



4th Annual Automotive Industry Warranty & Recall Symposium



Agenda

- 8:15 to 9:15 a.m. – SRR Presentation and Q&A
- 9:15 to 9:30 a.m. – Break
- 9:30 to 10:15 a.m. – SRR Presentation and Q&A
- 10:15 to 10:30 a.m. – Break
- 10:30 to 11:45 a.m. – Cost Recovery Panel and Q&A

Agenda – News and Recall Data

- 2016 Recap
 - Regulatory and legislative developments
 - Takata update
- Recall and Defect Overview
 - Year in review
 - General trends and observations
 - Supplier identification
 - Design, manufacturing, and assembly related defects
- Completion Rate Overview

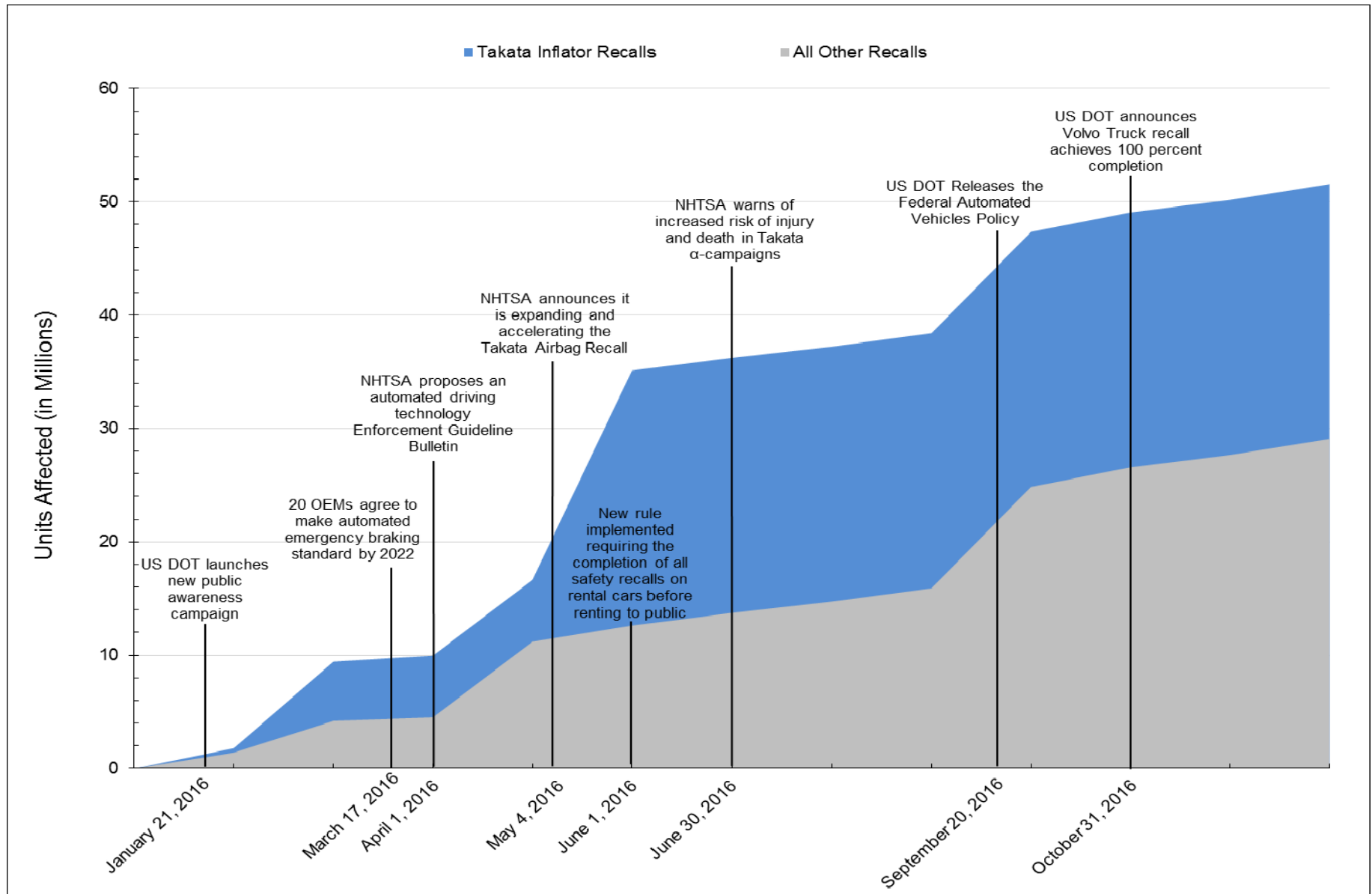
Agenda – Other Trends

- Motor Vehicle Defect Petitions
- Petitions for Inconsequential Non-Compliance
- International Markets
- Integrated Electronic Components and Software Defects
- Warranty and Recall Cost Recovery
- Things to Look For: Future Expectations
- Panel Discussion



- 2016 Recap

Headlines from 2016 - Timeline



Headlines from 2016 – Record Recalls

- Record 52 million vehicles recalled in 2016 in nearly 350 separate recalls
 - Exceeded record-breaking 50 million vehicles recalled in 2015
- Largest non-Takata inflator recalls were initiated by General Motors, Nissan, and Ford
 - General Motors sensing and diagnostic module software defect (3.6 million), Nissan occupant classification system (3.3 million), and Ford door latches (2 million) – together representing nearly 9 million of the approx. 30 million non-Takata recalled units.
- Takata air bag inflators linked to about 44% of recalled vehicles in 2016
 - 29,000,000 vehicles were recalled in 2016 exclusive of the Takata inflator recalls

Headlines from 2016 – Recall Sizes

- Largest individual recall of 2016:
 - Issued by FCA related to Takata airbag inflators
 - Affected **4,757,203** vehicles
- Largest non-Takata recall of 2016:
 - Issued by General Motors related to sensing and diagnostic module preventing the deployment of air bags and pretensioners
 - Affected **3,640,162** units
- Smallest recall of 2016 affected 1 unit
 - Mercedes Benz recalled **one** CLA45 AMG for a potentially defective weld between the clutch disk and hub that may develop a crack

Headlines from 2016 – Advancing Autonomous Technology

- On March 17, 2016, NHTSA and the Insurance Institute for Highway Safety (“IIHS”) announced the commitment of 20 automakers, representing more than 99% of the U.S. auto market to make automatic emergency braking (“AEB”) a standard feature on new vehicles as of September 1, 2022.
- *“NHTSA estimates that the agreement will make AEB standard on new cars three years faster than could be achieved through the formal regulatory process. During those three years, according to Insurance Institute of Highway Safety (IIHS) estimates, the commitment will prevent 28,000 crashes and 12,000 injuries.”¹*
- On April 1, 2016, NHTSA proposed an Enforcement Guidance Bulletin in regards to automated driving technologies:
 - *“This Enforcement Guidance Bulletin sets forth NHTSA's current views on its enforcement authority—including its view that when vulnerabilities in automated safety technology or equipment pose an unreasonable risk to safety, those vulnerabilities constitute a safety-related defect—and suggests guiding principles and best practices for motor vehicle and equipment manufacturers in this context.”²*

Headlines from 2016 – Other Regulatory Activity

- Effective March 21, 2017, a new safety standard regarding minimum sound requirements in hybrid and electric vehicles (with gross vehicle weight 10,000 pounds or less) became effective.⁴
- As of June 1, 2016 NHTSA requires that rental car companies must fix any and all safety defects before renting vehicles to customers, as required by the FAST Act of 2015.⁵
- On October 24, 2016 NHTSA proposed cybersecurity guidance to protect vehicles from malicious cyber-attacks and unauthorized access, focusing on layered solutions to ensure vehicle systems are designed to take appropriate and safe actions, even when an attack is successful.⁶
- On December 13, 2016, the US DOT issued a Notice of Proposed Rulemaking which would enable vehicle-to-vehicle communication on all new light-duty vehicles, enabling new crash-avoidance applications that could prevent deaths by helping vehicles talk to each other.⁷

Headlines from 2016 – Takata Update

- By 2020, 64 – 69 million inflators will be recalled⁷
- As of January 6, 2017, the overall completion rate is 37.5%⁸
- Third Amendment to the Coordinated Remedy Order Issued December 9, 2016
- OEMs Affected: 19
- As of December 2016 in the US:⁹
 - 11 fatalities
 - 184 injuries

Headlines from 2016 – Takata Update

- Takata Corp. Agrees to Plead Guilty on January 13, 2017:
\$1 Billion
 - Fine: \$25 Million
 - Restitution: \$975 Million
 - Settlement Finalized on February 27, 2017¹⁰
- December 2016, three Takata executives (who worked for Takata in US and Japan) charged with indictment for committing wire fraud and conspiracy¹¹
- In December 2016, the ACRO set forth a variety of new and additional requirements for affected OEMs



■ Data Analysis and Review: Recall and Defect Overview

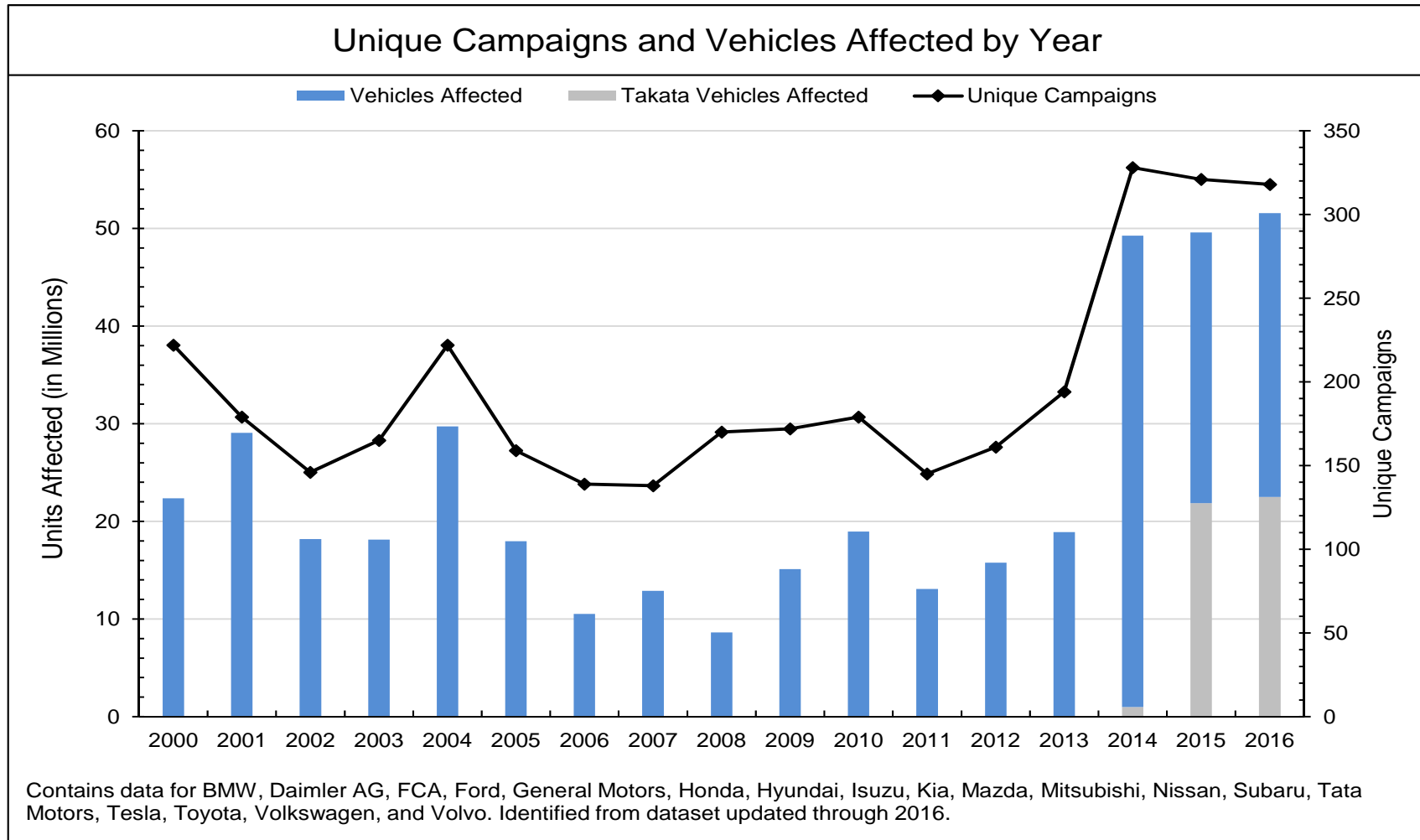
- “Big Picture” and Year in Review – The Current Automotive Recall Landscape
- General Trends and Observations
- Supplier Focus (573 Letter Review)

Recall Data Analysis: Process and Background

- Information downloaded from NHTSA website (www.nhtsa.gov) for historical recalls dating back to 1966
- NHTSA data provided detail regarding NHTSA campaign number, manufacturer, model and model year, component, total units affected, and certain additional fields
- SRR summarized, “scrubbed”, and analyzed the data to analyze recall trends for OEMs across various component groupings and timeframes

A Big Picture Look

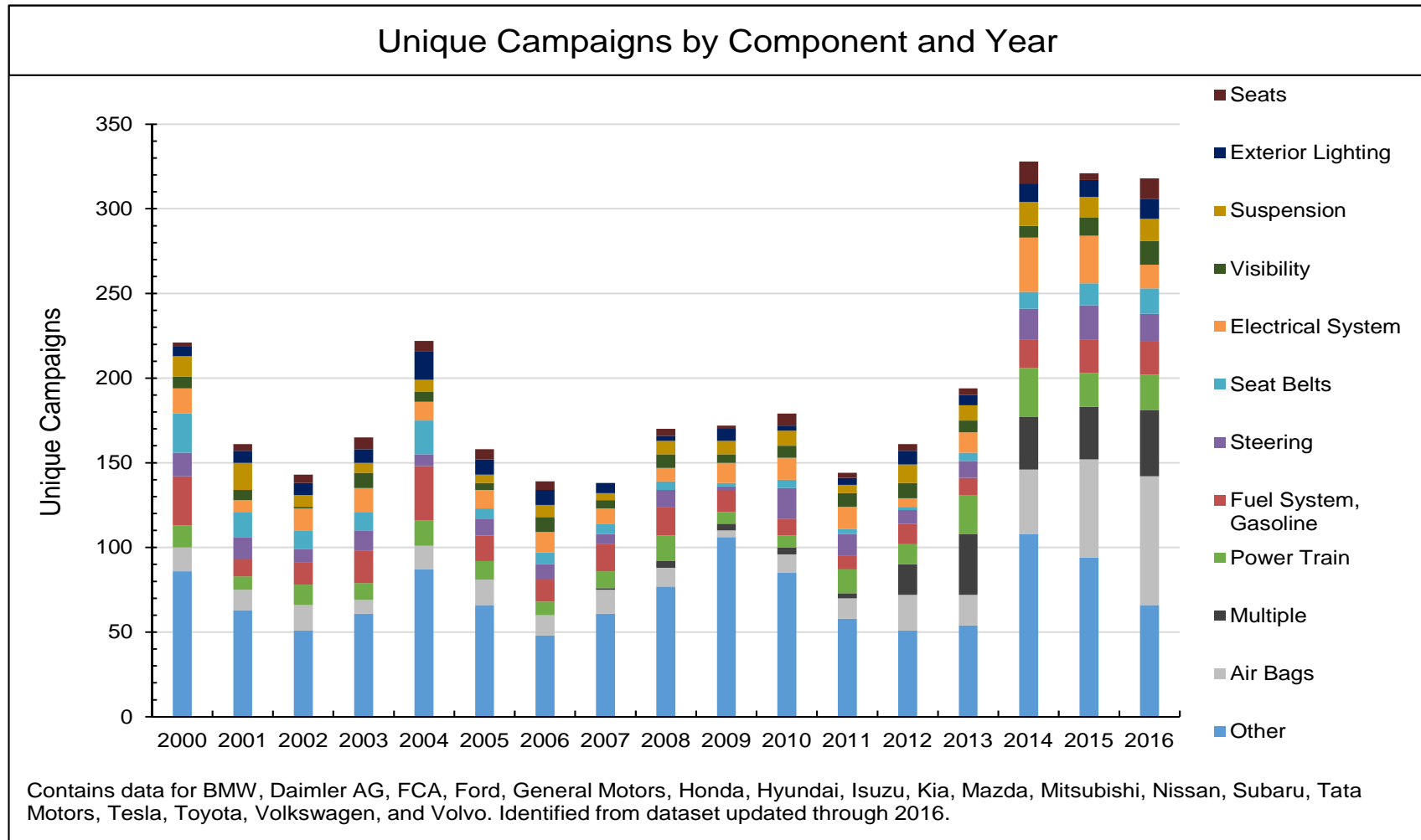
Overall Recall Trends (By Year):



Source: NHTSA Recall Data

A Big Picture Look

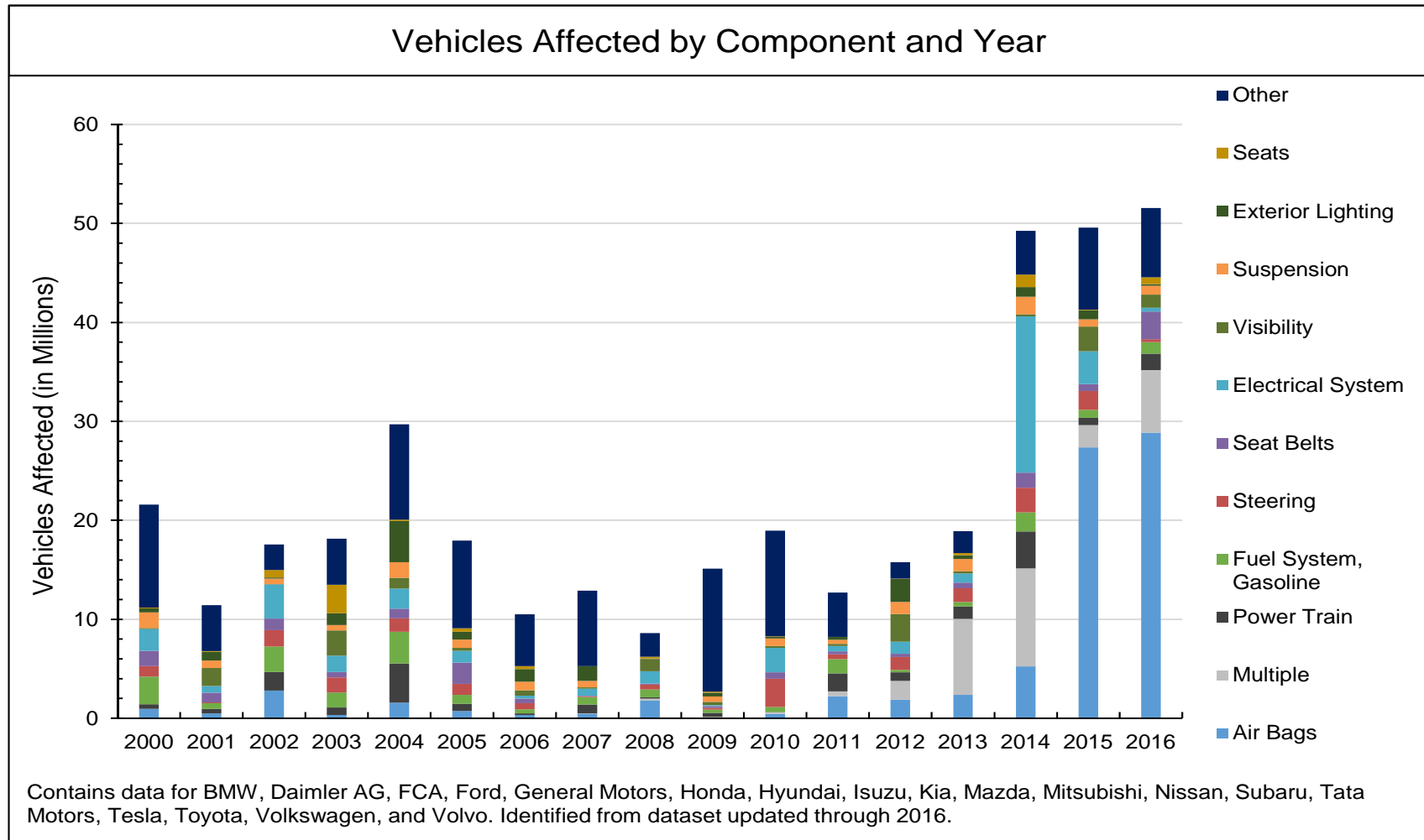
Broad Trends by Component Group (2000-2016):



