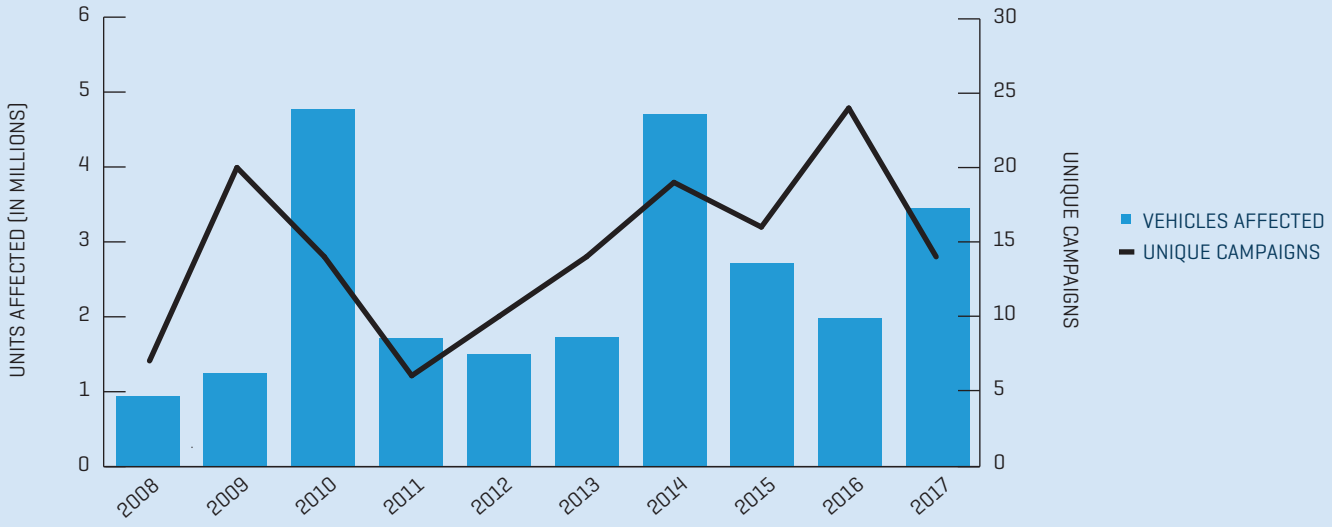


FIGURE 19 / UNIQUE EEC CAMPAIGNS BY AGE AT TIME OF RECALL (EXCLUDING TAKATA RECALLS)

