



5th Annual Automotive Industry Warranty & Recall Symposium



- Number of vehicles recalled in the U.S. has declined to lowest level since 2013
 - Number of individual campaigns consistent with elevated activity
 - Number of vehicles affected by recalls other than Takata inflator recalls is consistent with prior two years.
 - Approximately 23 million vehicles recalled exclusive of Takata inflators
- Non-Takata recalls of 2017 with more than 1 million vehicles affected include:
 - FCA (Dodge) powertrain: transmission may shift out of park without pushing the brake pedal or having the key in ignition (1.5 million vehicles)
 - Honda battery: case for the battery sensor may allow water to enter and cause an electrical short (1.1 million vehicles)
 - Ford door latches: doors may open during driving due to kinked cable or frozen latches (1.1 million vehicles)
 - FCA (Dodge) air bags: roll rate sensor may trigger a fault and cause the rollover side curtain air bag or seatbelt pretensioner not to deploy (1 million vehicles)

2017 Recall Sizes

- Largest recall of 2017:
 - Issued by FCA related to 2009 - 2017 Dodge Ram 1500, 2500, 3400, 4500, and 5500 trucks shifting out of park
 - 1,482,874 vehicles affected

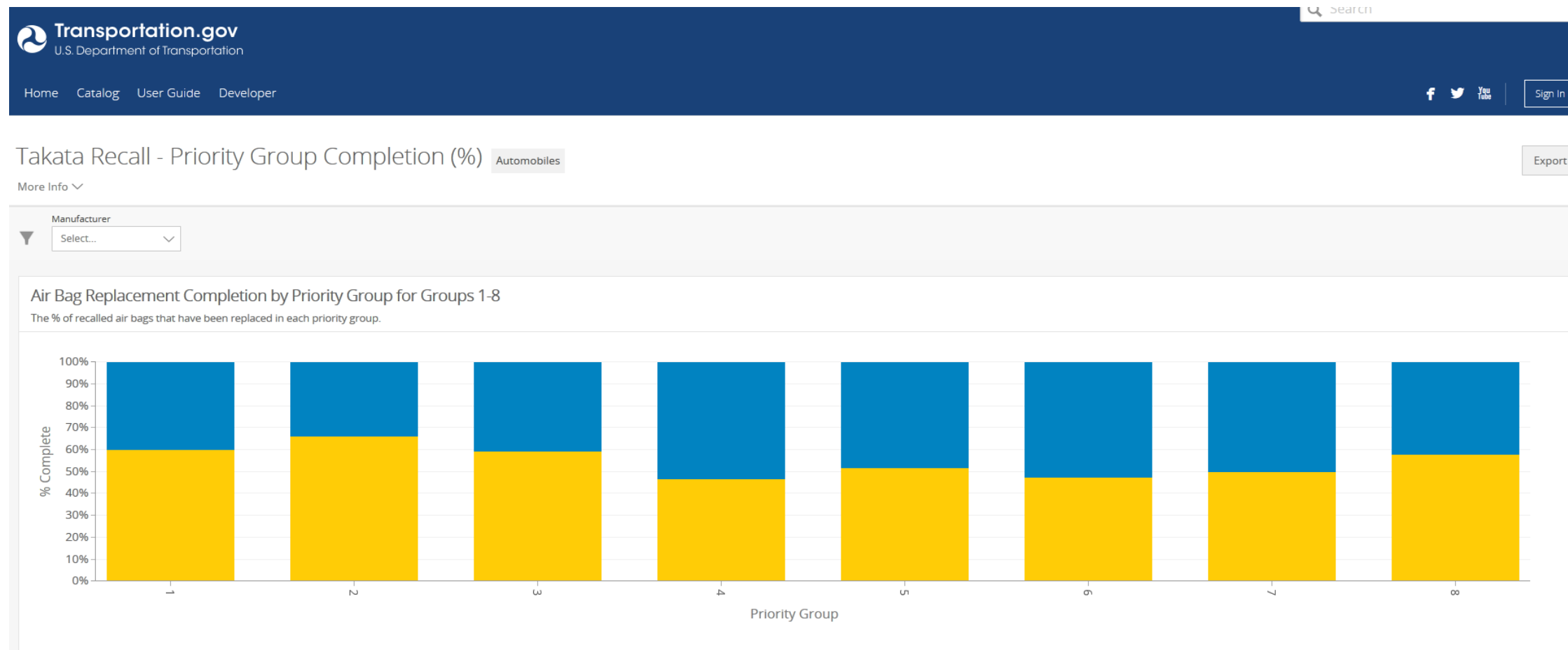
- Smallest recalls of 2017
 - 1 vehicle each recalled by Kia, Mercedes Benz, Land Rover, and Jaguar