Source: NHTSA Recall Data

A Big Picture Look

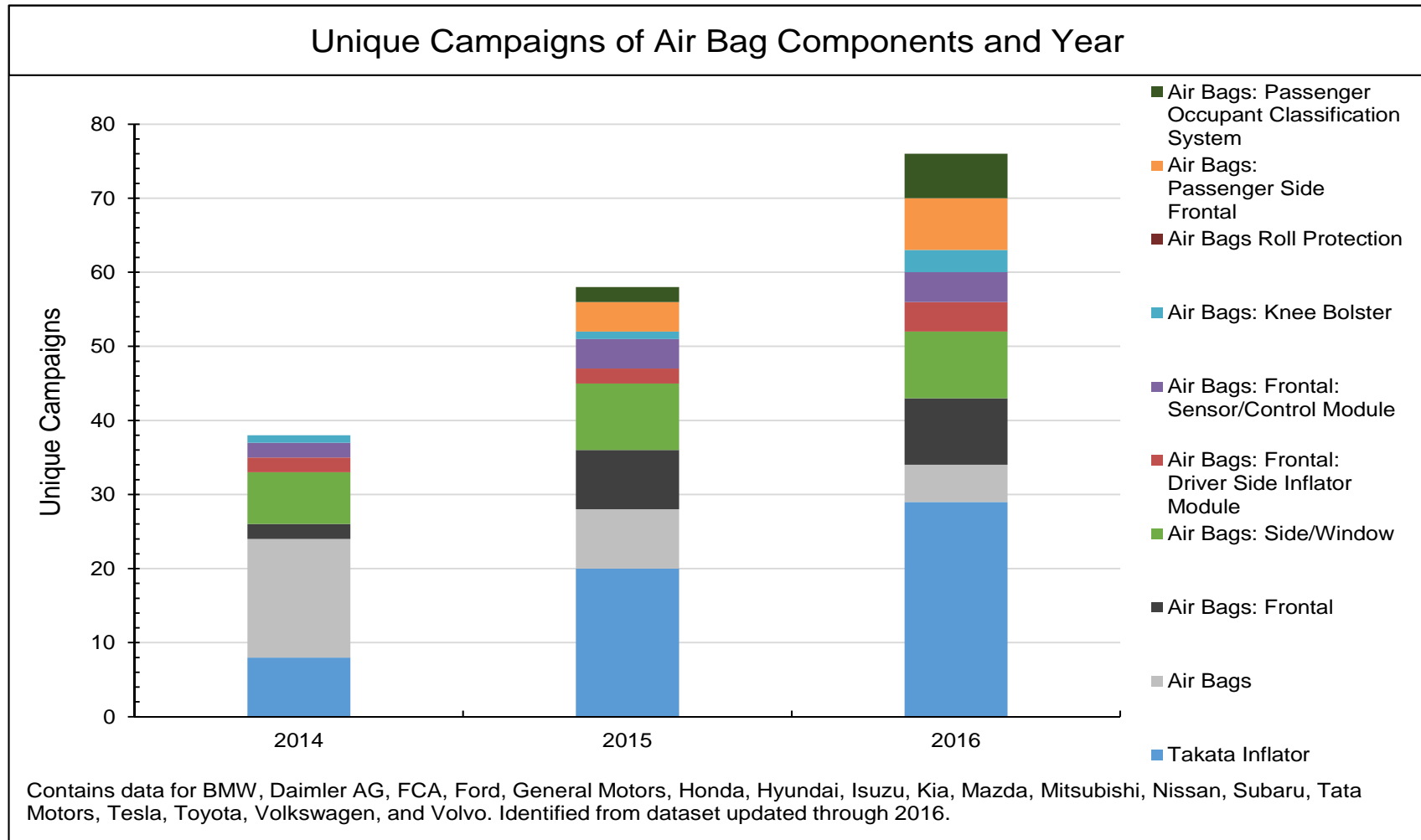
Broad Trends by Component Group (2000-2016):



Source: NHTSA Recall Data

A Big Picture Look

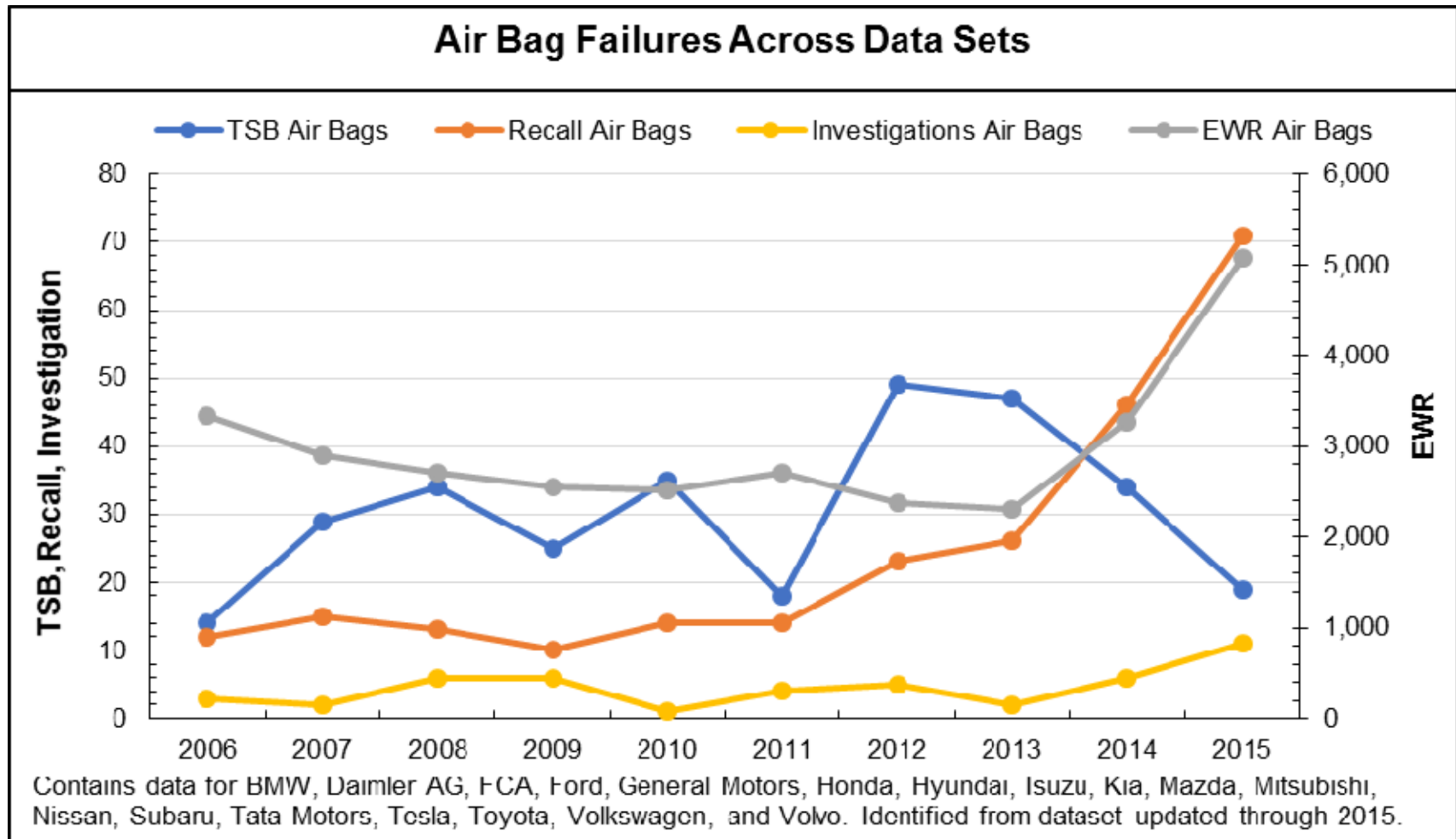
Air Bag Components (2014-2016):



Source: NHTSA Recall Data

A Big Picture Look

Air Bag Components Across All Datasets:



Source: NHTSA TSB, Recall, Investigations, and EWR Data

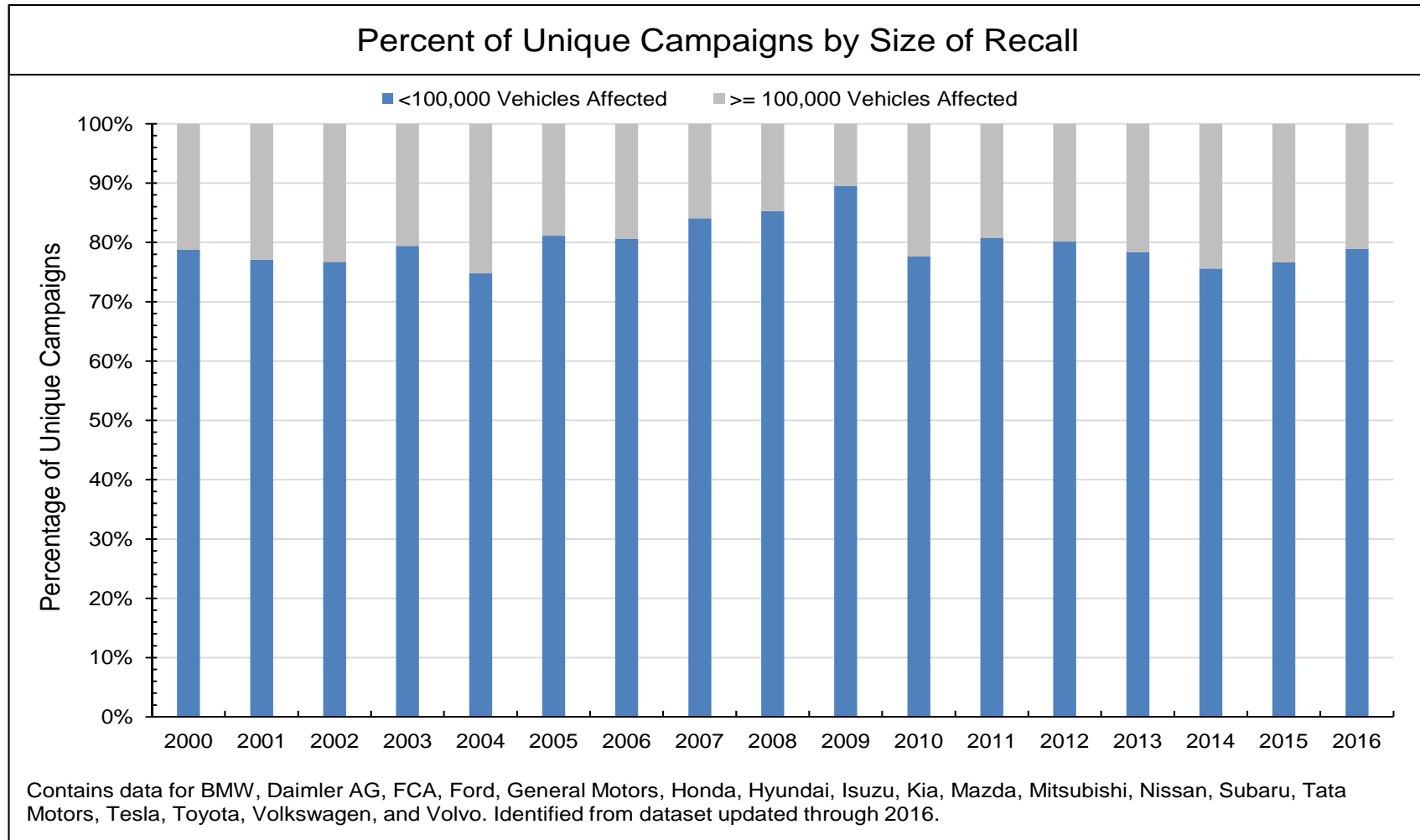
Year in Review: Another Historic Year for Recalls

- Units affected by recalls in 2016 narrowly edged the record setting totals in 2015
 - Recalls of Takata inflators played a significant role
 - Still a very active year for other recalls with approximately 29 million units affected by non-Takata campaigns.
- In addition to the increase in Takata inflator recalls, increases in the number of other frontal and side airbag, as well as occupant safety classification system recalls were experienced in 2016.

Analysis by Size of Recall

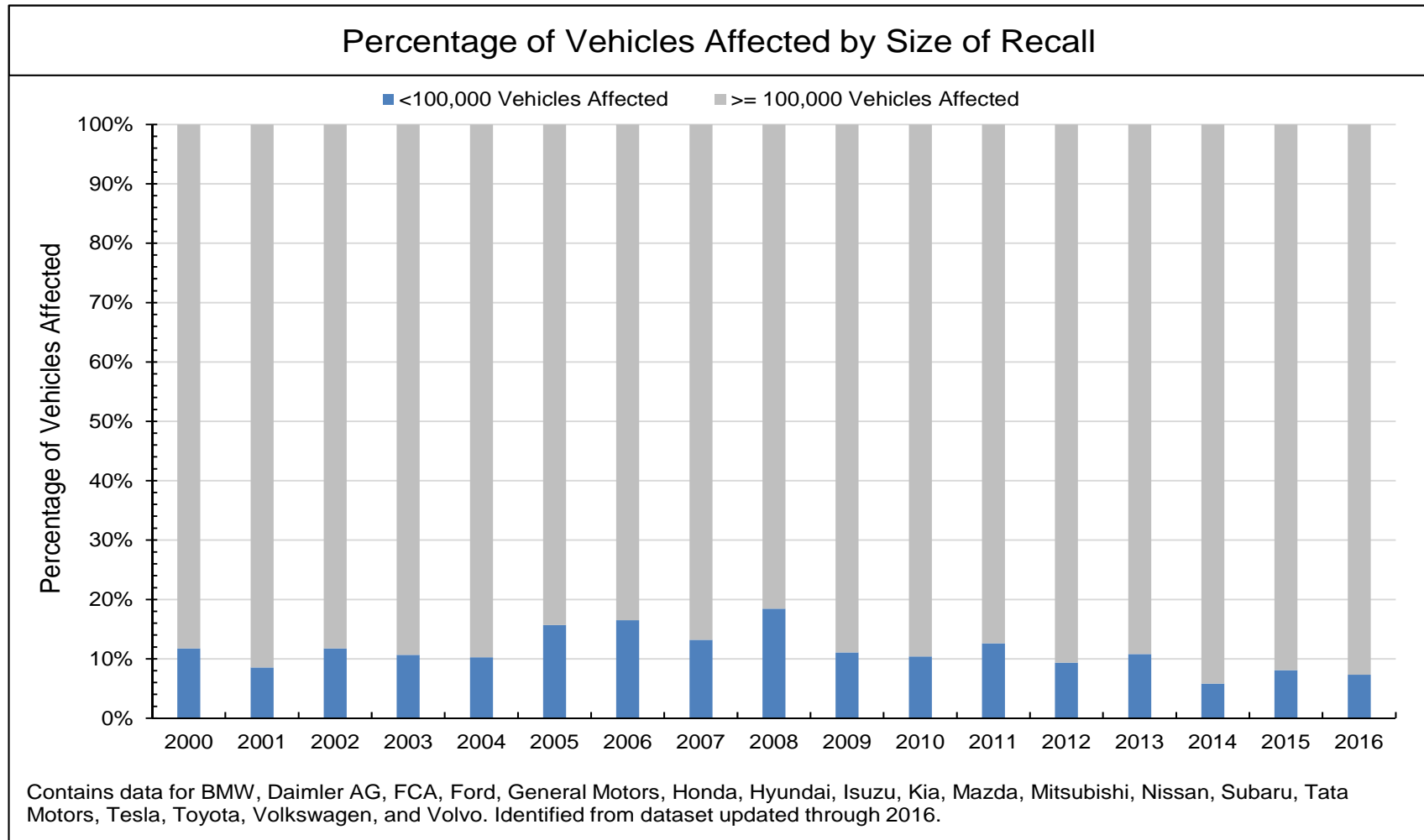
- Large recalls may be the most newsworthy, but historically have not been the most prevalent
 - Majority of recalls (on a unique campaign basis) involve fewer than 10,000 units, many with significantly less
- However, we see a continued increase in the number of large recalls
 - Recalls over 100,000 units represented approximately 20% of all unique recalls in 2016.
- We observe certain differences for large recalls as compared to small recalls, such as
 - Differences in completion rates
 - Differences in age of vehicles involved
 - Differences in frequency of a named supplier

Analysis by Size of Recall



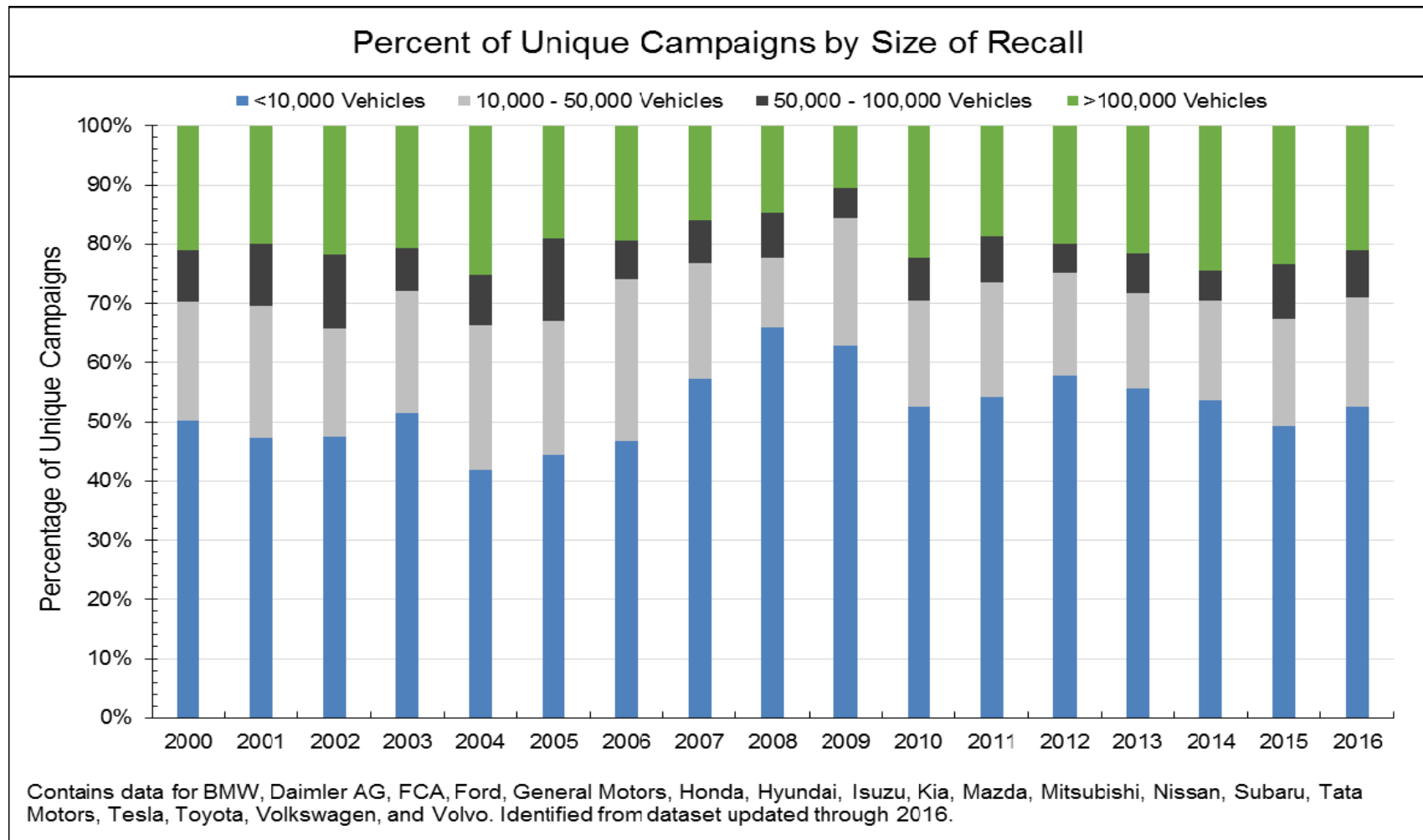
Source: NHTSA Recall Data

Analysis by Size of Recall



Source: NHTSA Recall Data

Analysis by Size of Recall



Source: NHTSA Recall Data

573 Letter Review^{12,13}

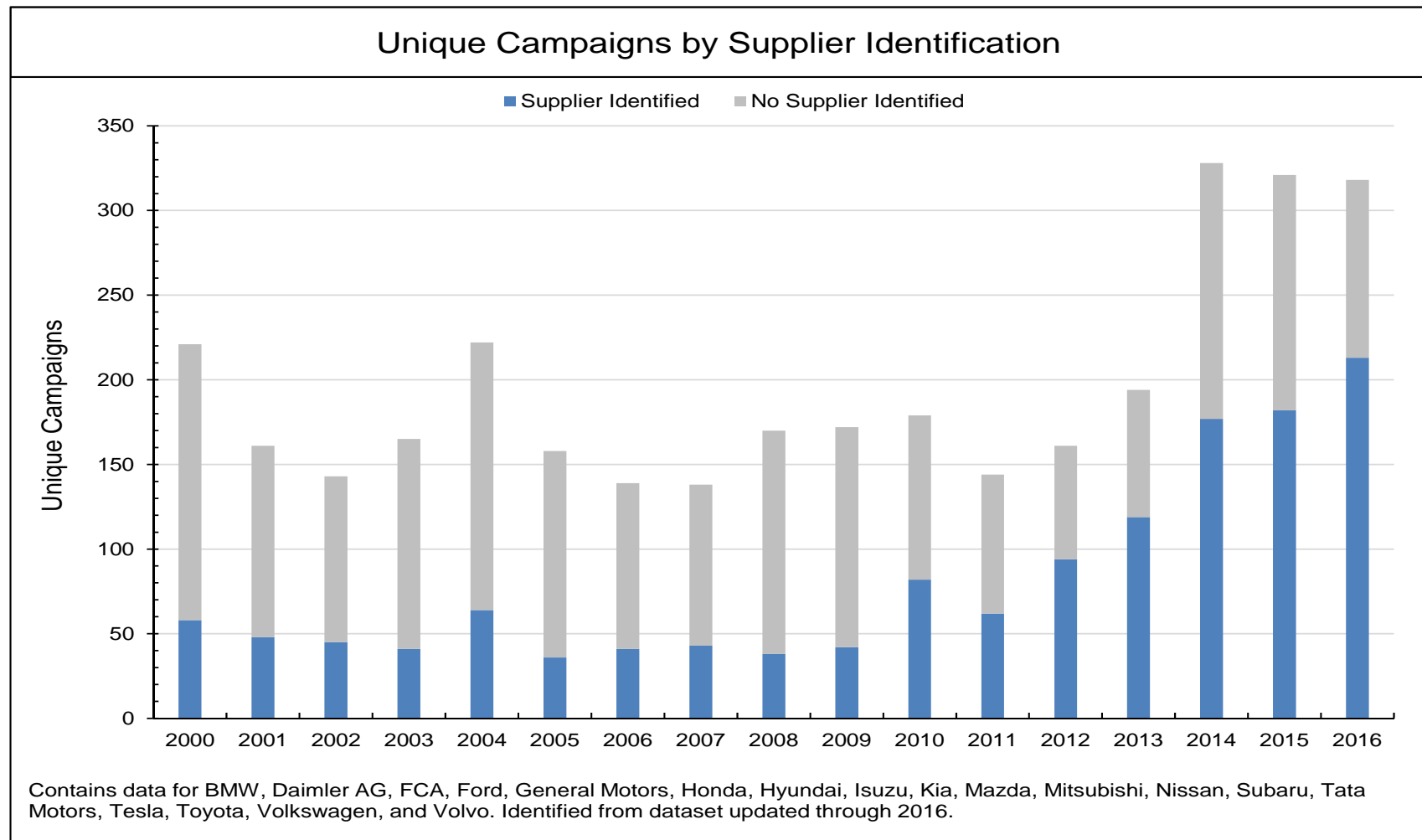
- For each recall initiated, OEMs are required to submit a Part 573 Report that serves as notification to the U.S. Department of Transportation, National Highway Traffic Safety Administration that a defect related to motor vehicle safety or noncompliance with Federal Motor Vehicle Safety Standards exists