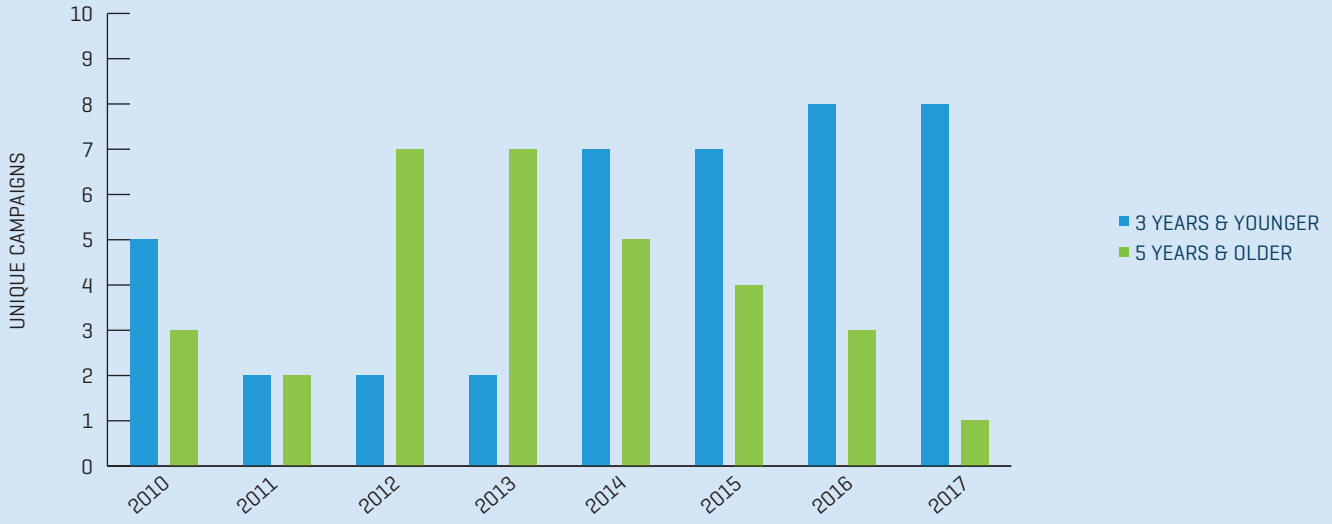
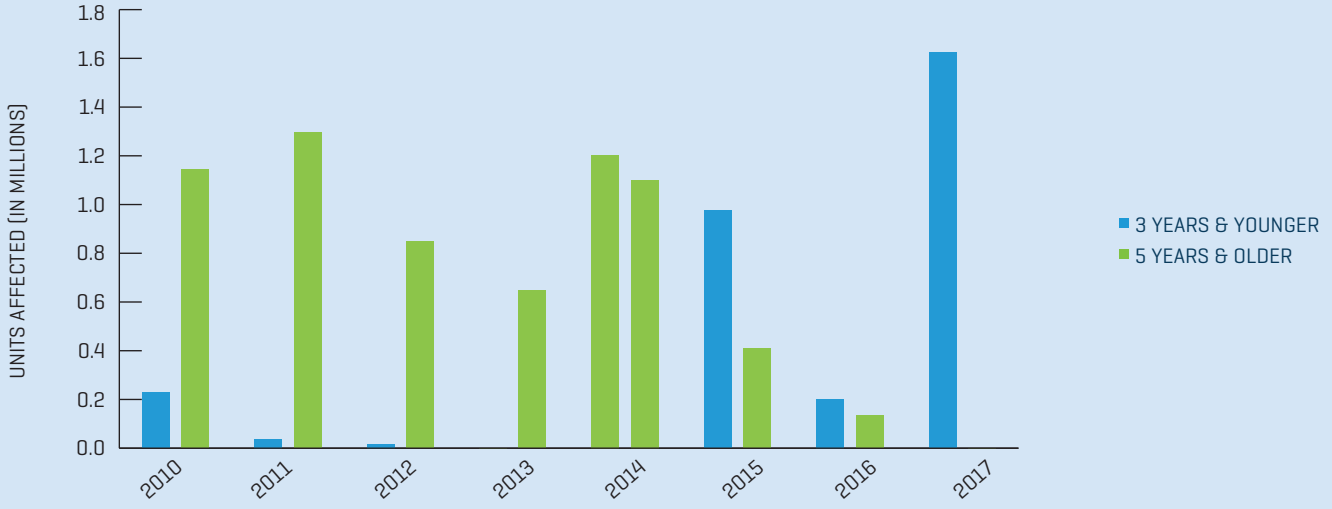


FIGURE 20 / VEHICLES AFFECTED BY EEC CAMPAIGNS BY AGE AT TIME OF RECALL (EXCLUDING TAKATA RECALLS)



Contains data for BMW, Daimler AG, FCA, Ford, General Motors, Honda, Isuzu, Kia, Mazda, Mitsubishi, Nissan, Subaru, Jaguar, Land Rover, Tesla, Toyota, Volkswagen, and Volvo. Identified from dataset updated through 2017.

GLOBAL RECALL EXPOSURE

As the supply and production of automotive components continues to become more globally standardized — with OEMs using the same or similar platforms of production around the world — manufacturers and suppliers face increased exposure to global risk. The ramifications of a multi-country recall can be devastating. In order to create a comprehensive risk-management strategy, OEMs and suppliers must take the data and trends from international markets into account.

For the preparation of this report, Stout compiled a comprehensive analysis of public records from Australia, Brazil, Canada, Germany, Japan, and the United Kingdom. We also performed a thorough examination of NHTSA records of international recalls involving vehicles similar to those sold in the U.S. (OEMs are required to inform NHTSA about these international campaigns involving similar vehicles.)

Gathering recall data from countries outside the U.S. is a challenge. Often times, the information made available and the format in which it's presented differs from country to country. Generally, each country provides information that shows the number of vehicles affected by a recall campaign, including their makes, models, model years, and the defect description. Due to the variation in the data we accumulate, Stout's analysis relies on a review of the information provided by each country.

For example, our analysis of 2017 recall activity in Australia as shown in *Figure 21* reveals an increase in airbag activity as well as activity in the electrical component and powertrain categories. These trends were consistent with what occurred in the U.S. this past year.

When we take an expanded view of all six of our international subjects, as represented in *Figure 22*, we see that all of the countries showed a slight decrease in their number of recall campaigns in 2017. While there were fewer vehicles affected by recalls, airbag components and electrical system defects continued to be leading contributors to recall activity. The consistency of this data collected from multiple countries reflects the initiative of OEMs to utilize the same production platforms in all of their global markets — a cost-effective strategy that optimizes efficiency, but one that also increases the potential risk of global recall consequences.