- Required sections of report include:
 - Manufacturer, designated agent, and other chain of distribution information
 - Identification of the recall population and its size
 - Description of the defect or noncompliance and chronology of events
 - The remedy program and its schedule
 - Manufacturer of defective component

573 Letter Review – A Supplier Focus

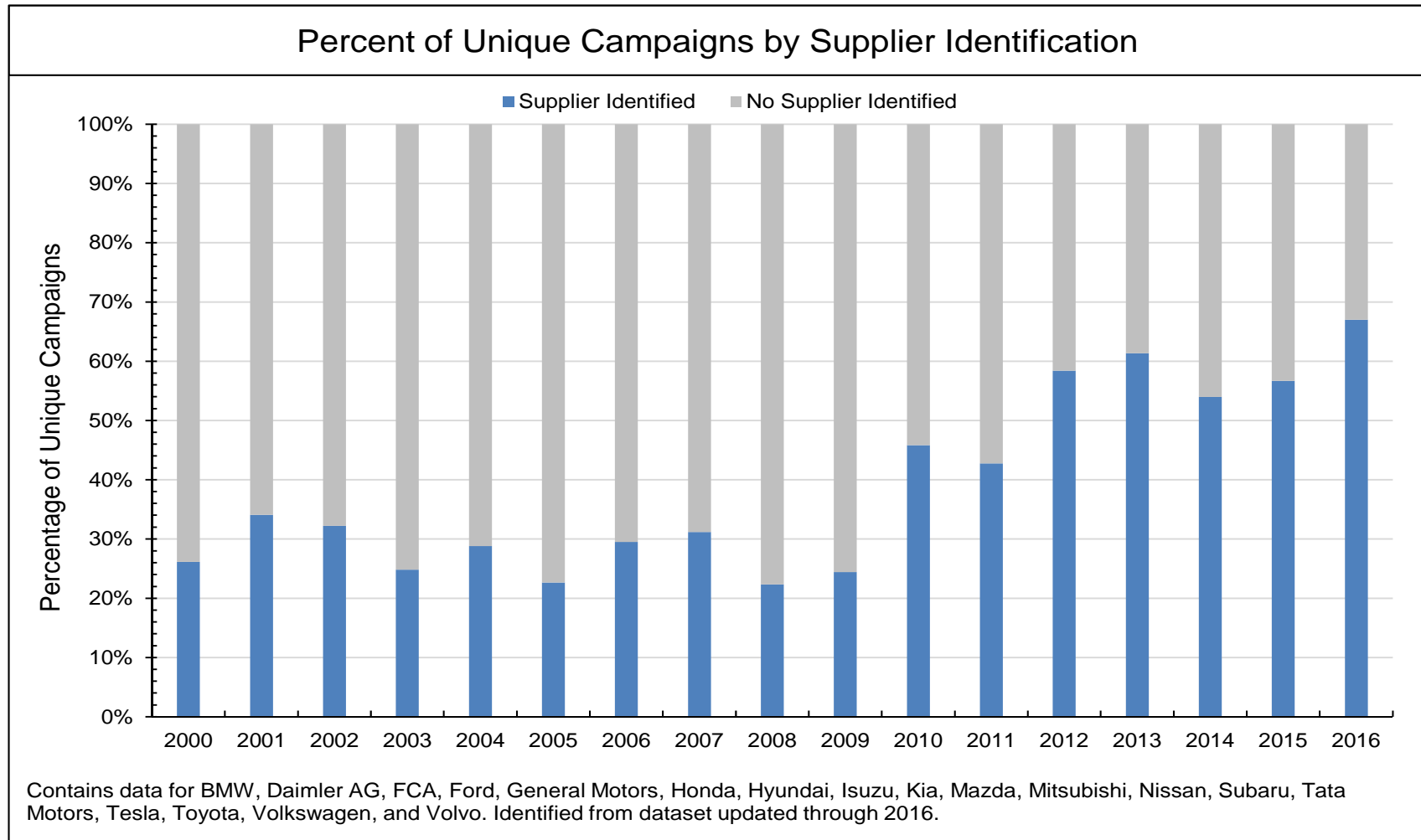
- For all recalls dating back to January 2000, SRR researched 573 disclosures provided to NHTSA by the OEMs to identify suppliers
 - Supplier subsidiaries and divisions combined and consolidated
 - Supplier information was then linked to the NHTSA Recall Database
 - Identified whether defect was likely design, manufacturing, or assembly related
- Using supplier recall database, SRR was able to
 - Analyze component groups for which suppliers are most often named
 - Analyze recall trends by supplier involved
 - Analyze the disclosed cause of the defect
- Suppliers are not named for every recall, and there are a number of reasons for this.

573 Letter Review – A Supplier Focus



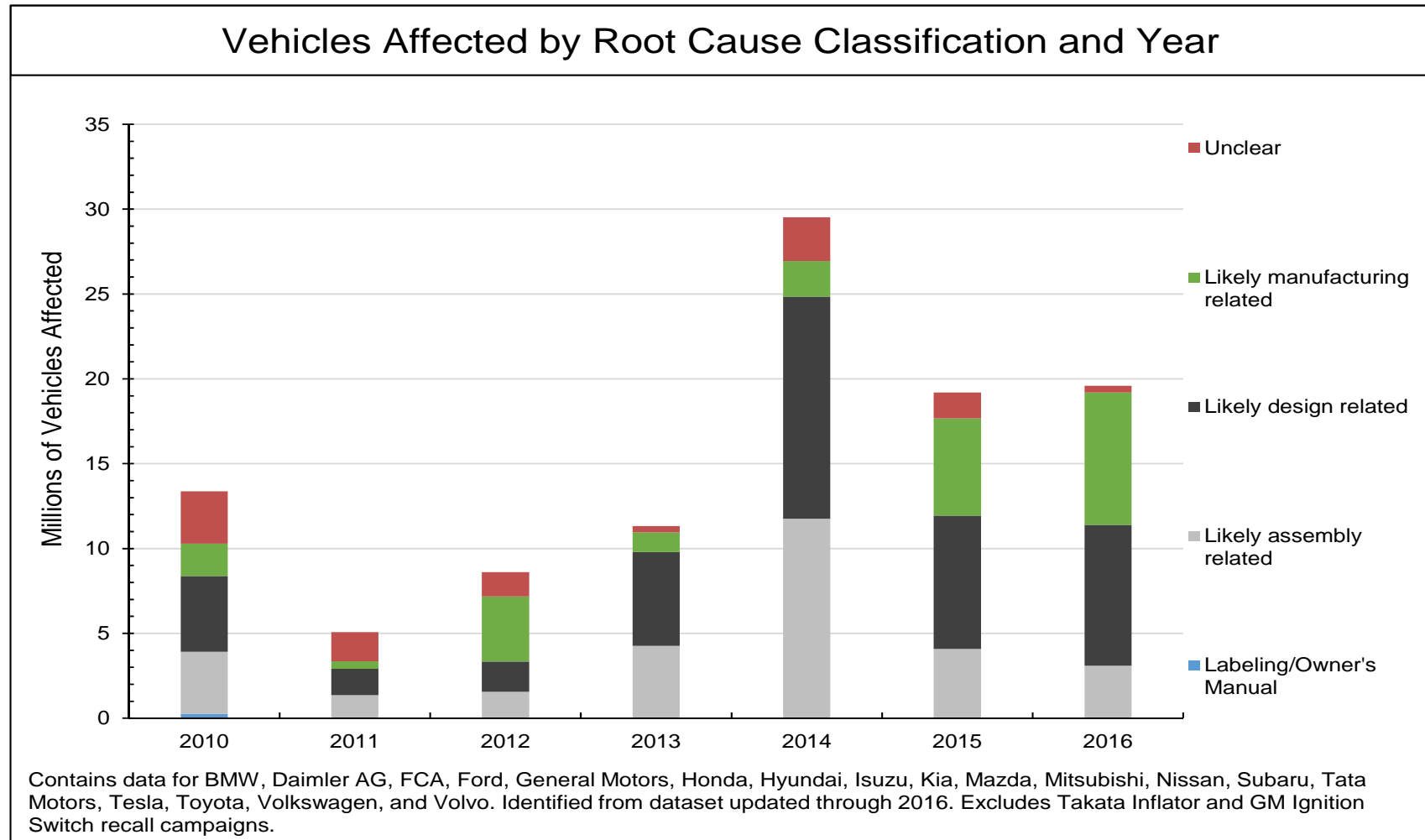
Source: NHTSA Recall Data and 573 Letters

573 Letter Review – A Supplier Focus



Source: NHTSA Recall Data and 573 Letters

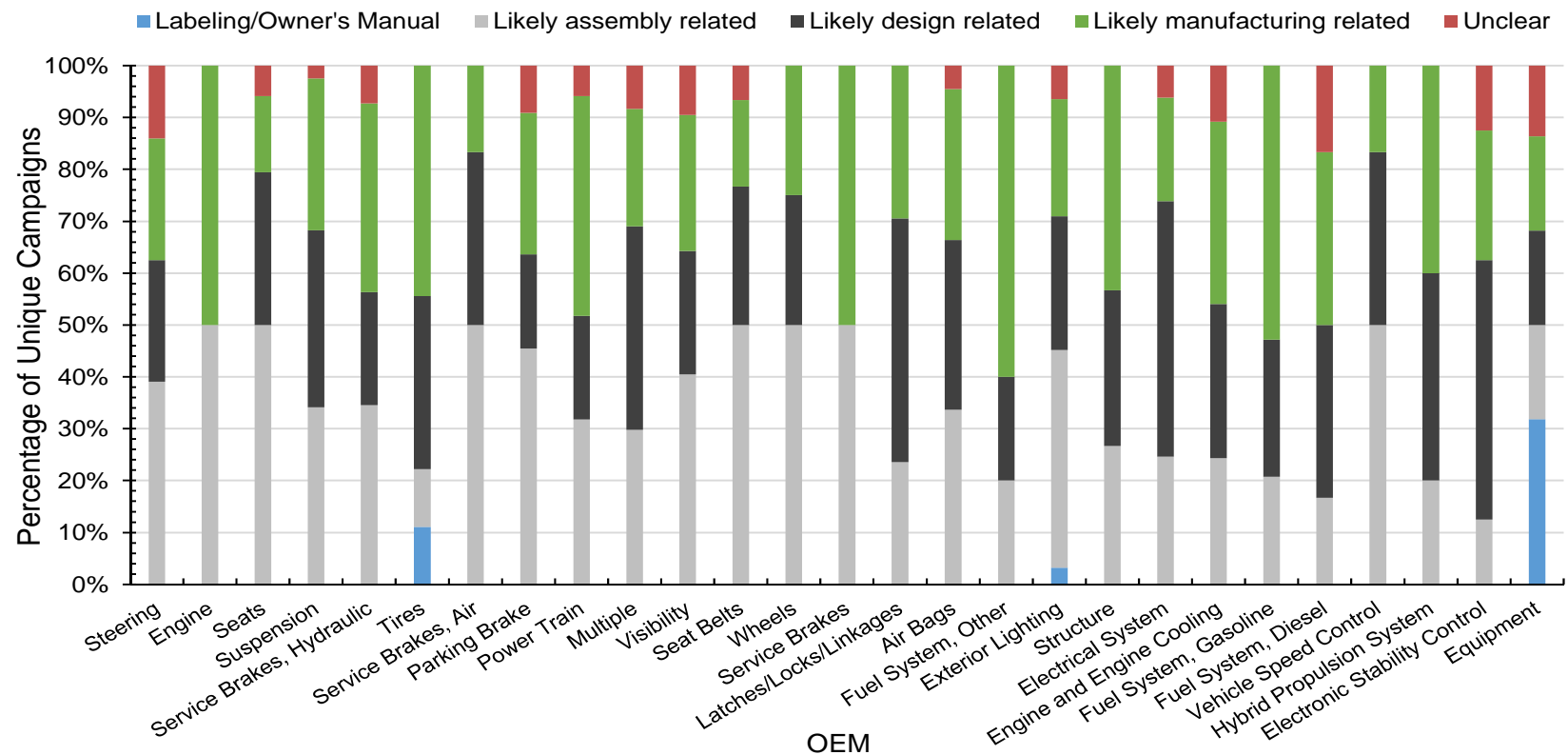
573 Letter Review – A Supplier Focus



Source: NHTSA Recall Data and 573 Letters

573 Letter Review – A Supplier Focus

Percentage of Unique Campaigns by SRR Root Cause Classification and Component (2009 - 2016)



Contains data for BMW, Daimler AG, FCA, Ford, General Motors, Honda, Hyundai, Isuzu, Kia, Mazda, Mitsubishi, Nissan, Subaru, Tata Motors, Tesla, Toyota, Volkswagen, and Volvo. Identified from dataset updated through 2016. Excludes Takata Inflator and GM Ignition Switch recall campaigns.

Source: NHTSA Recall Data and 573 Letters

573 Letter Review: Conclusion

- Review of 573 Reports indicates continued trend of more frequent supplier identification, particularly for certain components
 - Both in terms of number of campaigns and as a proportion of total campaigns
 - Air bags, seats, powertrain, and steering represent components where supplier is most likely to be identified



■ Completion Rates

- 2016 Completion Rate News
- Explanation of Data Sources and Analysis Performed
- General Trends and Observations

QPR Review - 2016 News

- Dr. Rosekind has sought to create a proactive recall environment:
 - “I’d rather have people be pre-emptive...[w]e’d rather have people at the proactive end, catching stuff early”
 - 100% recall completion has “got to be your target”

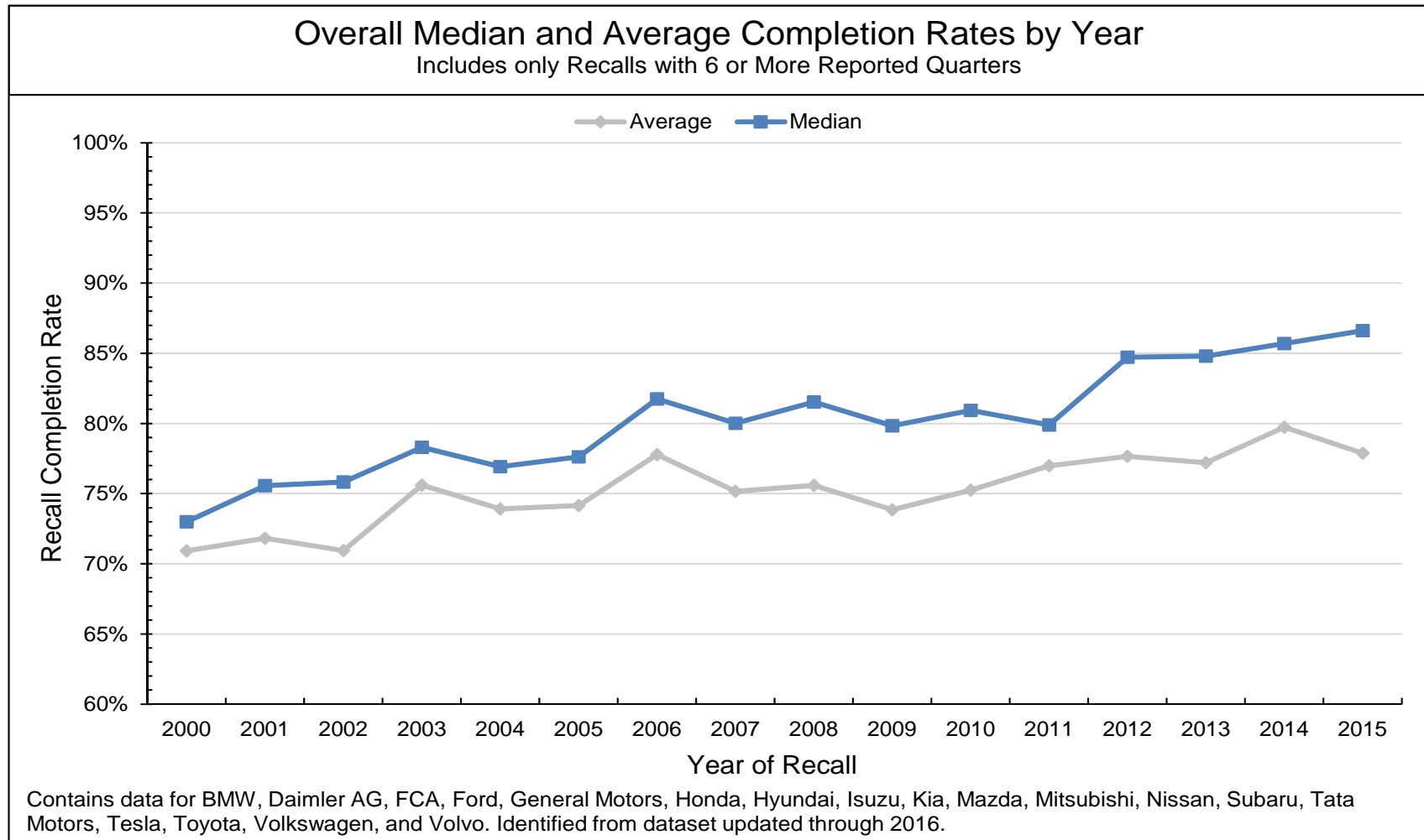
- NHTSA proposed to amend the means of recall notification to owners as required under the Safety Act to be provided in an electronic manner in addition to first class mail
 - Proposed rule in accordance with MAP-21 and the FAST Act
 - NHTSA also seeks to require manufactures to send additional notifications if a second notification does not result in adequate number of remedies

- Volvo Truck recall of 16,000 vehicles for steering defect achieved 100% completion (2016 and 2017 Volvo VNL, VNM and VNX model trucks and 2016 and 2017 Mack Titan trucks)
 - NHTSA collaborated with Federal Motor Carrier Safety Administration, posting notifications on social media platforms and trucking news outlets

QPR Review¹⁰

- NHTSA requires that beginning the quarter after the start of a recall, the manufacturer must submit a Quarterly Progress Report for **six** consecutive calendar quarters. The deadline for the report is the 30th day of the month following the quarter's end
- In analyzing this data, SRR linked Quarterly Progress Reports to NHTSA's larger recall database using campaign numbers in order to analyze trends in completion rates across different subsets of recall data.
- Required Data to be disclosed includes:
 - NHTSA-assigned recall identification number
 - Manufacturer-assigned recall identification number, if applicable
 - Various dates of notification for dealers and purchasers
 - Number of items involved in the recall
 - Number of items at respective quarter's end that have been remedied
 - Number of items as respective quarter's end that have been inspected and determined to not need a remedy
 - Number of items unreachable for inspection
 - Number of items returned and/or repaired by dealers, retailers and distributors