FIGURE 21 / PERCENT OF UNIQUE AUSTRALIAN RECALL CAMPAIGNS BY COMPONENT & YEAR

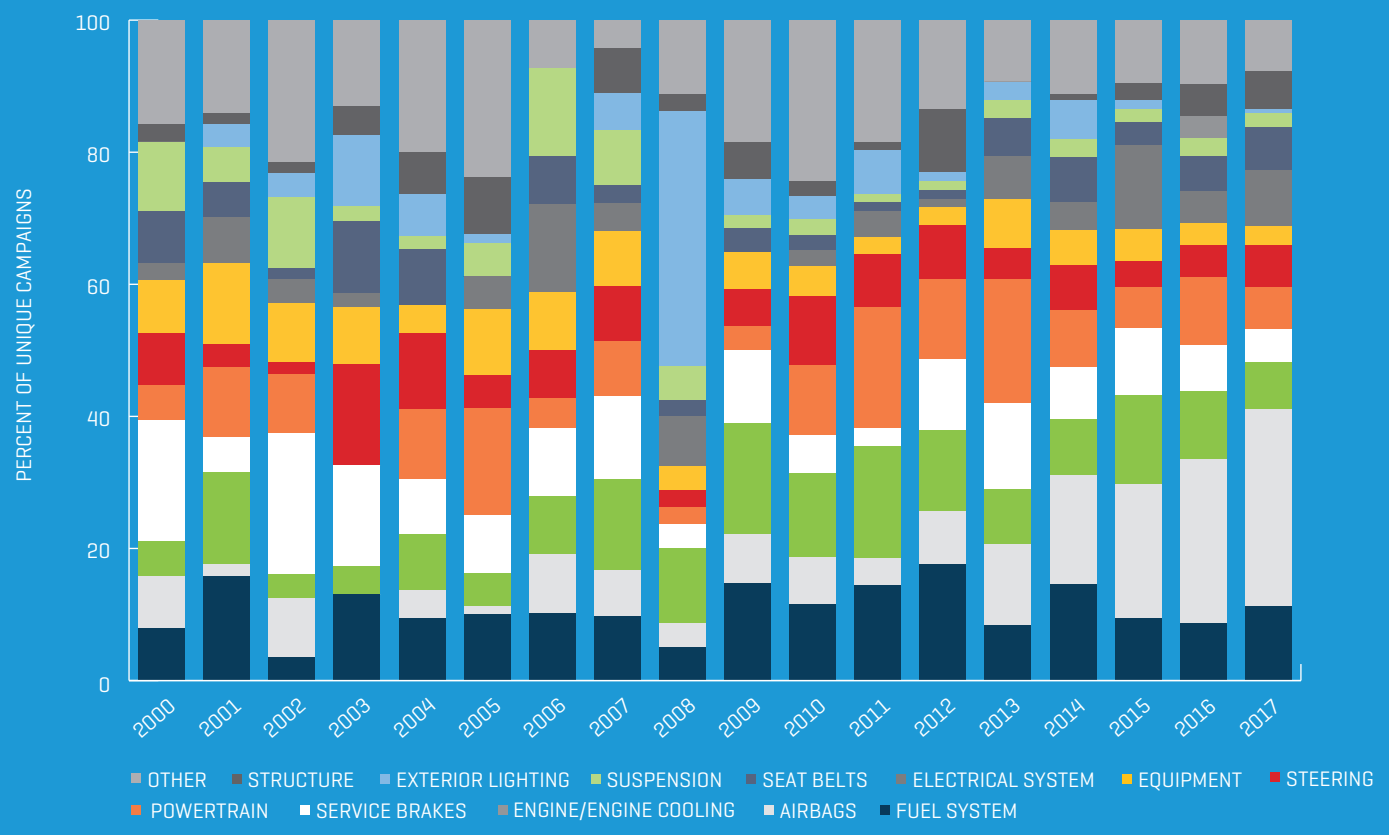
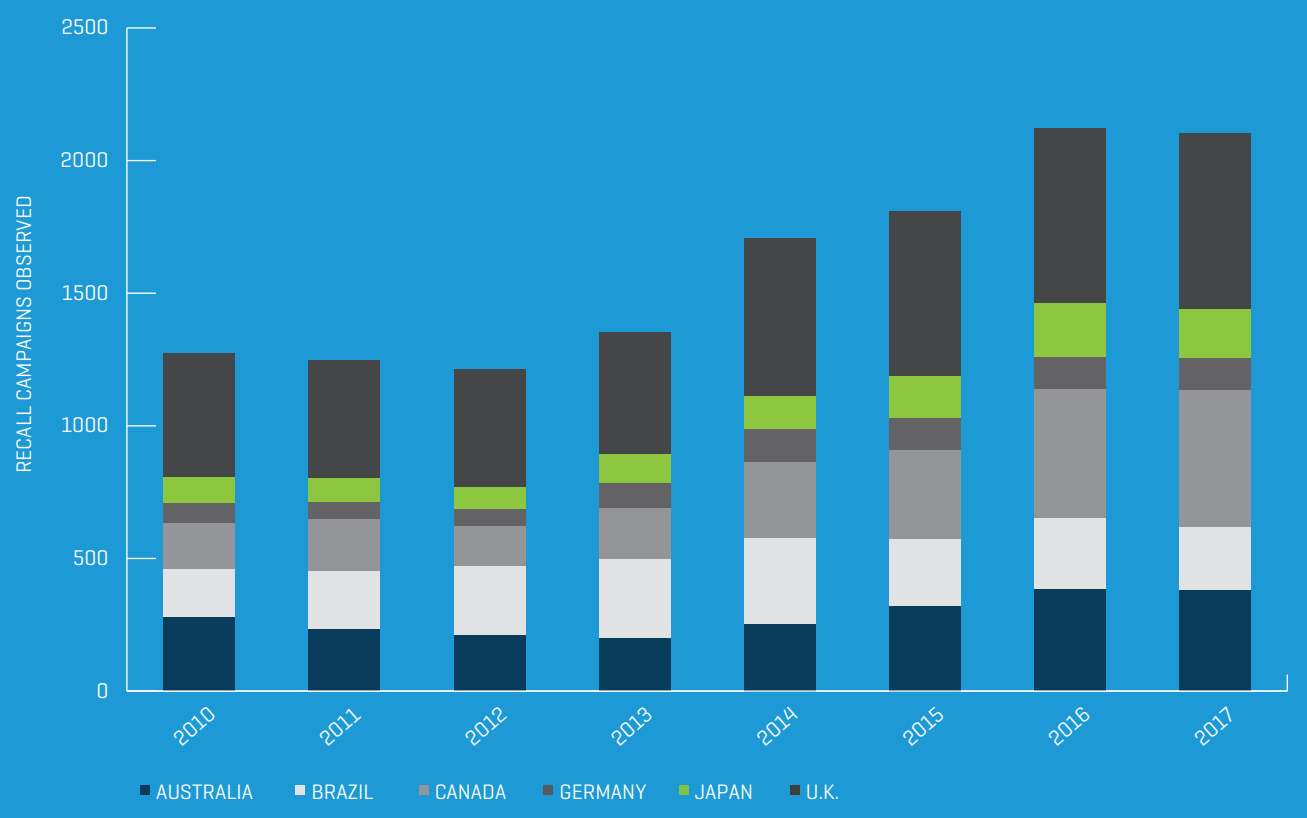


FIGURE 22 / INTERNATIONAL RECALL CAMPAIGNS BY COUNTRY AND YEAR



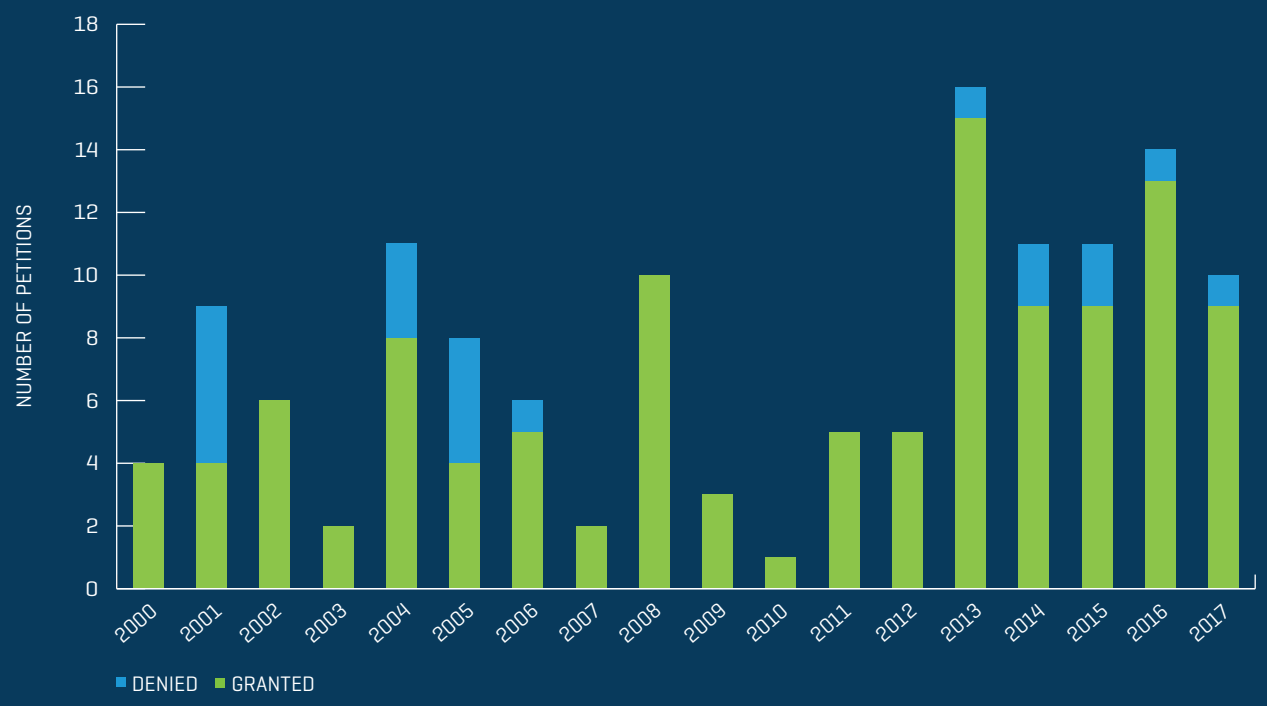
PINS & EXTERIOR VISIBILITY

When manufacturers acknowledge the existence of a potential violation that the manufacturer believes does not pose a safety risk to the public, they can submit a Petition for Inconsequential Noncompliance (PIN) to NHTSA. If/when a PIN is granted, the petitioning manufacturer is relieved of any further responsibility to provide notice and/or to remedy the defect or noncompliance in question. A denial of the PIN from NHTSA will continue to enforce all duties of the manufacturer relating to notice and remedy of the noncompliance.

As *Figure 23* reveals, most PINs are granted by NHTSA. In fact, NHTSA has only denied seven PINs in the past five years.

During Stout's review of PIN activity, we identified a trend involving exterior visibility components: four of the seven recent PIN denials were in this area. To gain a better understanding of any other trends or issues pertaining to exterior visibility, Stout conducted additional targeted analysis.

FIGURE 23 / PETITIONS FOR INCONSEQUENTIAL NONCOMPLIANCE
GRANTED AND DENIED REQUEST BY YEAR



Contains data for BMW, Daimler AG, FCA, Ford, General Motors, Honda, Isuzu, Kia, Mazda, Mitsubishi, Nissan, Subaru, Jaguar, Land Rover, Tesla, Toyota, Volkswagen, and Volvo. Identified from dataset updated through 2017.

2018

DENIED

NHTSA denied a BMW petition related to a failure of some of the rear reflex reflectors on the affected vehicles to fully conform to the minimum photometric performance required.

2017

DENIED

NHTSA denied a Daimler (Mercedes-Benz) petition related to the sealing caps of a horizontal adjustment screw associated with visually aimed headlamps.

2016

DENIED

NHTSA denied a Daimler (Mercedes-Benz) petition related to the candle power output level of turn signals resulting from a programming issue.

DENIED

NHTSA denied a GM petition in which the indicator for a turn signal failure of a multiple-bulb turn signal would not illuminate until all bulbs failed.

DENIED

NHTSA denied a Daimler (Mercedes-Benz) petition related to a tire pressure monitoring system software mis-programming that resulted in the indicator light not illuminating properly.

DENIED

In 2015, NHTSA denied a GM petition related to the height of letters in labels that were applied to compressed natural gas vehicles.

2015

DENIED

NHTSA denied a Ford petition related to the formation of air bubbles in the windshield of F-Series trucks when subjected to high temperatures.