Completion Rates – Overall Trends

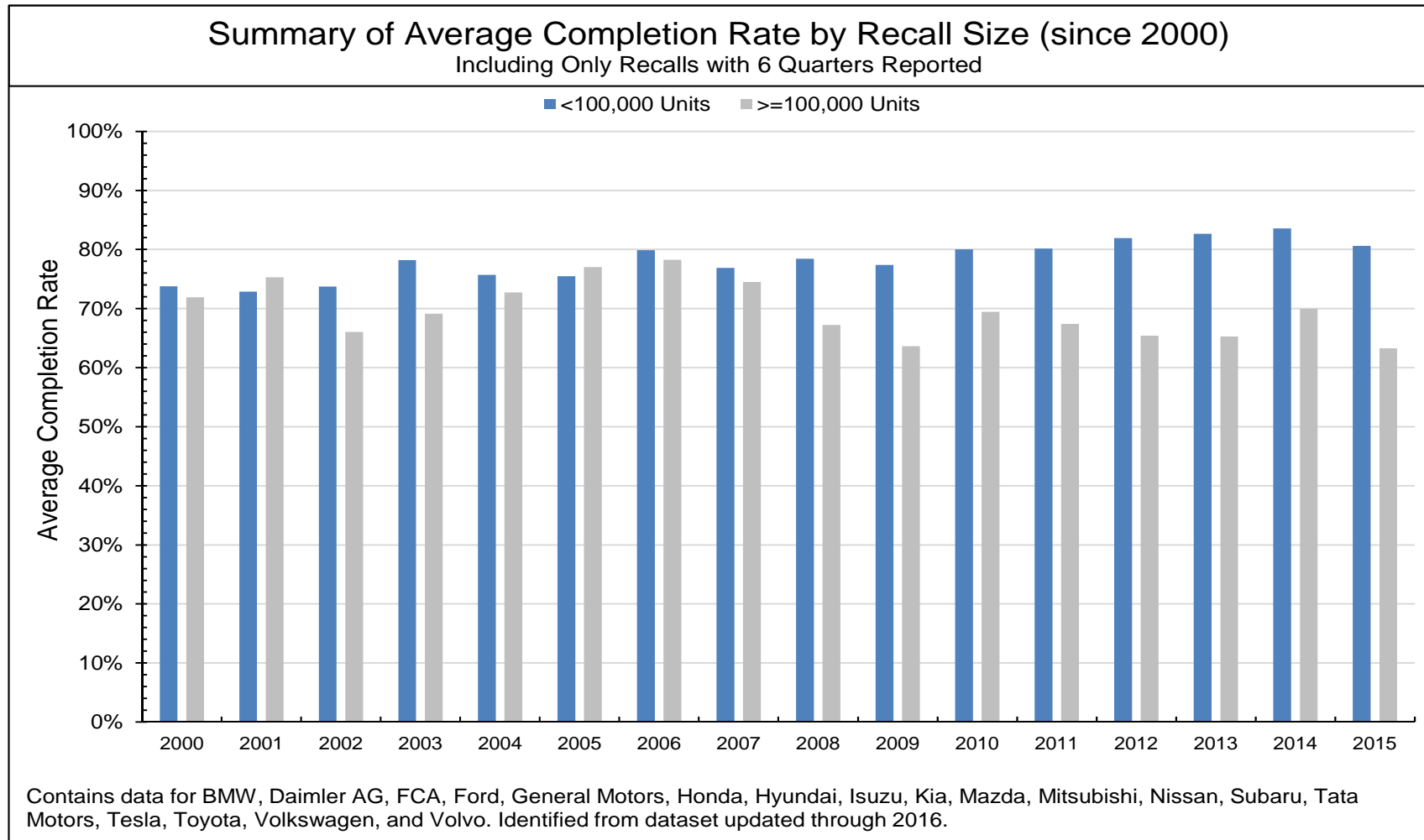


Source: NHTSA Recall Data and Quarterly Progress Reports

Completion Rates – Influential Forces

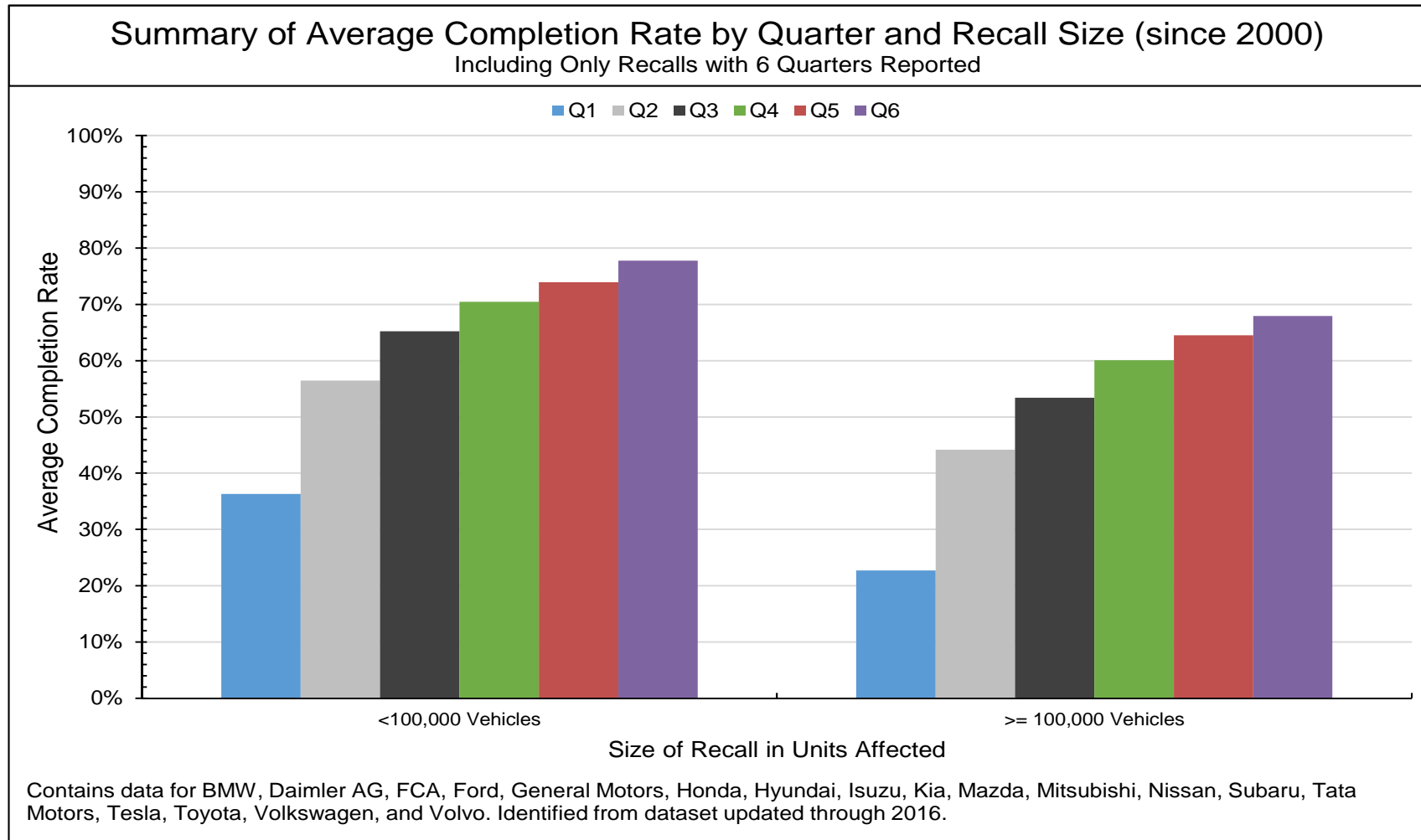
- In addition to specific differences observed for certain OEMs or component groups, certain factors appear to have a universal impact on the ultimate completion rates for recalls:
- Vehicle Age: Completion rates for recalls involving older vehicles are generally lower, sometimes significantly. This impact becomes more pronounced as vehicles get older.
- Recall Size: Completion rates for larger recalls (>100,000 units) are often approximately 5-10% lower than for smaller-sized recalls.
- Vehicle Type: Completion rates for trucks and minivans appear to perform differently than for sedans and full-size vehicles.
- Owner Ability to Self-Diagnosis: If the vehicle owner can easily self-diagnose whether the vehicle suffers from the defect, completion rates may suffer.
- Outreach Efforts: New ways of engaging with vehicle owners is demonstrating success.

Completion Rates – Influential Forces



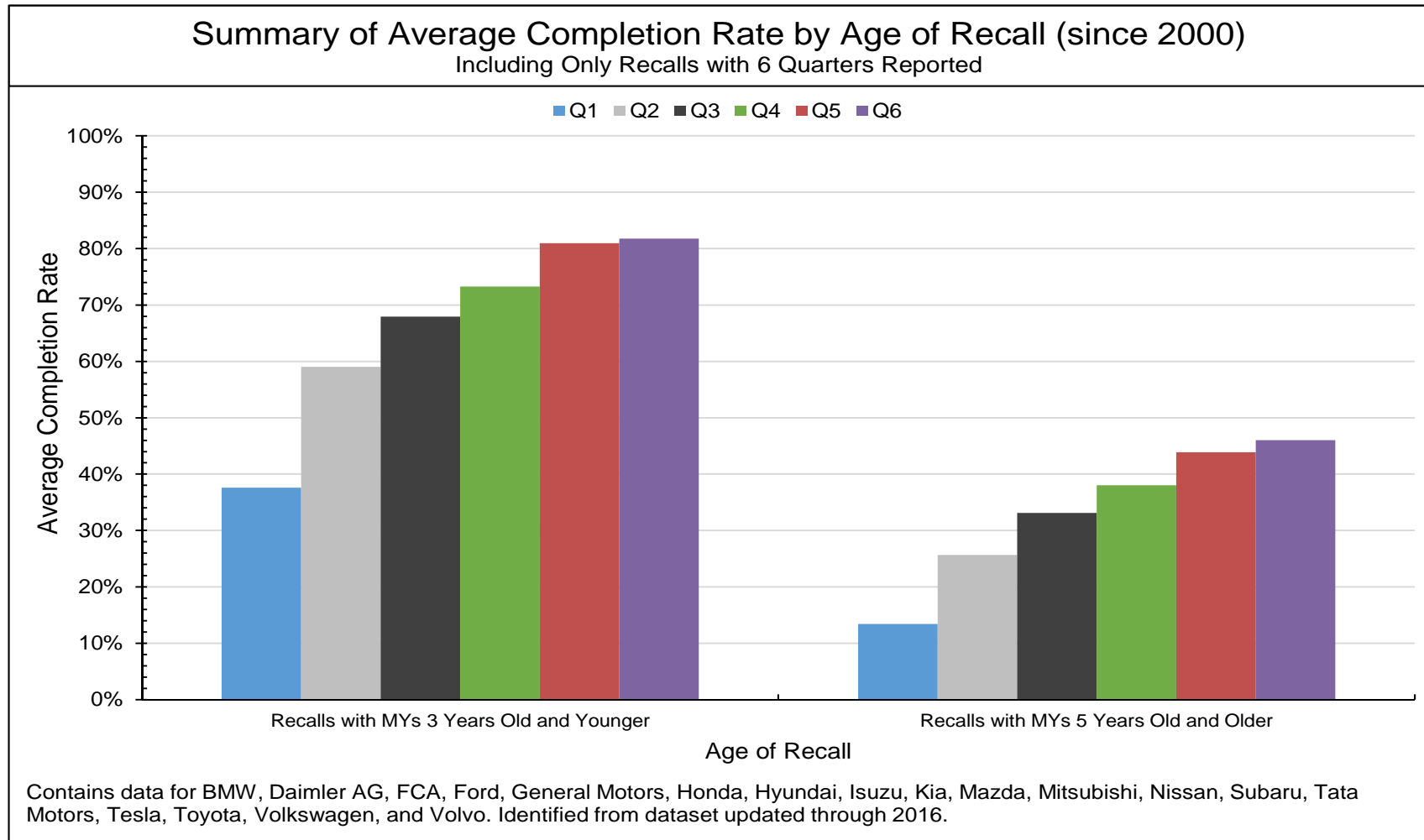
Source: NHTSA Recall Data and Quarterly Progress Reports

Completion Rates – Influential Forces



Source: NHTSA Recall Data and Quarterly Progress Reports

Completion Rates – Influential Forces

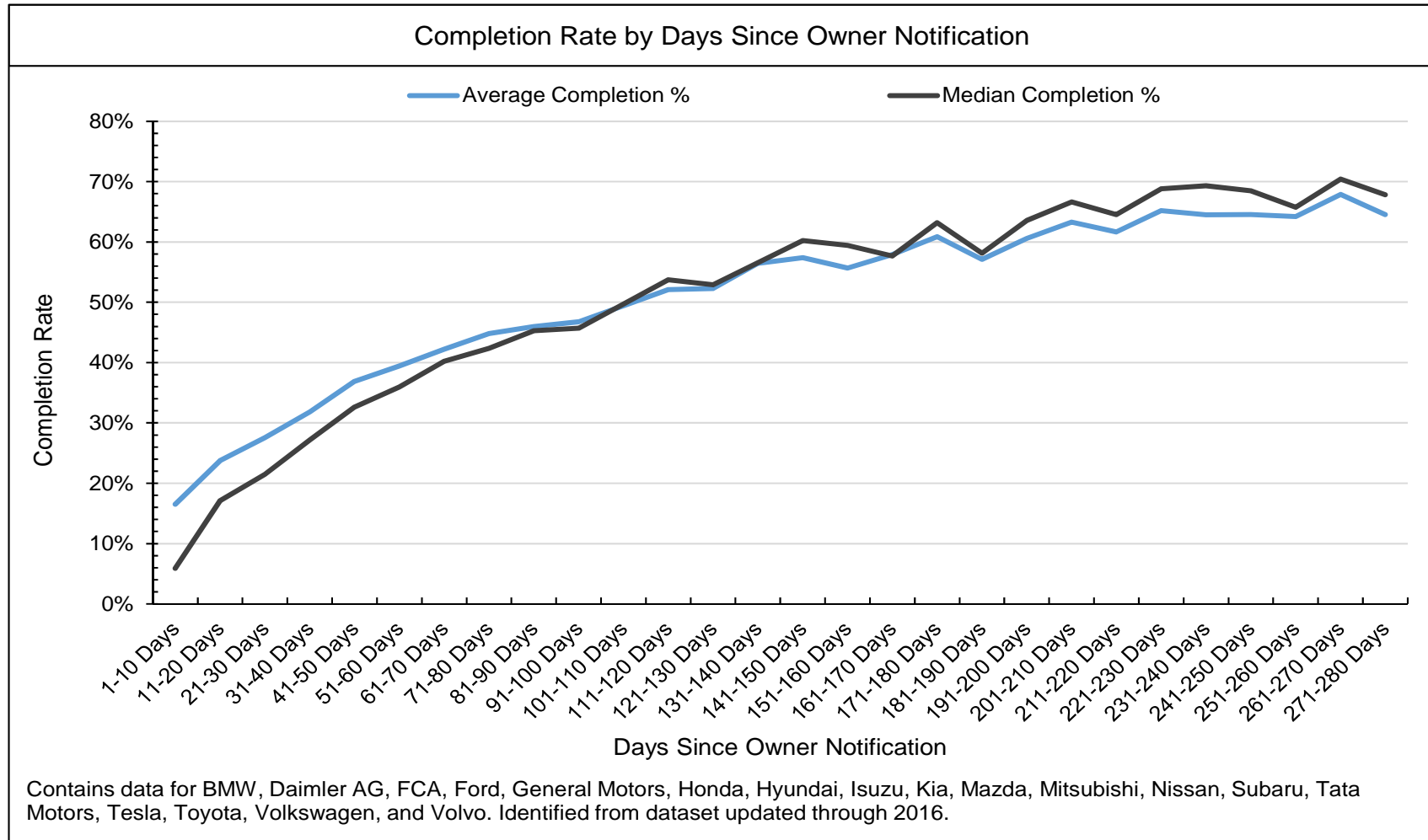


Source: NHTSA Recall Data and Quarterly Progress Reports

Completion Rates – Pace of Completion

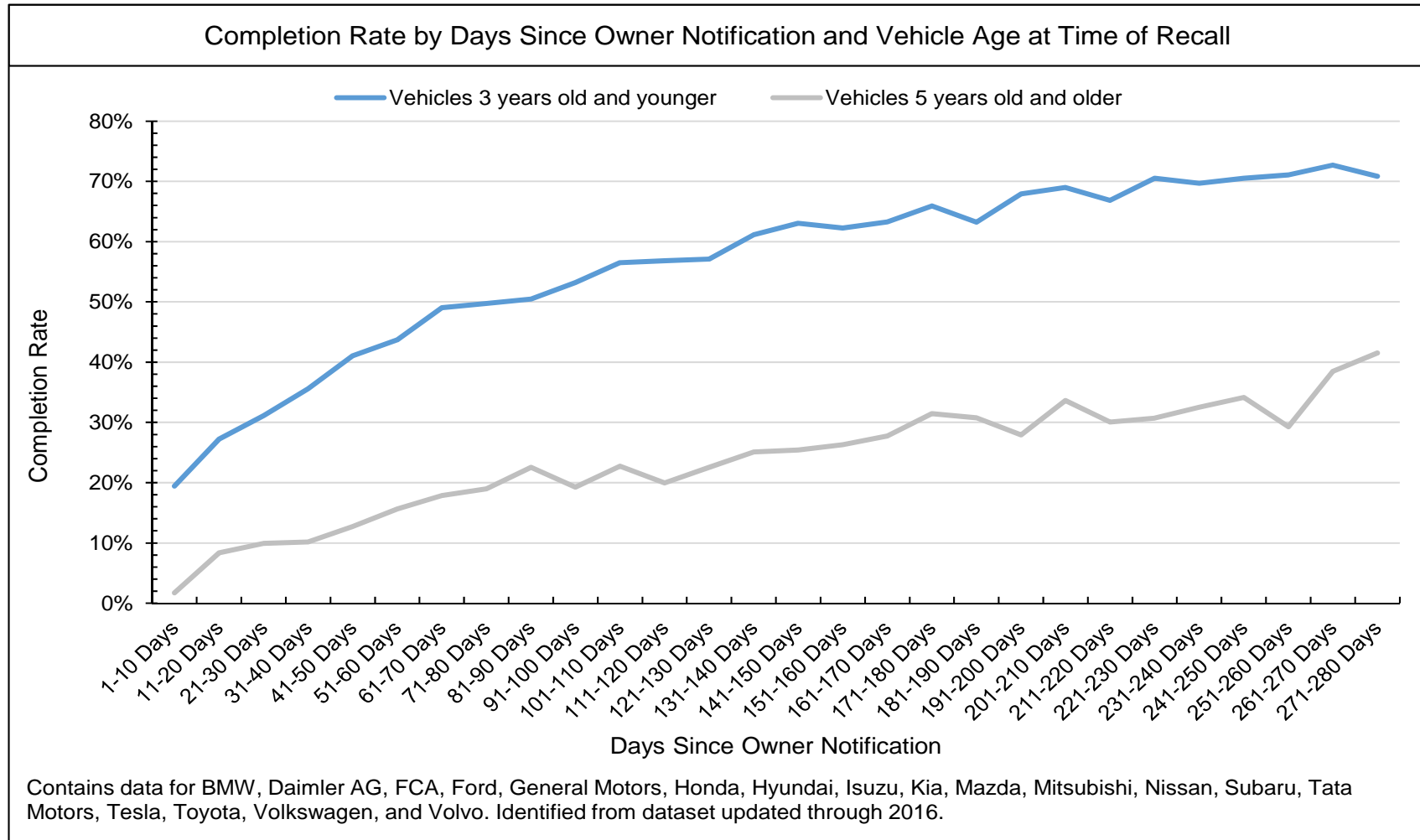
- Using a proprietary database containing NHTSA QPR data, SRR was able to perform a detailed analysis of the progression of recall completion rates in the period after owner notification.
- QPRs must be submitted by OEMs for each recall for 6 calendar quarters after recall initiation. However, depending on when the recall is initiated, the initial report can be issued anywhere from a few days after customers receive notification letters to almost an entire quarter after the first notifications are delivered.
- Using this information we can, on aggregate, analyze how completion rates progress on a daily basis.
- This analysis has allowed SRR to refine our understanding of the progression of recall completion rates beyond the typical quarterly completion analysis.

Completion Rates – Pace of Completion



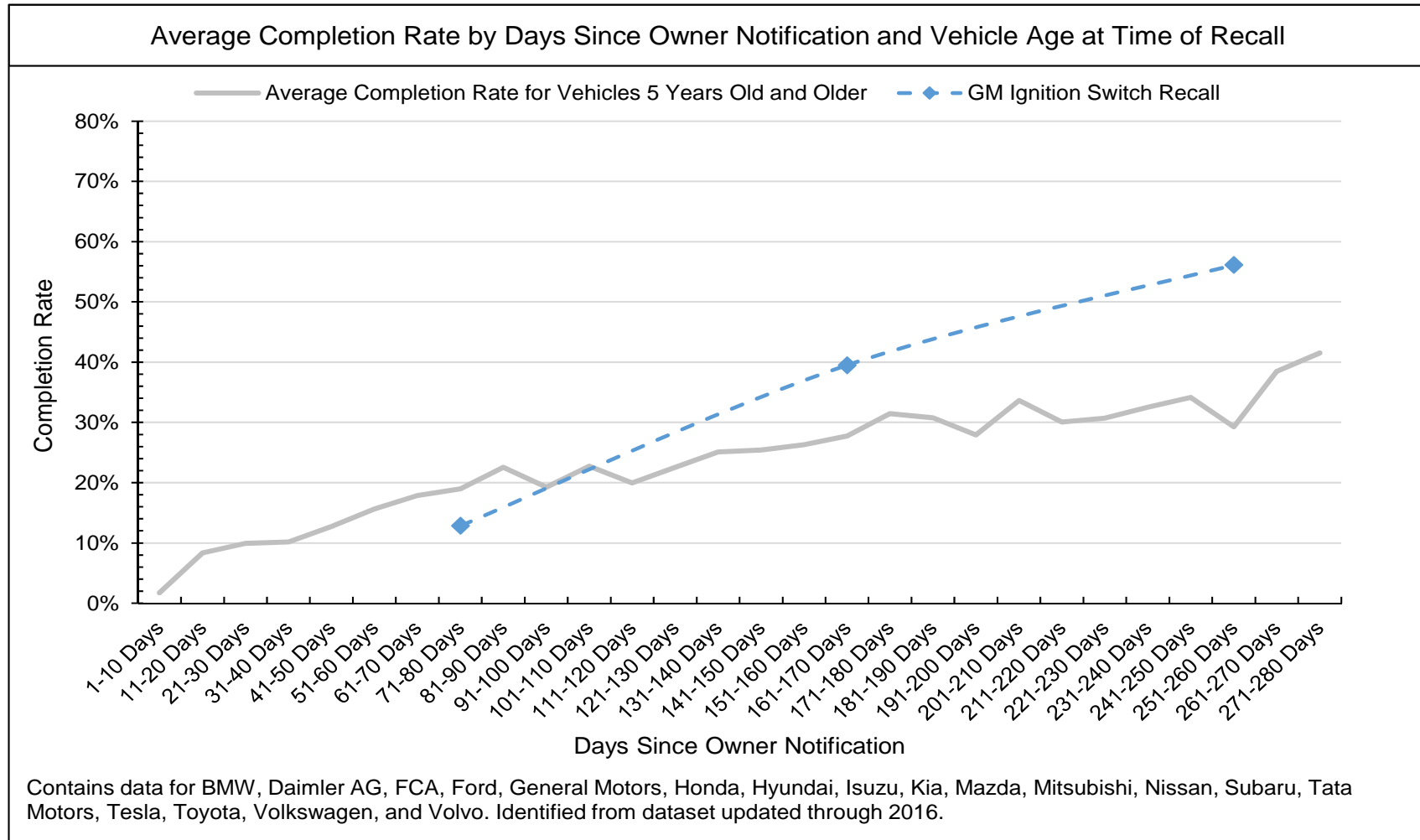
Source: NHTSA Recall Data and Quarterly Progress Reports

Completion Rates – Pace of Completion



Source: NHTSA Recall Data and Quarterly Progress Reports

Completion Rates – Pace of Completion



Source: NHTSA Recall Data and Quarterly Progress Reports

Recall Trends and Analysis: Conclusion

- Recalls of Airbag Components, even when excluding the Takata recalls, are increasing
- Suppliers are increasingly being named by OEMs in 573 letters – raising concerns regarding recall risks and cost recovery exposure
- Observations of the analysis of the pace of recall completion yield some interesting insights:
 - Newer vehicles are generally repaired much more quickly at the beginning of the recall before leveling off whereas older vehicles tend to complete more linearly (at a lesser rate);
 - Enhanced outreach (such as in the GM Ignition Switch Recall) can change the behavior of older recalls to more closely resemble newer recalls and to increase the efficacy of newer vehicle recalls.



- Break



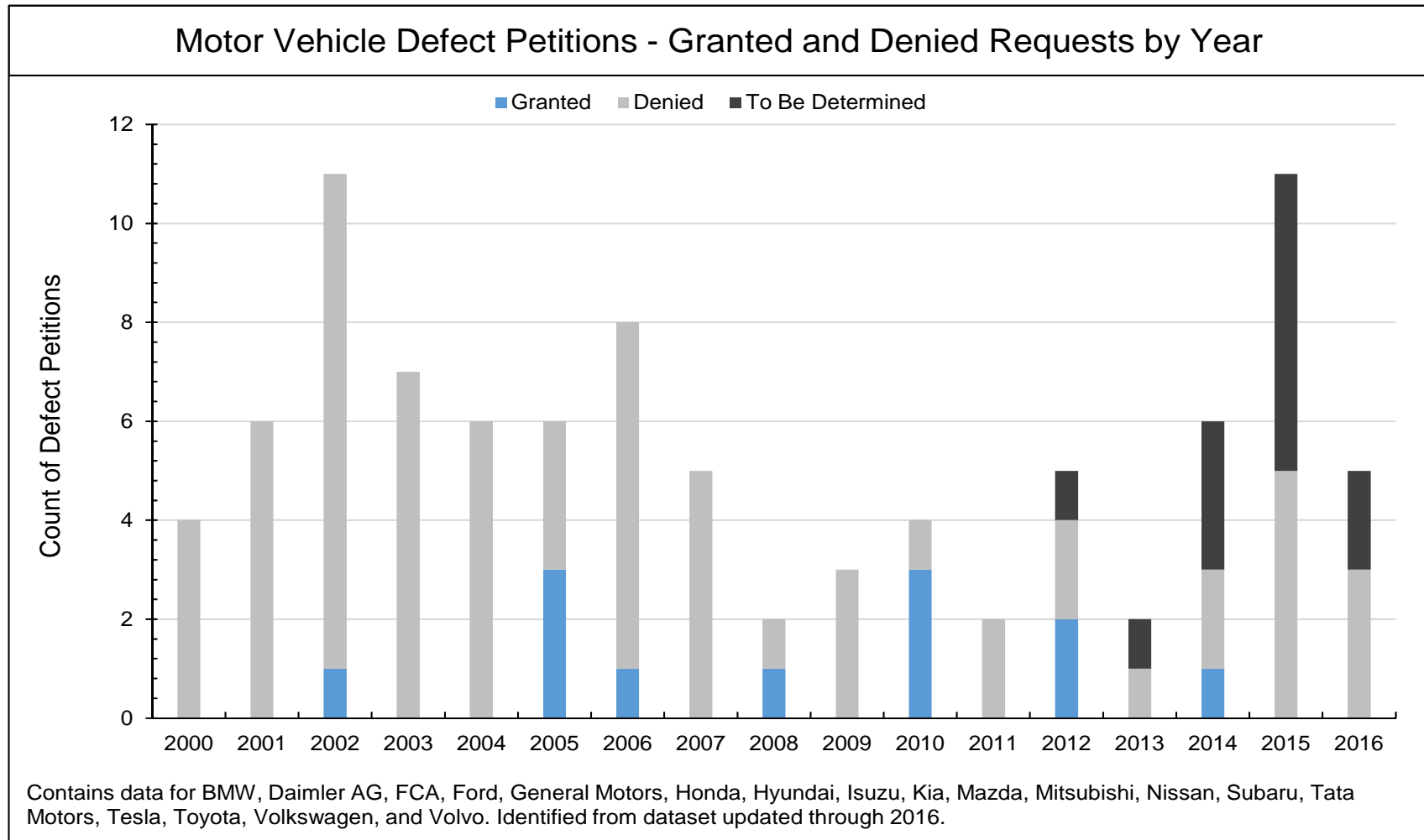
- Data Analysis and Review: Motor Vehicle Defect Petition (MVDP) Data

- Understanding MVDPs
- Overall Trends in MVDP Data

Motor Vehicle Defect Petitions (MVDP)

- Under the Safety Act, the public has the ability to petition NHTSA to open an investigation into a suspected defect or determine whether a manufacturer has appropriately conducted the recall notification and remedy process
- According to safecar.gov:
 - “Any person may submit a petition requesting NHTSA to open an investigation into an **alleged safety defect**. After conducting a technical analysis of such a petition, ODI informs the petitioner whether it has been granted or denied. If the petition is granted, a defect investigation is opened. If the petition is denied, the reasons for the denial are published in the Federal Register. Similarly, a person may submit a petition requesting NHTSA to hold a hearing on whether a manufacturer has **reasonably met its obligation to notify and/or remedy a safety defect or noncompliance with a Federal motor vehicle safety standard**. If the petition is granted, a hearing is held to assess the matter and decide what corrective action should be taken. If the petition is denied, the reasons for the denial are published in the *Federal Register*.”
- The filing, granting and denial of MVDPs may be an early indicator of defects, field service actions, and recalls

Motor Vehicle Defect Petitions (MVDP)



Source: NHTSA

Motor Vehicle Defect Petitions (MVDP)

- NHSTA denied three MVDPs in 2016:
- Alleged defect in the electronic throttle control software in Toyota vehicles which caused unexpected vehicle acceleration while travelling at slow speeds and attempting to park.
 - *“Reports of braking ineffectiveness in controlling a vehicle experiencing the onset of unintended acceleration from a stopped position or when moving slowly requires an explanation for the ineffectiveness, such as physical evidence of damage to the brake system. Under these circumstances, investigating for phenomena other than pedal misapplication absent an explanation for the ineffectiveness of the brakes, which are independent of the throttle control system and are designed to dominate engine torque, is not likely to be useful.”*
- Alleged defect involving cab sway, cab misalignment, bottoming out, and loss of control issues in Volvo Trucks allegedly related to crash avoidance systems.
 - *“This alleged defect does not adversely affect vehicle control. Furthermore, the advanced safety systems are controlled by inputs on the chassis and not the cab; therefore the systems are not affected.”*

Motor Vehicle Defect Petitions (MVDP)

- Automatic transmission failures due to engine coolant leakage in 2005-2010 Nissan vehicles. Complaints included “sudden jerking” and “loss of control” in vehicles. Nissan extended warranties in October 2010 and 2012.
- *“The Office of Defects Investigations (ODI) has opened many defect investigations into engine stalling and / or loss of motive power. The majority of investigations resulting in safety recalls involved a complete loss of motive power, frequently accompanied by loss of power-assist to steering and brake systems (the latter conditions not present here). Factors that support recalls to remedy these conditions include a lack of warning or precursor symptoms to the driver; stalling during power-demand situations such as accelerating or to maintain highway speeds / uphill grades; and an inability to immediately ‘restart’ or restore mobility to a stranded vehicle. Absent very high failure rates in new vehicles, NHTSA has not successfully pursued hesitation, reduced engine power modes, or stalling outside the conditions listed above, primarily because these conditions have not been found to demonstrate an unreasonable risk to motor vehicle safety. Experience of harsh shifting and transmission degradation over time would typically fall into this category, even if it leads to an eventual loss of motive power condition.”*



- Data Analysis and Review: Petitions for Inconsequential Noncompliance

- Understanding Petitions for Inconsequential Noncompliance
- Overall Trends in Inconsequential Noncompliance Data

Petitions for Inconsequential Noncompliance

- Manufacturers can petition NHTSA to alert it of a potential violation or defect that the manufacturer believes is an inconsequential issue that does not pose a safety risk.
 - The existence of these defects may be identified by the manufacturer or an initial determination by NHTSA

- By NHTSA's grant of a petition, the manufacturer is relieved of any further responsibility to provide notice and remedy the defect or noncompliance. A denial will continue to enforce all duties of the manufacturer relating to notice and remedy of the defect or noncompliance.

- Examples of issues that may be included on such a petition are listed below:
 - Misspelling on safety label that wouldn't reasonably lead to confusion
 - Failure of cup-holder mechanism
 - Seat cushions that fail to meet the burn rate requirements set forth by NHTSA

Petitions for Inconsequential Noncompliance

- NHTSA has only denied 6 Petitions for Inconsequential Noncompliance in the last 5 years:
 - In 2013 NHTSA denied a Ford petition related to the formation of air bubbles in the windshield of F-Series trucks when subjected to high temperatures
 - In 2014 NHTSA denied a Daimler (Mercedes Benz) petition related to a tire pressure monitoring system software misprogramming that resulted in the indicator light not illuminating properly
 - In 2014 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
 - In 2015 NHTSA denied a GM petition related to the height of letters in labels that were applied to CNG vehicles
 - In 2015 NHTSA denied a Daimler (Mercedes Benz) petition related to the candle power output level of turn signals resulting from a programming issue
 - In 2016 NHTSA denied a Daimler (Mercedes Benz) petition related to the sealing caps of a horizontal adjustment screw associated with visually aimed headlamps

- It is unclear if recent denials relate to a more focused effort on NHTSA's behalf.
 - Recent denials may be indicative of NHTSA's threshold for safety concerns



■ Data Analysis and Review: International Recall Data

- Legislative Requirements
- Specific International Campaign Review
- Analysis of SRR International Recall Database
- Observations Relating to International Campaign Data

International Campaigns¹⁴

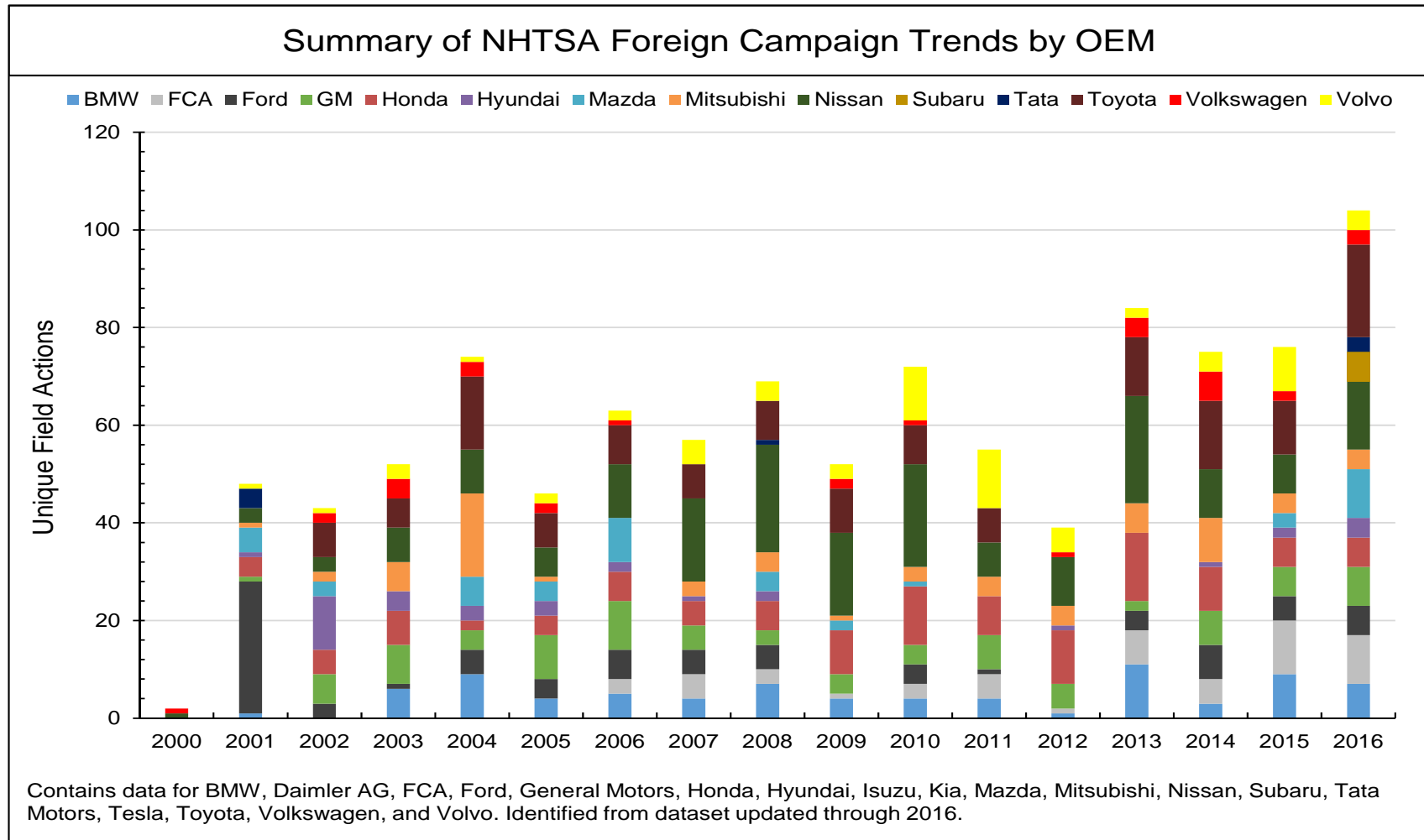
- NHTSA legislative requirements relating to international recall campaigns:
 - Manufacturers of motor vehicles or items of motor vehicle equipment must notify NHTSA if the manufacturer or a foreign government determines that the manufacturer should conduct a recall or other safety campaign on a motor vehicle or item of motor vehicle equipment that is **identical or substantially similar to** a motor vehicle or item of motor vehicle equipment offered for sale in the United States

International Campaigns – NHTSA Foreign Campaigns

- SRR compiled all NHTSA foreign data for the OEMs analyzed dating back to 2000
 - Information reported to NHTSA includes subject vehicles and dates of manufacture, description of defect, identification of “substantially similar” vehicles sold in U.S., and comments regarding whether these vehicles may also be affected

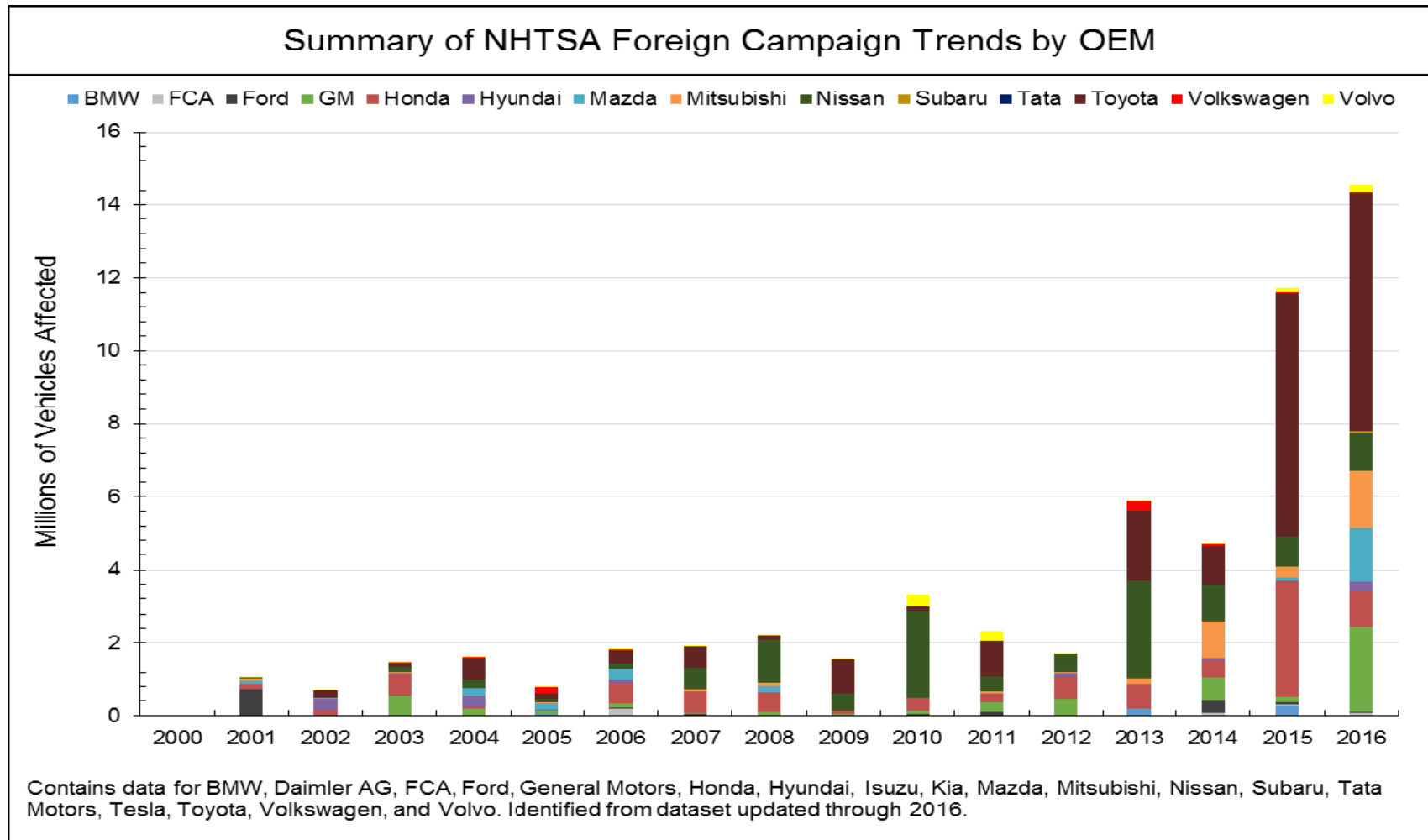
- Significant limitations relating to analysis of international campaign data
 - Data generally not as “clean” or uniform
 - No standard component classification (generally only verbatims) and the component at issue is not always clear
 - Information is provided by region or country, but it is not always possible to identify the number of vehicles impacted in each area