2014

FIGURE 24 / UNIQUE EXTERIOR VISIBILITY CAMPAIGNS AND VEHICLES AFFECTED BY YEAR

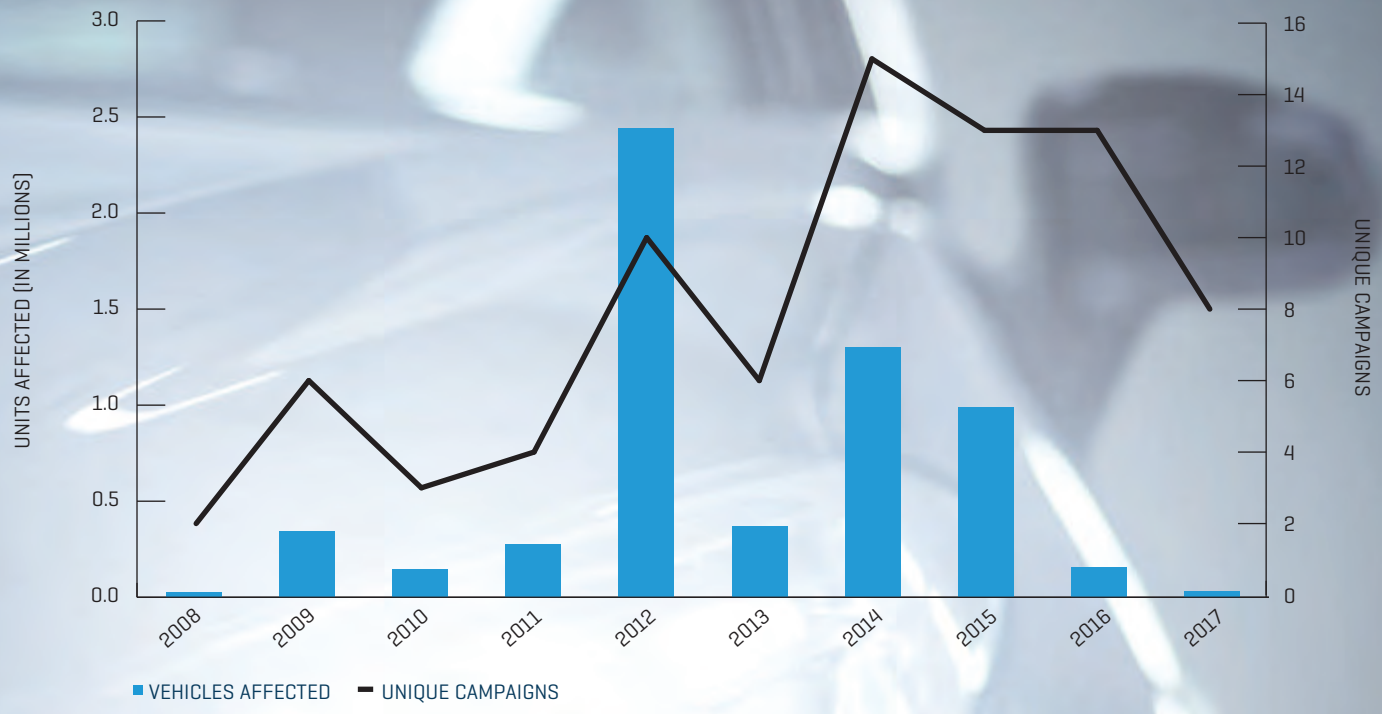
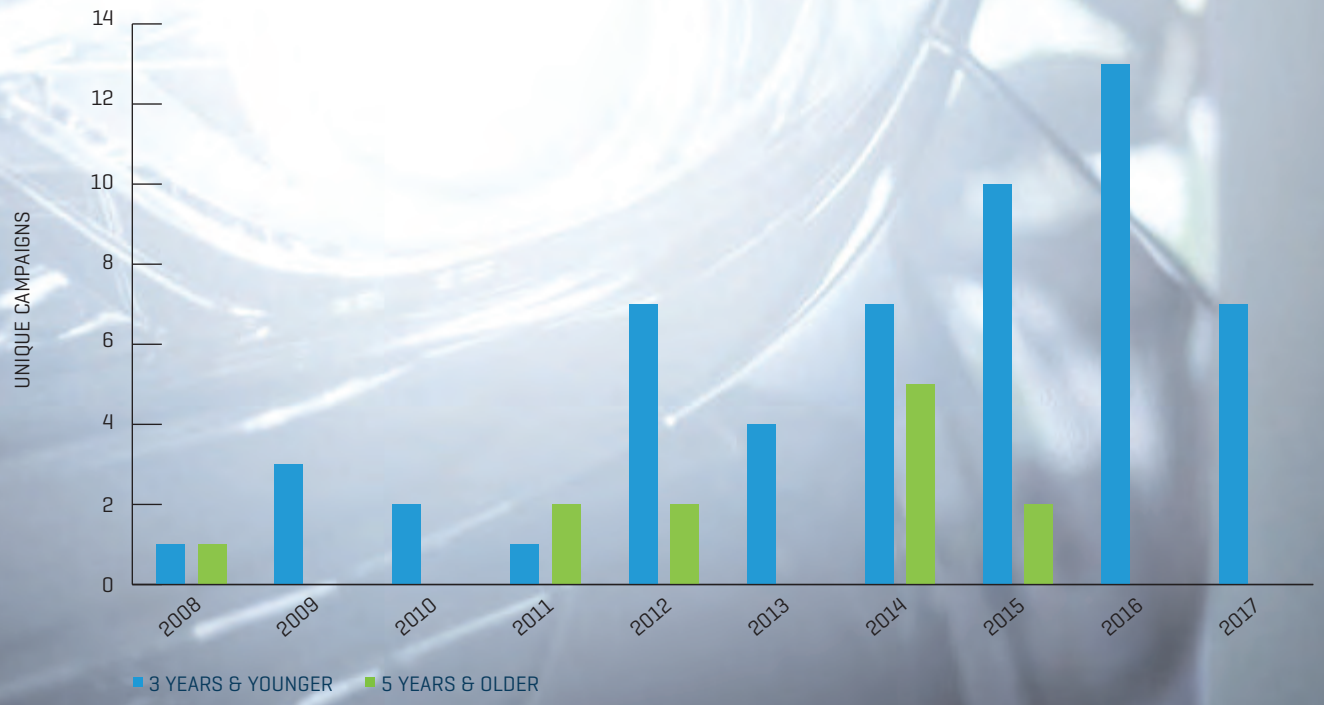