International Campaigns – Overall Trends



Source: NHTSA International Campaign Data

International Campaigns – Overall Trends



Source: NHTSA International Campaign Data

Specific International Campaign Review

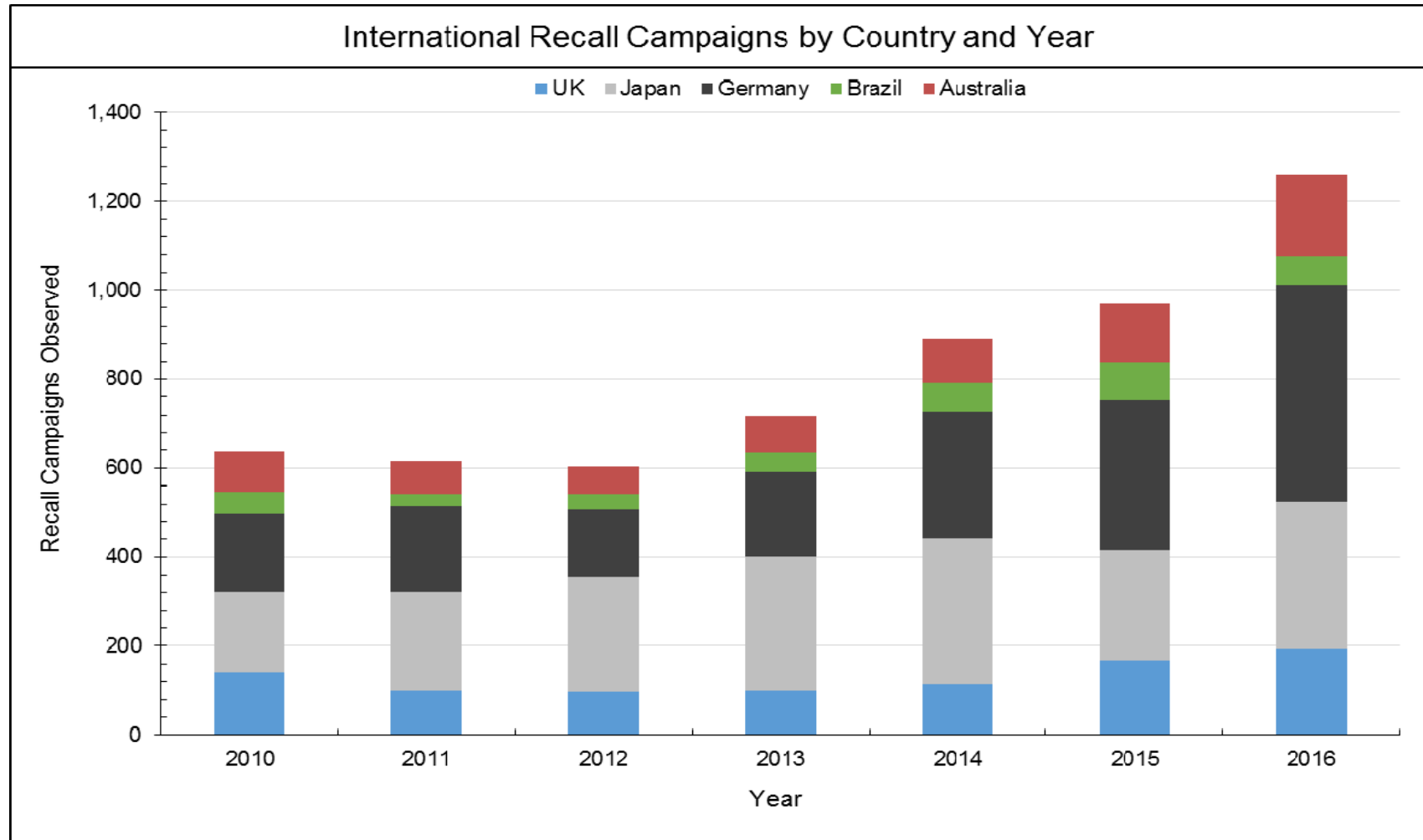
- Toyota represents the largest share of the units affected in NHTSA international campaigns in 2016, primarily related to the recall of Takata airbag inflators
- Toyota recalled 4.6 million vehicles globally related to Takata SDI inflators
- Toyota also recalled approximately 2.9 million vehicles globally for a defect related to a crack in the fuel evaporative emission control unit
- Together, recalls from GM, Mazda, and Mitsubishi represented an additional 37% of vehicles recalled globally

International Campaigns – SRR International Recall Database

- SRR has also compiled all available automotive recall data for five countries in addition to the United States, including:
 - United Kingdom
 - Japan
 - Germany
 - Australia
 - Brazil

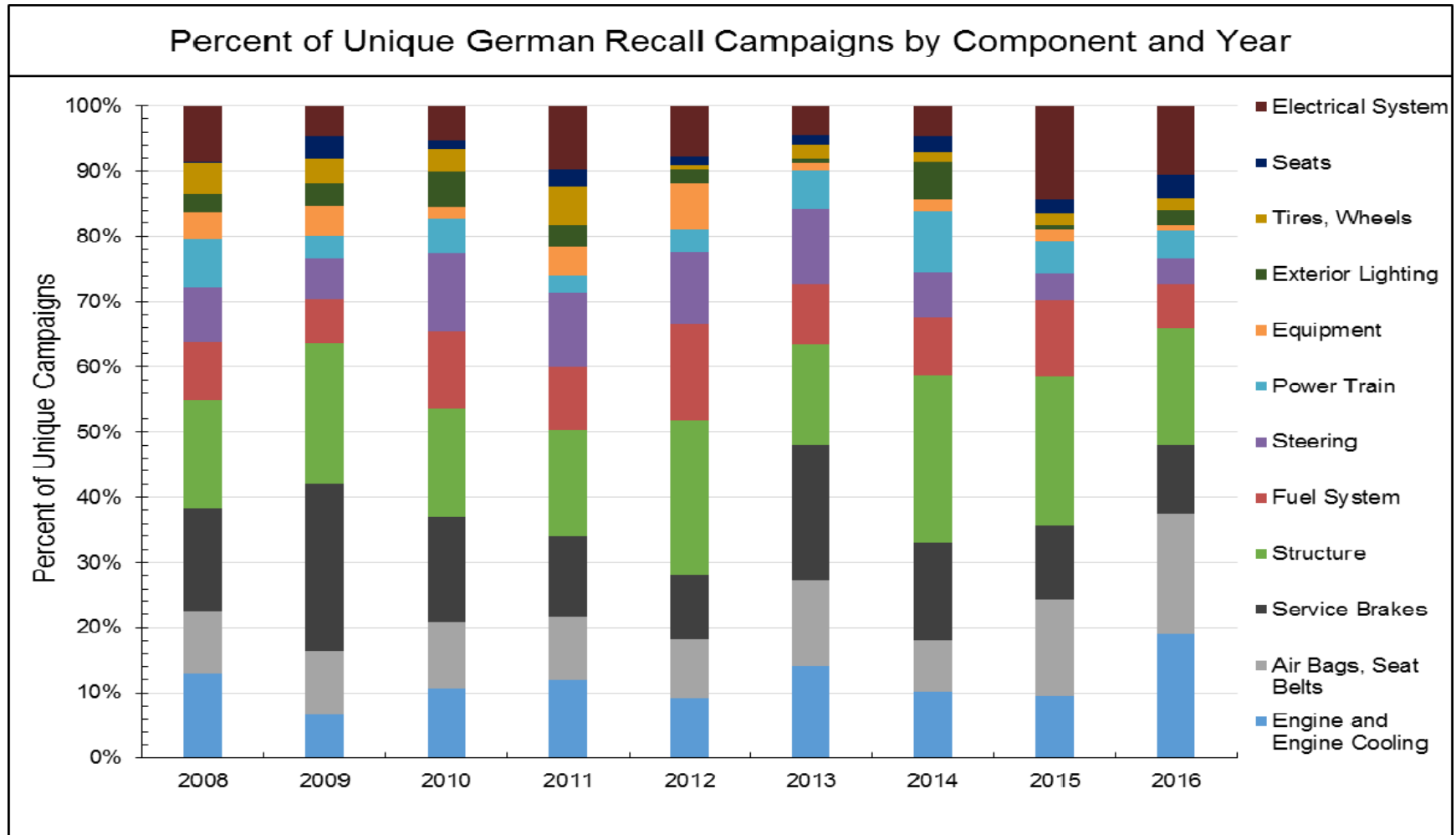
- As each locale has its own requirements for reporting, the information contained in the data collected by SRR varies by country. These countries may provide information indicating the make, model, and model year affected, number of vehicles potentially affected, and the defect description. Because of the variation in the availability and accessibility of this data, SRR's analysis relies upon manual review of the information provided by each country.

International Campaigns – Overall Trends



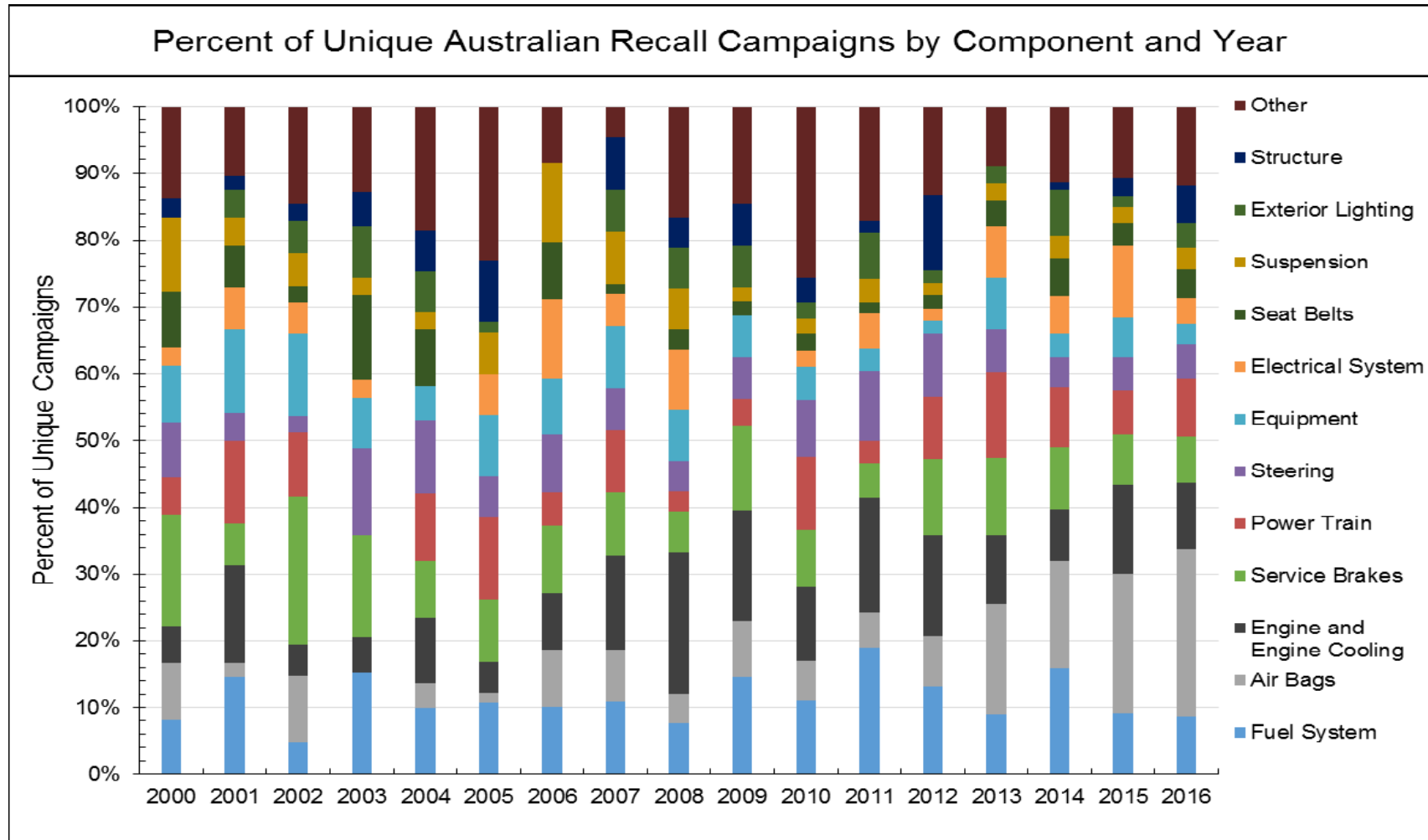
Source: SRR International Recall Datasets

International Campaigns – German Recalls



Source: German Vehicle Recall Campaign Data

International Campaigns – Australian Recalls



Source: Australian Vehicle Recall Campaign Data

International Campaign Data – Observations

- It was observed that the issues underlying foreign campaigns often do not necessarily affect U.S. vehicles
 - However, pervasive defects are identified in the U.S. and international recalls, including:
 - Increased airbag recall activity, with and without Takata inflator recalls
 - Volkswagen emissions defect
- Identification of globally pervasive defects is expected to continue into the future as production and supply of components continues to become more global and standardized
- However, more detailed and affirmative analyses are a challenge given the nature of the international campaign data



■ Electronic Components and Software Defects

- Recent News
- Classification of Electronic Component Recalls
- Analysis of Electronic Component Recall and TSB Trends
- Review of Electronic Component Investigations

Electronic Components: Background

- Electronic components continue to become increasingly important aspects of vehicle safety and customer satisfaction as these systems become more sophisticated and further integrated into vehicles and consumer devices
- Accordingly, electronic components represent an increasingly valuable share of the automotive industry:
 - *“The automotive semiconductor market was worth \$26.5 billion in 2013 up 5% from 2012. The electronics content continues to increase per car from \$312 in 2013 to \$360 in 2018. This leads to a healthy 6% CAGR from 2013 to 2018 when the market will top \$36 billion.”¹⁵*
 - *“The drivetrain now accounts for 30 percent of all semiconductor content in an automobile, or a market of about \$7 billion a year.”¹⁶*
 - *“Infotainment – a market of about \$6 billion – accounts for almost a quarter of the semiconductor content in automobiles, up from 20 percent ten years ago.”¹⁶*

Electronic Components: Recent News

- Vulnerabilities in electronic components and operating software have been the subject of increased attention by manufacturers, NHTSA, and the public.
- On September 8, 2016, GM announced that it would be recalling nearly 4.3 million vehicles due to a software defect which may prevent airbags from deploying during a crash.¹⁷
 - This defect had been linked to one death and three injuries
- In October, Honda announced that it is recalling approximately 350,000 2016 Civics related to the software that controls the vehicle stability control unit, which may prevent the application of the electronic parking break when it is applied immediately after turning the vehicle ignition switch off.¹⁸
- On March 13th of this year, Maserati recalled 3,299 model year 2017 Levante vehicles. Due to a software problem, the transmission may unexpectedly shift into neutral or cause the engine to shut off when operated at slow speeds.¹⁹
- On March 25, Uber suspended its pilot program for driverless cars after a vehicle equipped with the technology collided with a second vehicle that had “failed to yield” to the Uber vehicle while making a turn.²⁰

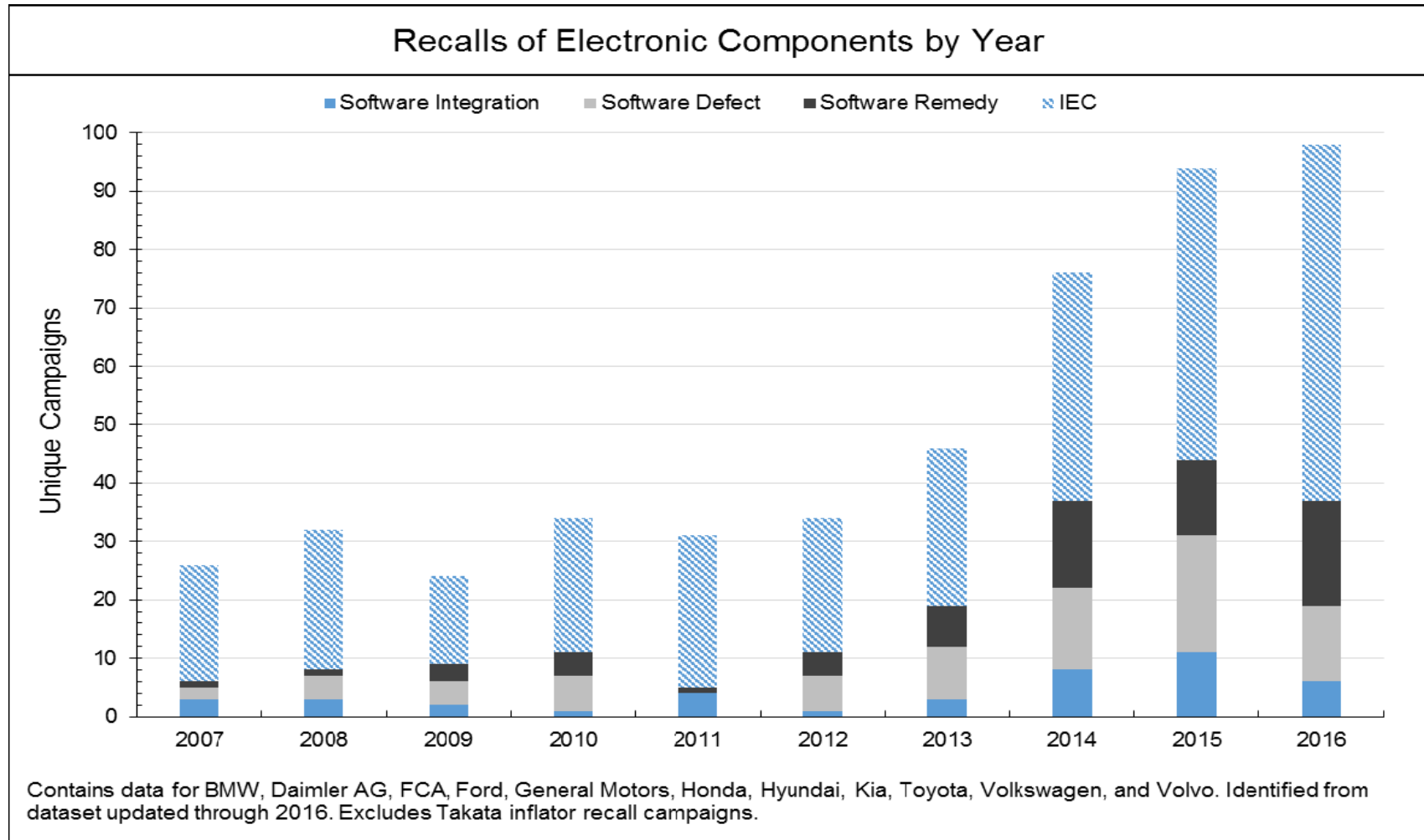
NHTSA Investigation – Advanced Driver Assistance Systems²¹

- On May 7, 2016, a Tesla Model S vehicle was involved in a fatal collision with a tractor trailer.
 - The vehicle was equipped with Tesla's Autopilot system and Automatic Emergency Braking (AEB) system.
- The Office of Defects Investigation analyzed the AEB system design and performance, human-machine interface issues related to Autopilot operating mode, data from crash incidents related to Tesla's Autopilot and AEB systems, and changes implemented by Tesla to those systems.
- NHTSA's examination did not identify any defects in the design or performance of the AEB or Autopilot systems.
 - ODI found that the Autopilot system requires "continual and full attention of the driver...[to] be prepared to take action to avoid crashes."
- Tesla's design included a hands-on the steering wheel system for monitoring driver engagement. That system has been updated to further reinforce the need for driver engagement through a "strike out" strategy. Drivers that do not respond to visual cues in the driver monitoring system alerts may "strike out" and lose Autopilot function for the remainder of the drive cycle.

Electronic Components: Analysis

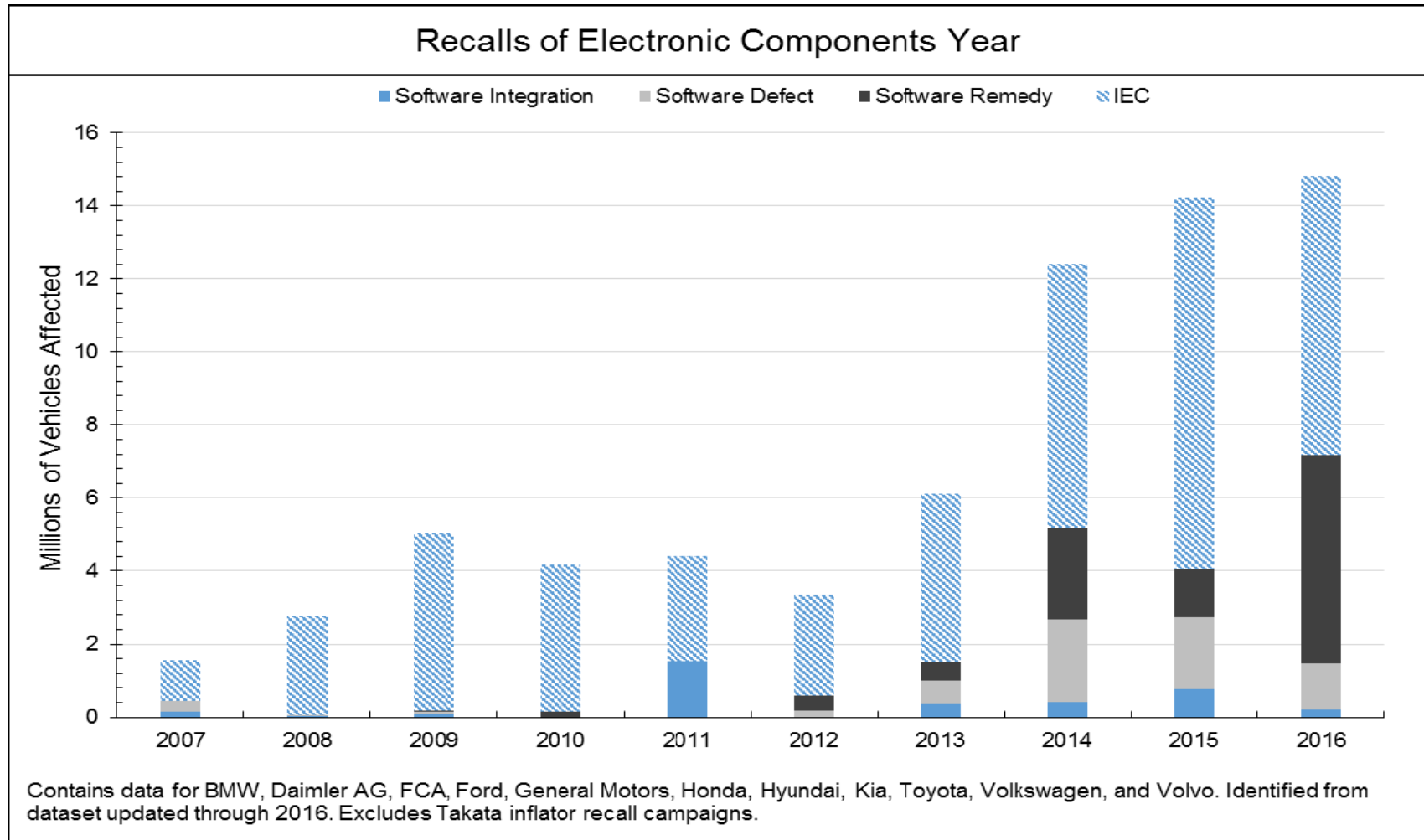
- Our analysis of automotive electronics highlights the role of software in the failure or remedy of electronic defects.
- SRR's analysis has focused on the following categories of defects:
 - Integrated Electrical Components (“IECs”) – Failure of electrical components due to physical defect. Includes defects related to water intrusion, wiring failure, etc.
 - Software Defect – Failure of components related to defect in operating software
 - Software Integration – Failure results from software interfacing with other components or systems in the vehicle
 - Software Remedy – Software flash or replacement is identified as the appropriate defect remedy

Electronic Components: Recall Data



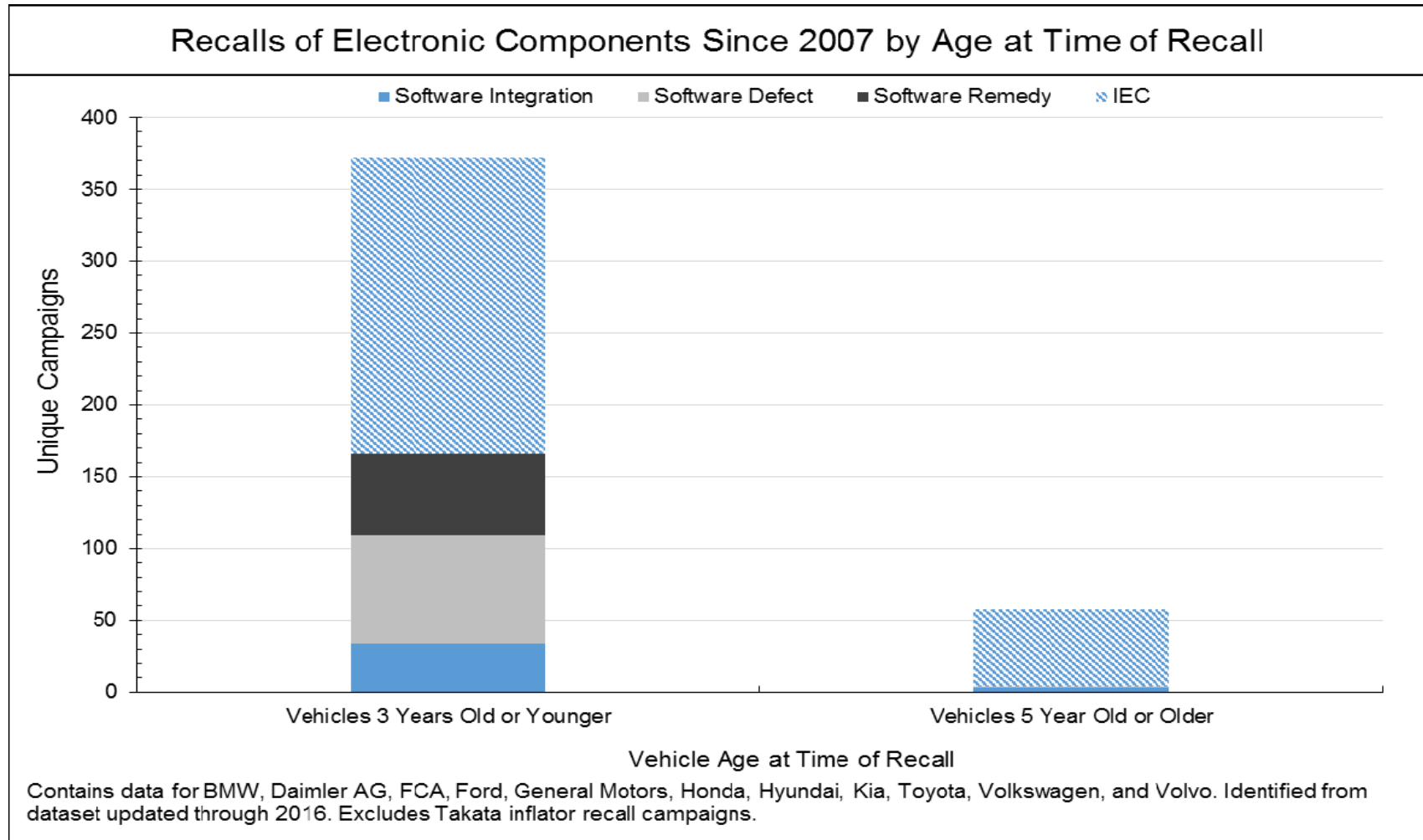
Source: NHTSA Recall Data

Electronic Components: Recall Data



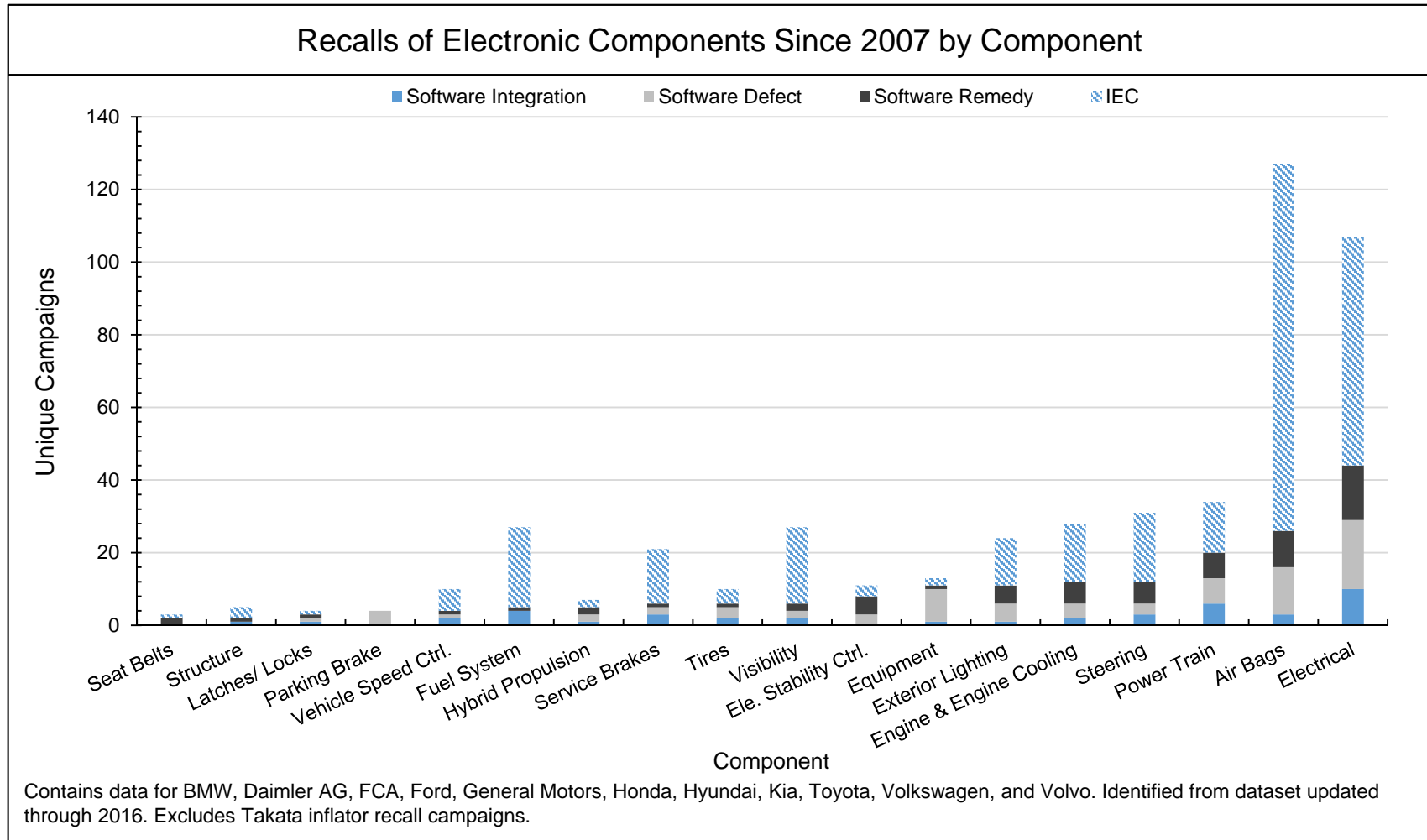
Source: NHTSA Recall Data

Electronic Components: Recall Data



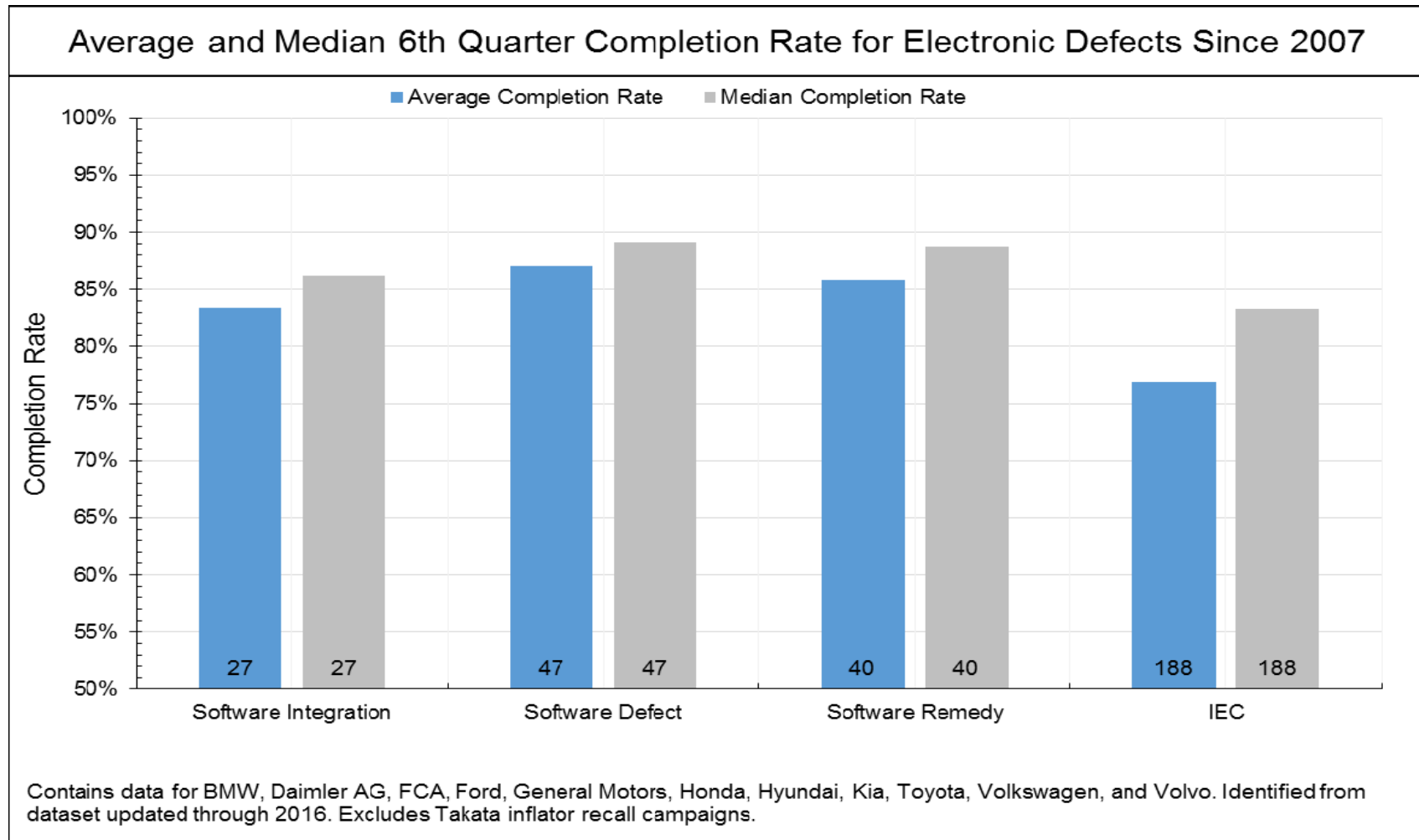
Source: NHTSA Recall Data

Electronic Components: Recall Data



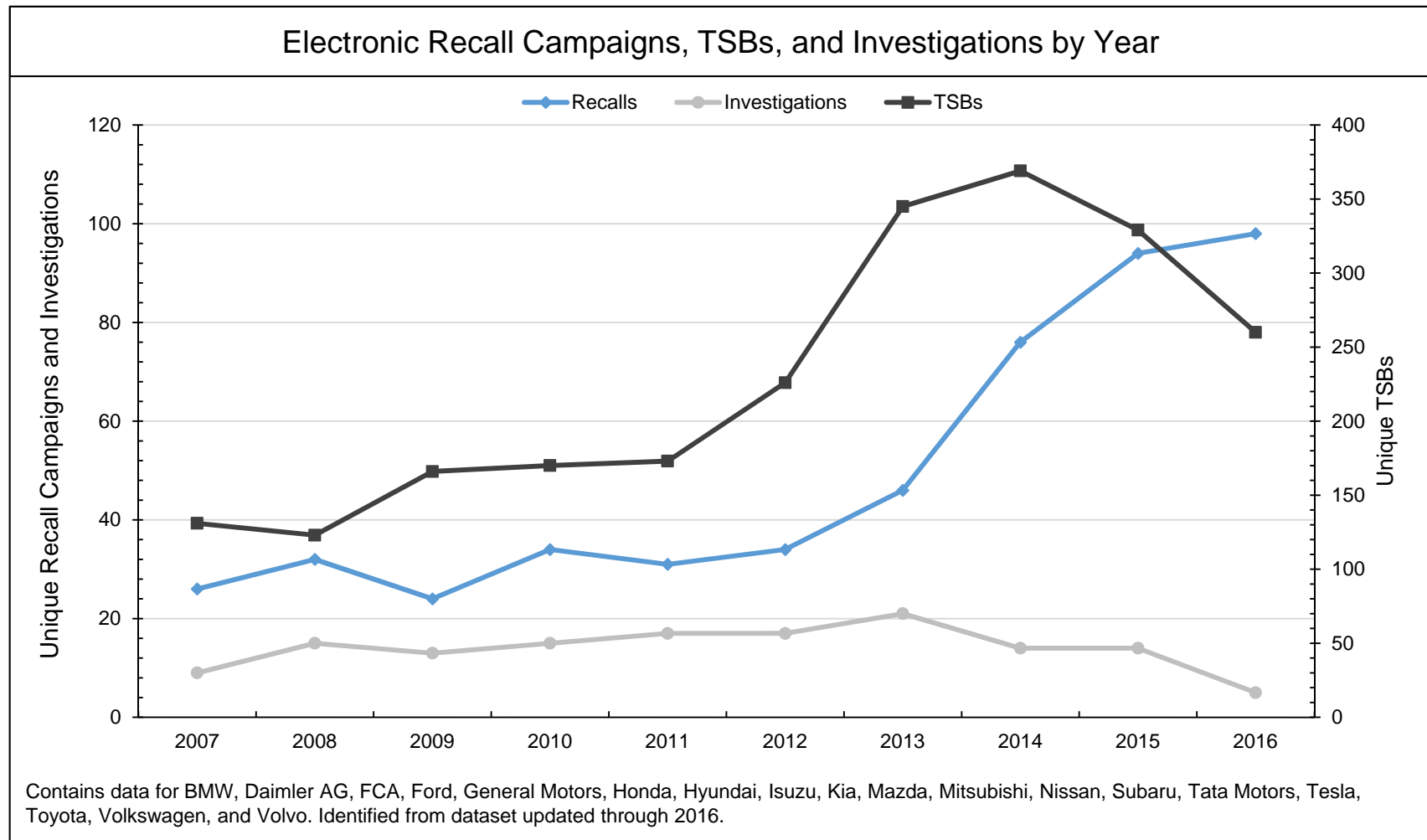
Source: NHTSA Recall Data

Electronic Components: Completion Rates



Source: NHTSA Completion Rate Data

Electronic Components: Recalls, TSBs, and Investigations



Source: NHTSA Investigation, Recall, and Technical Service Bulletin Data

Electronic Components: Investigations

- SRR has also reviewed NHTSA investigations related to electronic components. NHTSA initiated five investigations related to electronics and software issues during 2016:
 - On February 3, 2016 ODI opened an engineering analysis to assess the scope, frequency, and safety related consequences of an alleged defect related to the shifter design in FCA's Chrysler 300, Dodge Charger, and Jeep Grand Cherokee vehicles. This investigation resulted in the recalls of FCA and Maserati vehicles.
 - A consumer filed a defect petition in May 2016 alleging a defect related to a kink in the in the sensor mat utilized by the Passenger Sensing System in Pontiac Solstice and Saturn Sky vehicles which may cause the circuitry to fail and cause the passenger airbag system to become inoperative.
 - On July 1, 2016, ODI opened an investigation of occupants reporting exhaust odors in the occupant compartment of Ford Explorers. Ford had previously issued two TSBs related to this defect, one involving software changes to the recirculation mode of the air conditioning system during full throttle events.
 - On September 3, 2016, ODI opened an investigation based upon reports alleging the rear brakes of 2016 Hyundai Sonatas locked or applied while driving without pedal application. The defect is the result of an error within the Electronic Parking Brake control logic. Hyundai issued a service campaign to reflash the software; the ODI investigation was closed.
 - On December 12, 2016, ODI opened an investigation into the Anitlock Braking System Hydraulic Control Unit of MY 2007 – 2009 Ford Fusions and Mercury Milans after receiving numerous consumer complaints of sudden and unexpected increases in stopping distance.

Electronic Components: Conclusions

- Recalls of electronic components have been increasing steadily since 2013.
 - Software related defects represent an increasing proportion of electronic related defects, including those defects addressed by software remedies.
- Vehicle models involved in recalls of electronic defects are much more likely to be newer vehicles.
 - *De Minimis* number of recalls of older vehicles involving software defects and software integration issues; zero recalls of older vehicles utilize software remedies.
- Recalls of airbags are significantly more likely to involve electronic components.
 - Other notable affected component categories include powertrain, steering, visibility, and fuel systems.