FIGURE 25 / UNIQUE EXTERIOR VISIBILITY CAMPAIGNS BY AGE AT TIME OF RECALL



Contains data for BMW, Daimler AG, FCA, Ford, General Motors, Honda, Isuzu, Kia, Mazda, Mitsubishi, Nissan, Subaru, Jaguar, Land Rover, Tesla, Toyota, Volkswagen, and Volvo. Identified from dataset updated through 2017.

STOUT ANALYSIS: SPOTLIGHTING EXTERIOR VISIBILITY

Stout performed keyword searches of recall data to identify those recalls with defect descriptions containing words like "reflector," "photometric," and "reflective." Within those recalls, we identified the following three categories of exterior-visibility-related defects:

MALFUNCTIONING COMPONENT

Identified component fails to function properly (e.g., switch fails and causes lamp not to illuminate).

NONCONFORMING COMPONENT

Identified component does not provide functionality at the level required by FMVSS (e.g., incorrect lenses may adversely affect turn signal visibility).

DRIVER INDICATION

Defect results in failure of vehicle to notify driver of potential failed visibility component (e.g., no indication to driver if turn signal bulb burns out).

As the data in *Figure 24* indicates, 2017 continued a downward trend of unique campaigns and vehicles affected by recalls associated with visibility defects. This may be related to NHTSA's scrutiny of these components, as evidenced by denials of petitions for inconsequential noncompliance in recent years.

Figure 25 reveals that exterior visibility campaigns only affected newer vehicles in 2017, providing another indication that OEMs may be working to more proactively identify and respond to component defects.

PINS AS COMPLEMENT TO OTHER DEFECT DATA

PINs can provide manufacturers and suppliers with valuable insight regarding certain components, and their various levels of risk assessment. In conjunction with other internal and external data and analysis, PINs can help suppliers and manufacturers gain a better understanding of which components may present an elevated level of recall risk or field service action.

STOUT'S AUTOMOTIVE COMPONENT KNOWLEDGE BASE

A MORE COMPLETE UNDERSTANDING OF RISK, BASED ON INTERNAL AND EXTERNAL DATA, PRESENTS UNIQUE COMPETITIVE ADVANTAGES FOR SALES, ENGINEERING, FINANCE, INSURANCE, AND LEGAL TEAMS IN YOUR ORGANIZATION.

As a supplier of automotive parts, understanding the risks and costs of recalls and other defects is increasingly essential. In addition to the internal knowledge of your team, you must also consider external data in order to fully understand and appreciate the risks and opportunities. A more complete understanding of risk, based on internal and external data, presents unique competitive advantages for sales, engineering, finance, insurance, and legal teams in your organization.

Stout's Automotive Component knowledge base contains the industry's most comprehensive analysis of component risk factors – leveraging more than 20 data sets from across the industry, including proprietary data sets built by Stout's team of automotive recall experts.

We can provide direct access to this data or provide a comprehensive assessment for components and consult with your team on how best to understand and apply our findings within your organization. With our expansive capabilities, experience, and expertise, we are uniquely positioned to provide your team with insights regarding recalls, technical service bulletins, cost recovery factors, recall completion percentages, repair costs, legislation, and litigation. We utilize the expertise of our client's cross-functional teams to develop complex text mining and analysis that is comprehensive and tailored to the specific components you supply.

With Stout's Automotive Component Knowledge base, suppliers can make better decisions across the board. Suppliers are adjusting to the new reality of an increased volume of recalls, as well as a heightened likelihood that they will be deemed partially or primarily responsible for the defect.

LEGAL

Provides information that is:
1) critical in identifying opportunities to mitigate risks through contractual clarifications with suppliers and customers.
2) valuable in responding to cost recovery actions from customers or pursuing cost recovery from subsuppliers.

FINANCIAL

Helps to determine the appropriate level of self-insurance (capital reserves) or assists third-party insurance providers in appropriately and reasonably pricing coverage.

PROCESS, ENGINEERING, & DESIGN

Can be integrated with internal information and expertise to provide opportunities for enhanced product development, design, production, and quality as well as continual feedback loops that assist in identifying risk mitigation opportunities and process improvements.

SALES

Can be used to identify products and sales opportunities with the greatest margin and lowest risk. It's also valuable to identify competitive advantages by identifying defects of competitors.

BOARD OF DIRECTORS

Provides a refined understanding of broad risk and exposure to the company related to recall and large-scale product defects.

CONCLUSION

As the automotive industry continues to transform, it's imperative for OEMs and suppliers to have systems in place that allow them to adapt to fast-moving industry changes.

New driver-assistance, autonomous vehicle, and over-the-air technologies continue to provide an exciting glimpse of what the very near future might look like, but they also present new challenges regarding how all of these advanced systems and components will interact. The global standardization of component production currently offers obvious financial and operational benefits to manufacturers, but it can also expose them to more global risk should an international recall become necessary.

In response to unprecedented challenges of the past and emerging areas of risk like the ones cited above, OEMs and suppliers are taking the initiative to implement safety protocols that fit the current pace of the industry. The industry saw fewer cars recalled, and an increase in smaller recall campaigns and higher completion percentages. However, there were still over 20 million vehicles recalled last year, affecting 19 vehicle manufacturers and 476 models.

As Stout's 2017 analysis revealed, risks related to system integration, airbag components, and visibility components all require continuing attention and risk-mitigation efforts. Environmental factors related to weather and water intrusion must be taken into consideration, as well. 2017 continued to show that understanding how and where a component is going to be used are essential factors to consider in the risk-mitigation process.

In order to insulate themselves from risk as best they can, suppliers need to have a sophisticated understanding of recall and component defect trends — both domestic and international — as well as an integrated, iterative, cross-functional process to both identify risks and remedy them.

A process that enables this type of agility will allow suppliers to pivot quickly in order to address current and developing risks, without negatively affecting margins or hindering their organization's ability to respond to new business opportunities and investments. Such processes also enable suppliers to create robust knowledge management platforms for the continuous improvement of risk-mitigation strategies to be applied across the organization over the long term.

While no one can perfectly predict the future ebbs and flows of the industry, having access to the most current data, trends, and insights will allow suppliers to anticipate and adapt if/when significant changes occur. Powered by information, this ability to navigate the evolving industry landscape can represent a significant competitive advantage for suppliers and OEMs.

OUR AUTOMOTIVE EXPERTISE

Stout is recognized internationally as a leading advisory firm in the automotive sector. Our experts have advised companies ranging from multinational, publicly traded OEMs and Tier 1 suppliers to closely held component suppliers around the world. We have also worked with franchised and independent dealerships, raw material suppliers, logistics and data providers, and other stakeholders and participants in the automotive supply chain.

Our professionals understand the complex relationships between OEMs and tiered automotive suppliers, both internationally and domestically. Our expertise is the result of numerous transactional, valuation, consulting, and dispute advisory engagements in the automotive industry. Our cross-functional expertise affords the confidence that our technical knowledge reaches far beyond general economic and financial theory to the specialized, industry-specific considerations of the automotive manufacturing and distribution supply chain.

120
km/h
140
160
180
200

WHAT WE DO

Stout professionals have provided consulting services and expert testimony for significant automotive industry warranty and recall programs and disputes.

On behalf of both OEMs and suppliers, Stout has analyzed:

- Warranty and recall data collection systems, warranty repair history, administrative processes and costs, recall risks and costs, component risk factors, recall completion rates, and other information
- Warranty and recall circumstances of many sizes and types – from the largest of recalls affecting millions of vehicles, to small recalls or extended warranty actions affecting several thousand vehicles – and everything in between

Our analyses are used to assist clients in understanding the risk and economic costs of warranty service repair, recall campaigns, and other actions for purposes of risk mitigation, improved business processes, customer and supplier negotiations, claim assessment, or settlement and trial testimony.

We work closely with our clients to understand the risk and potential impacts associated with defects of automotive components, whether it is a customer service action, extended warranty offers, a voluntary recall or one required by NHTSA, or other responses to warranty data, component defects, or customer complaints.

HOW WE DO IT

We take a collaborative approach leveraging our clients' knowledge, experience, and expertise – seeking to integrate cross-functional expertise from our clients with Stout's data and experience. To do this, we:

- Develop and use over 20 data sets containing recall and other defect campaign data
- Use our expertise in understanding the wide variety of potential warranty and recall activities, and the costs associated with each
- Employ traditional and creative approaches in assessing risk from multiple perspectives, as appropriate
- Make use (wherever possible) of supplier and program-specific information to further refine and support our analysis
- Apply both quantitative and qualitative risk factors impacting warranty and recall risk, as warranty and recall risk is often nuanced and not easily represented by simple mathematical or actuarial calculations
- Identify likely warranty and recall scenarios and establish cost and risk parameters for each
- Work to develop risk-mitigation strategies based on our work with the cross-functional teams of our clients (engineering, legal, insurance, risk management, sales, etc.)

ABOUT THE AUTHORS

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