Electronic Components: Conclusions

- Higher completion rates among software related defects are likely observed due to:
 - Vehicles with more systems controlled by software tend to be newer
 - Software related defects are identified earlier than other IEC defects
 - Software remedies likely to involve shorter repair times
 - May even be loaded on a flash drive sent to owners or pushed over-the-air (“OTA”)
- Conversely, IEC defects:
 - May not manifest as quickly, therefore impacting an older vehicle population
 - May involve longer repair times
 - May be more easily diagnosed by owners

Electronic Components: Conclusions

- Electronic and software components are becoming increasingly common and integrated into vehicle safety and customer comfort systems
 - These components are also increasingly integrated with customer devices and data networks
- As software components continue to be integrated into vehicle systems, the pace of related recalls, field service actions, and investigations has increased
- Just as NHTSA has created new EWR reporting categories related to forward collision avoidance and automatic braking, we expect to see continued interest by NHTSA in relation to software and IEC components



- Financial Statement Analysis and Review: Warranty and Recall Claims and Accruals

Indicators of Cost Recovery

- Cost recovery influences OEM reserves and financial reporting
- After returning to a pre-recession low-point during the massive recalls of 2014, OEM cost recovery, as measured by suppliers' share of industry warranty claims, has been increasing
 - Range of OEM cost recovery has historically been within the range of 10 – 20% of total claims
- A variety of factors may influence OEM cost recovery, including root cause, macroeconomic conditions, supplier viability, and contractual sharing ratios

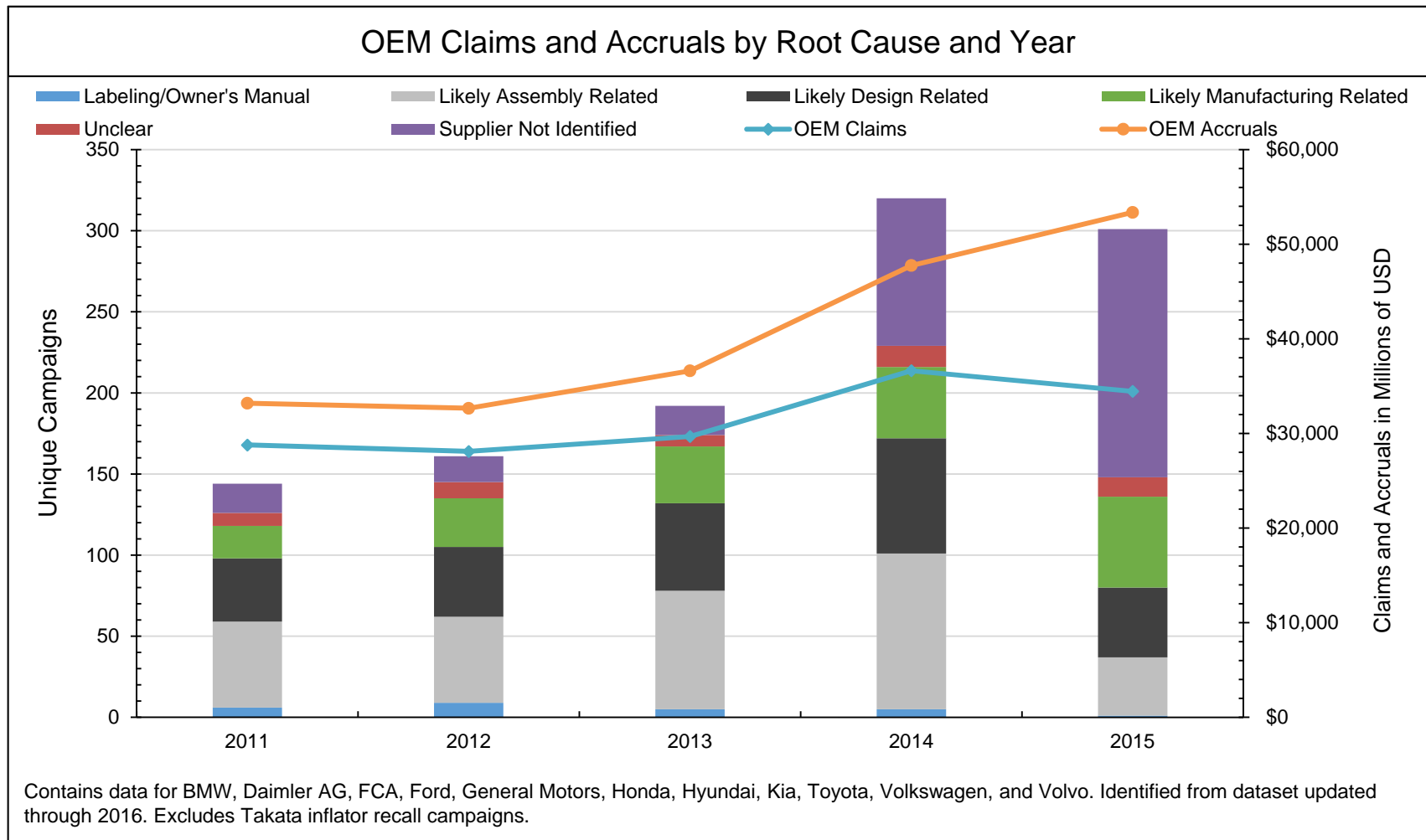
Source: Warranty Week

Indicators of Cost Recovery

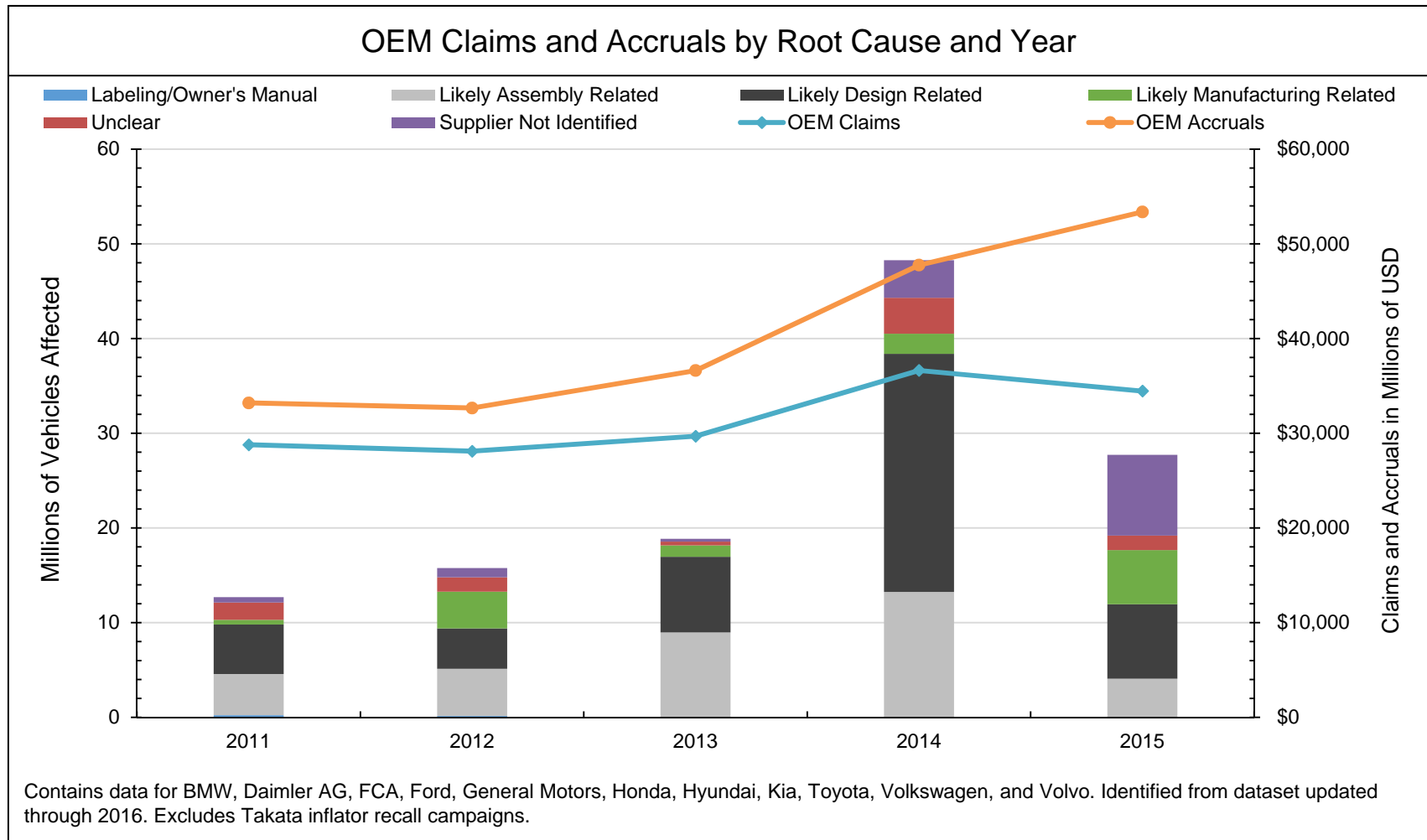
- SRR has studied the attributes of specific recalls as well as the patterns of OEM and supplier claims and accruals to identify any relationship between the two

- SRR has compared the claims and accrual activity to the following recall attributes:
 - Design related – defects arising from failure, omission, etc., related to the design of a component (may be OEM or supplier design)
 - Manufacturing related – defects arising from supplier's manufacture of component (e.g., material failure or out of tolerance)
 - Assembly related – defects arising from OEM assembly of components into finished vehicle
 - Labeling / owner's manual – Recalls associated with non-functional defects

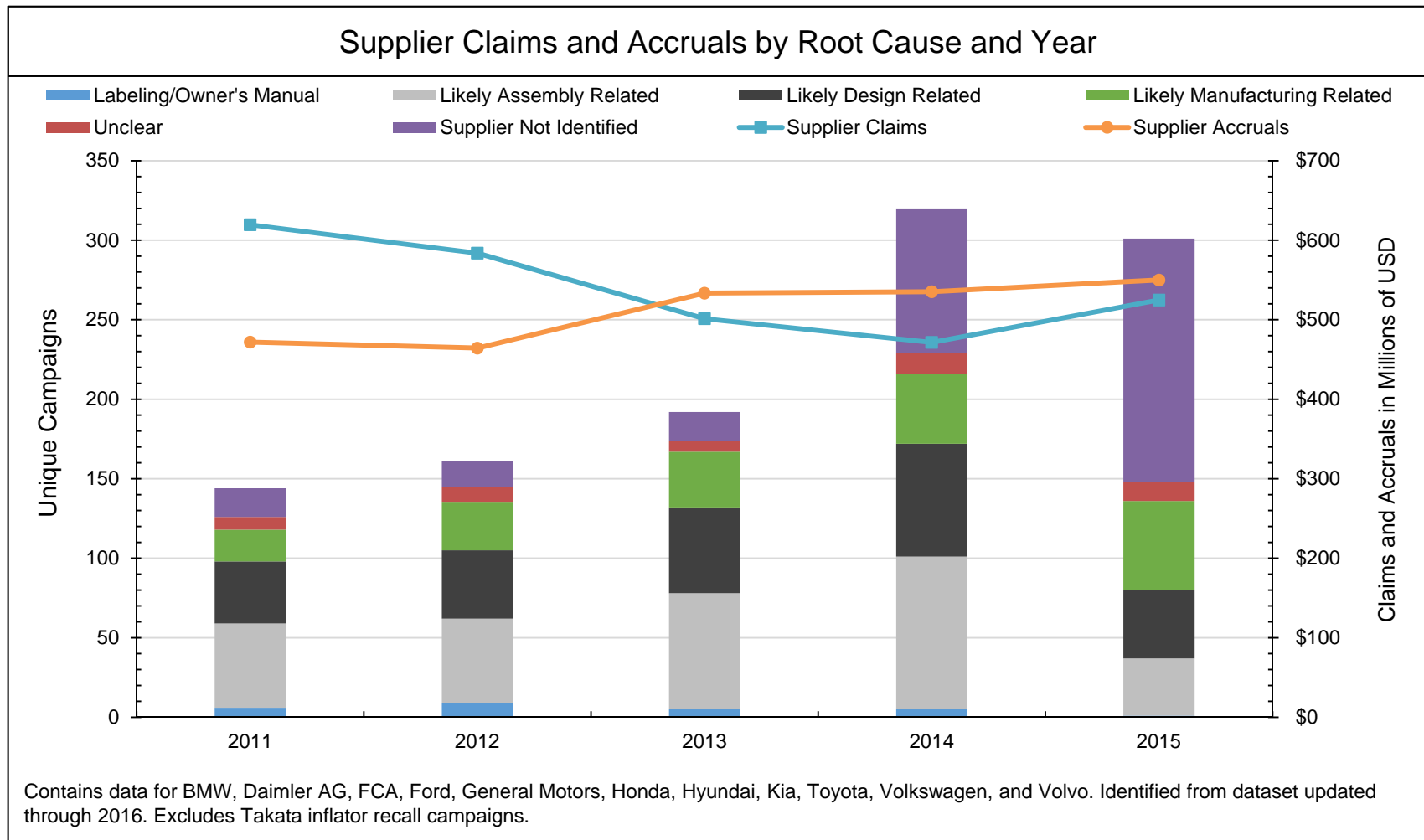
Cost Recovery Indicators – OEM Claims and Accruals



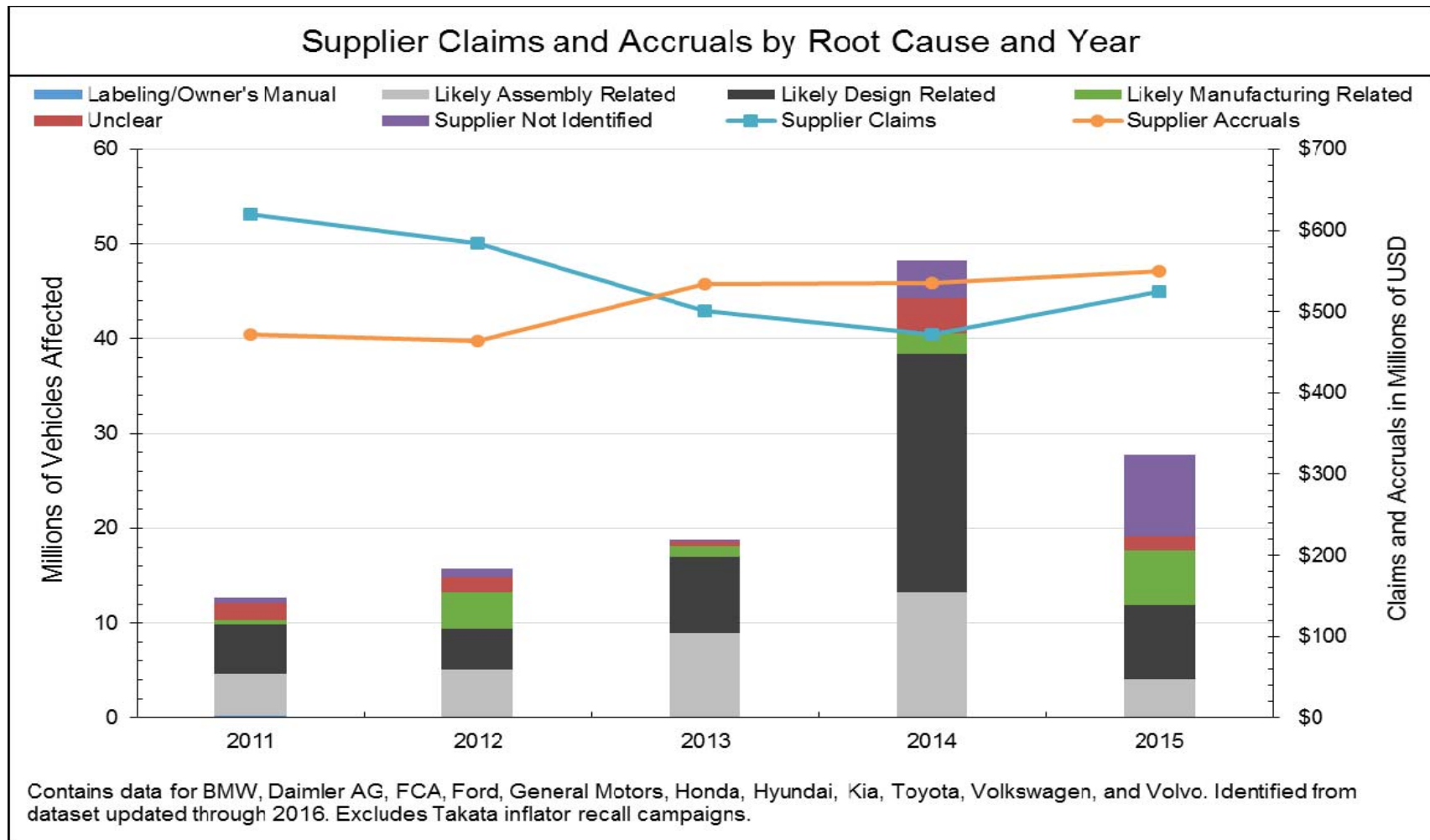
Cost Recovery Indicators – OEM Claims and Accruals



Cost Recovery Indicators – Supplier Claims and Accruals



Cost Recovery Indicators – Supplier Claims and Accruals



Cost Recovery Indicators - Observations

- Increase in claims experienced by suppliers and decrease in claims experience of OEMs suggests meaningful cost recovery efforts in the industry
- Our analysis provides an opportunity for OEMs to benchmark their cost recovery performance against the industry
 - OEMs must understand the mix of defects they experience in order to properly assess their cost recovery performance relative to the industry
 - Suppliers may consider the degree to which they are exposed to design or manufacturing related defects
- With an increase in the number of units affected by design and manufacturing related defects in 2016, we may observe an increase in the amount of supplier claims and accruals, and OEM efforts pertaining to cost recovery



- Things to Look For: Future Expectations



- Break



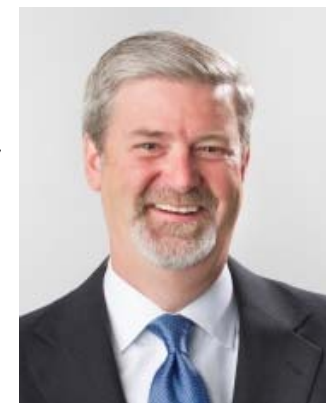
- Panelist Introductions

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Privileged & confidential information.

Footnotes

¹ <https://www.nhtsa.gov/press-releases/us-dot-and-iihs-announce-historic-commitment-20-automakers-make-automatic-emergency>

² <https://www.federalregister.gov/documents/2016/09/23/2016-23010/nhtsa-enforcement-guidance-bulletin-2016-02-safety-related-defects-and-automated-safety-technologies>

³ <https://www.federalregister.gov/documents/2016/12/14/2016-28804/federal-motor-vehicle-safety-standards-minimum-sound-requirements-for-hybrid-and-electric-vehicles>

⁴ <https://www.nhtsa.gov/press-releases/effective-today-new-federal-law-recalled-rental-cars-protects-consumers-vehicle>

⁵ <https://www.nhtsa.gov/press-releases/us-dot-issues-federal-guidance-automotive-industry-improving-motor-vehicle>

⁶ <https://www.nhtsa.gov/press-releases/us-dot-advances-deployment-connected-vehicle-technology-prevent-hundreds-thousands>

⁷ <https://www.nhtsa.gov/recall-spotlight/takata-air-bags>

⁸ <https://www.safercar.gov/rs/takata/takata-completion-rates.html>

⁹ <https://www.nhtsa.gov/recall-spotlight/takata-air-bags>

¹⁰ US Department of Justice

¹¹ The Japan Times

¹² “Safety Defect and Noncompliance Report Guide: PART 573 Defect and Noncompliance Report”, NHTSA Website February 2015

¹³ “Safety Recall Compendium: A Guide for Reporting, Notification, and Remedy of Motor Vehicle and Motor Vehicle Equipment in Accordance with Title 49 of the United States Code, Chapter 301 and Supporting Federal Regulations,” www-odi.nhtsa.dot.gov

¹⁴ “49 CFR Parts 573, 577, and 579: Early Warning Reporting, Foreign Defect Reporting, and Motor Vehicle and Equipment Recall Regulations”, NHTSA Department of Transportation, August 9, 2013

Footnotes

- ¹⁵ <https://technology.ihs.com/529008/automotive-semiconductor-market-tracker>
- ¹⁶ Winning share in automotive semiconductors – McKinsey
- ¹⁷ <http://fortune.com/2016/09/09/gm-recall-software/>
- ¹⁸ <http://autoweek.com/article/recalls/honda-recalls-350000-civics-electronic-parking-brake-glitch>
- ¹⁹ <https://www.nhtsa.gov/vehicle/2017/MASERATI/LEVANTE/SUV/AWD#recalls>
- ²⁰ <http://www.cnbc.com/2017/03/26/uber-self-driving-car-arizona-crash-suspended.html>
- ²¹ <https://static.nhtsa.gov/odi/inv/2016/INCLA-PE16007-7876.PDF>