Takata Update

- TK Holdings Inc. and 11 of its U.S. and Mexican affiliates filed for Chapter 11 bankruptcy on June 25, 2017¹
- In July, Takata issued a defect information report (DIR) recalling certain desiccated inflators contained in approximately 3 million vehicles²
- Independent Monitor issued The State of the Takata Airbag Recalls on November 15, 2017³
- More than 40 states and the District of Columbia have reached a settlement with Takata⁴
- 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 Ranger⁵
- Senators Markey and Blumenthal issued the Automaker Report Card, urging OEMs to offer loaner cars to owners of vehicles affected by recalls⁶
- On March 20, 2018 a Senate Commerce subcommittee overseeing NHTSA held a hearing regarding the pace of recall repairs⁷
- 15 confirmed fatalities in the U.S. ³
 - 22 confirmed fatalities worldwide ⁸

Takata Update

- As of March 2, 2018 the overall recall completion percentage for Takata recalls was 57%²
- The completion percentages for Priority Groups 1 – 8 are available at NHTSA.gov :

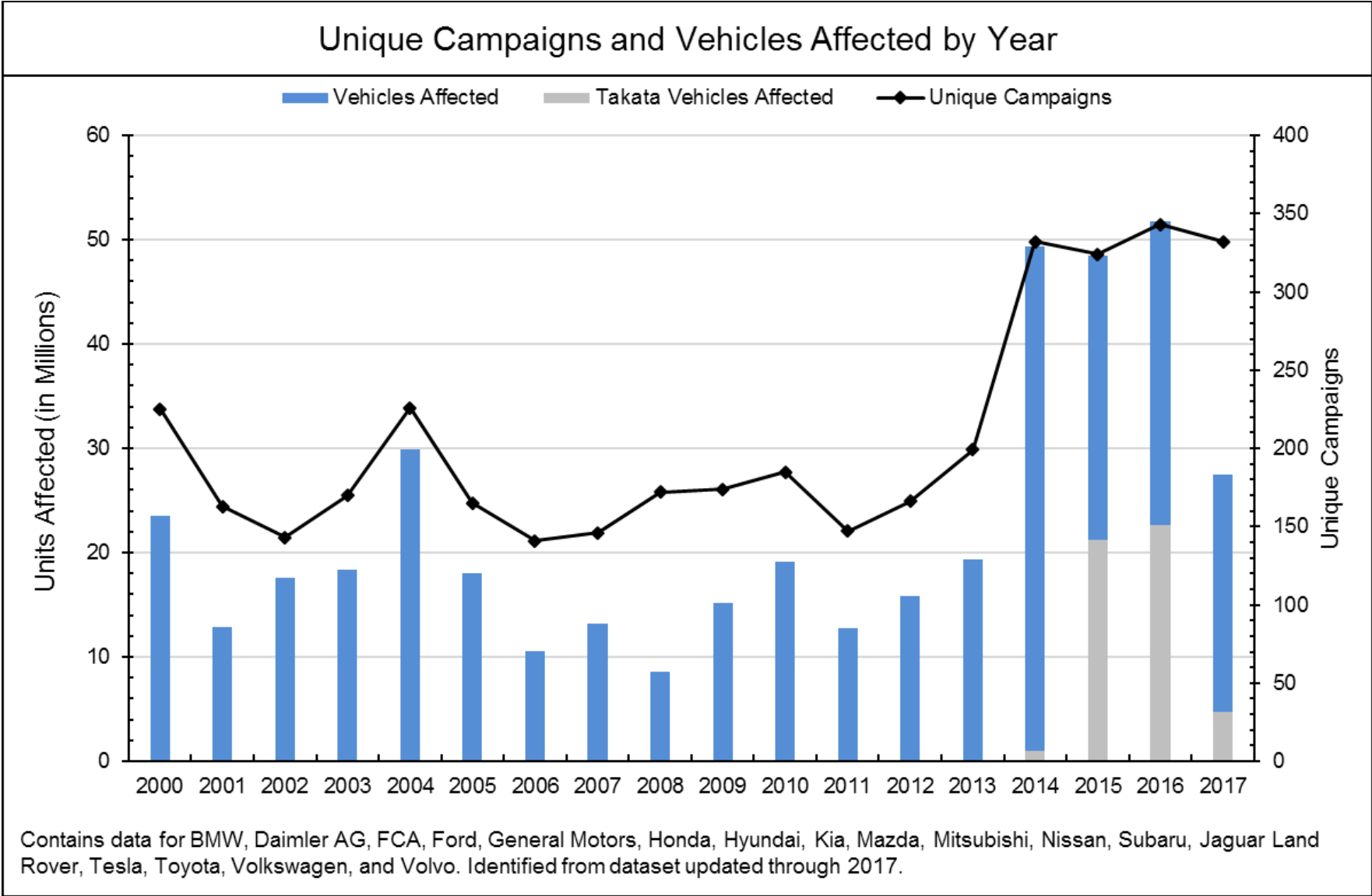


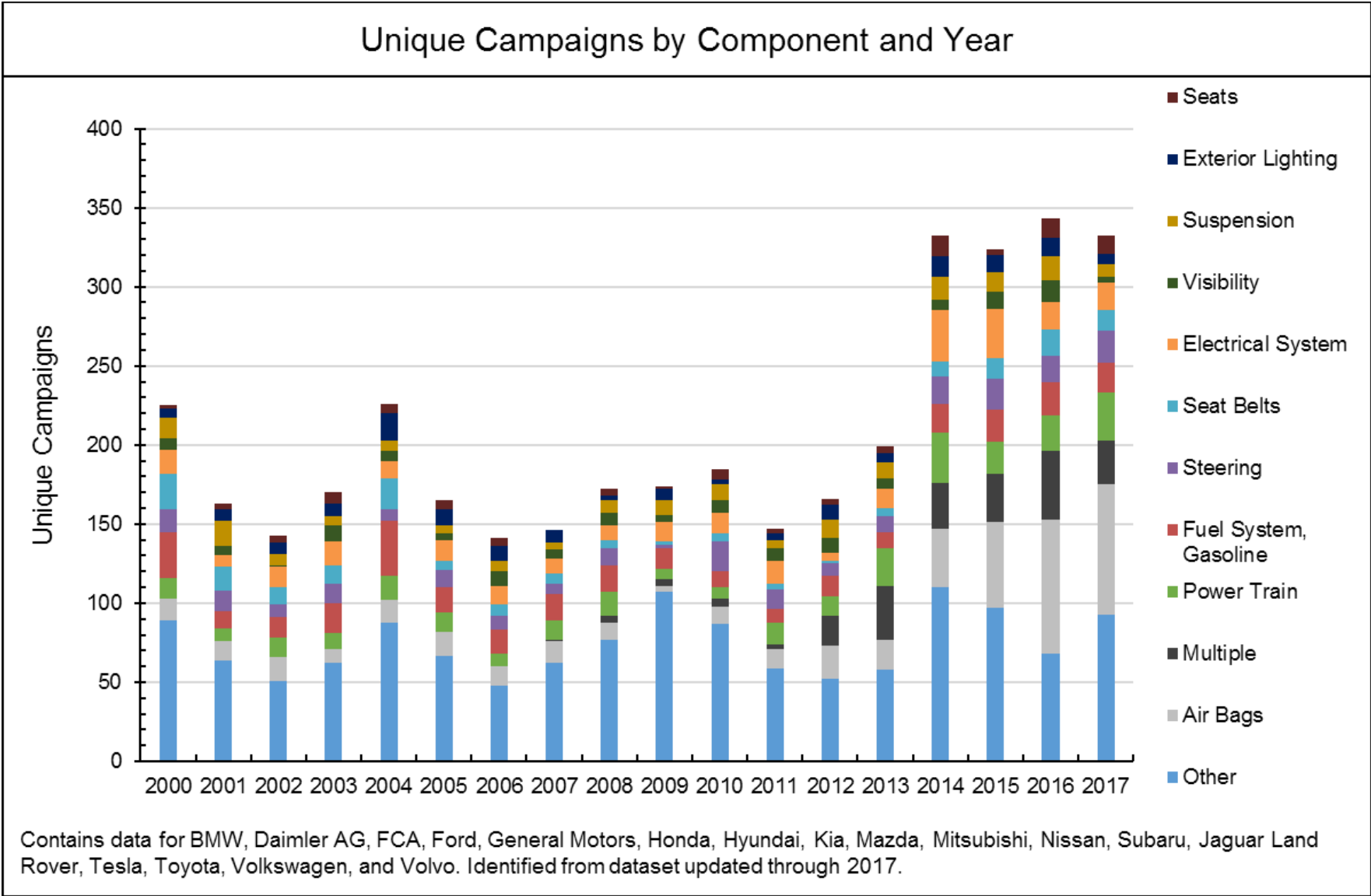


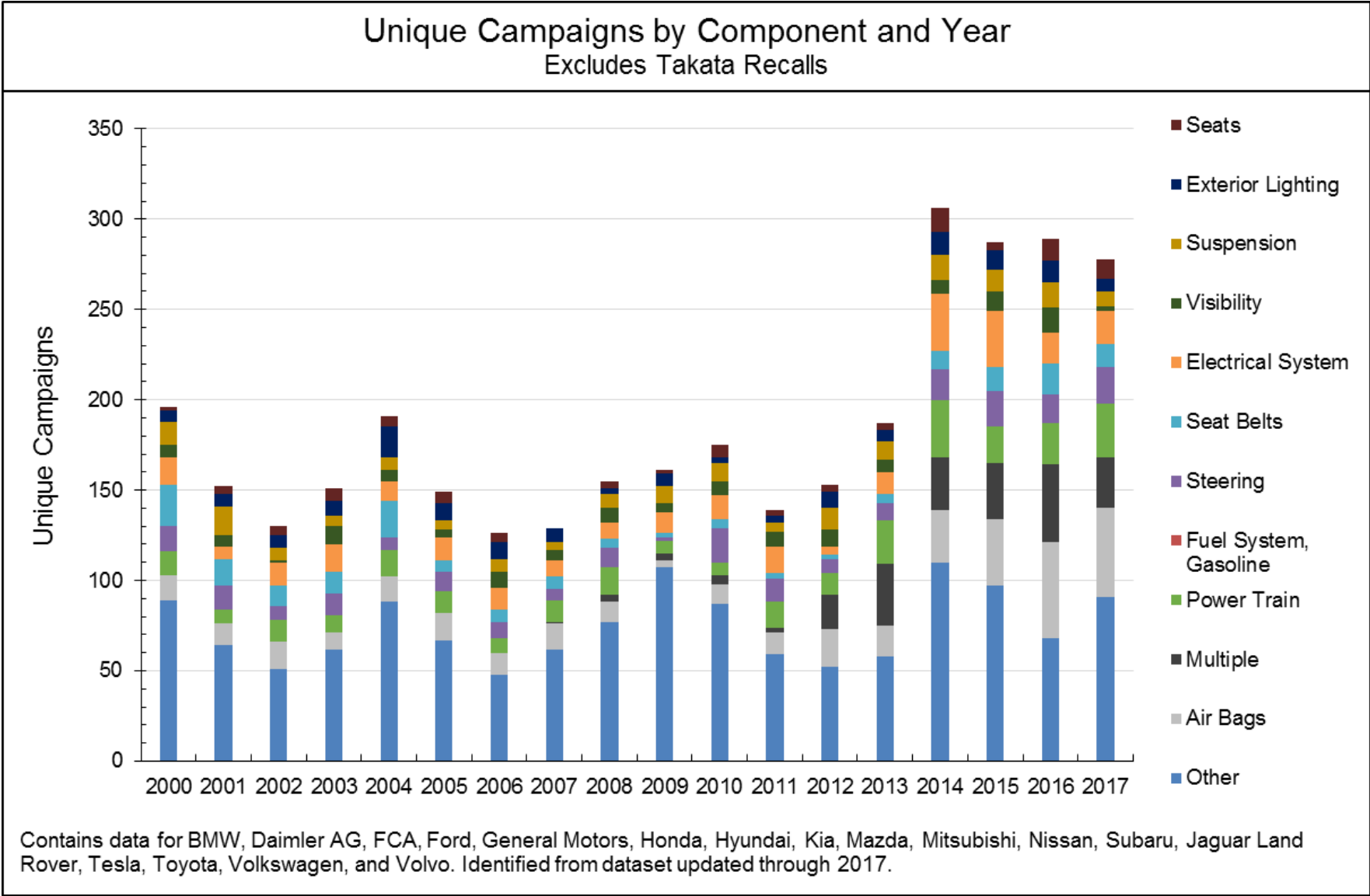
Data Analysis and Review: Recall and Defect Overview

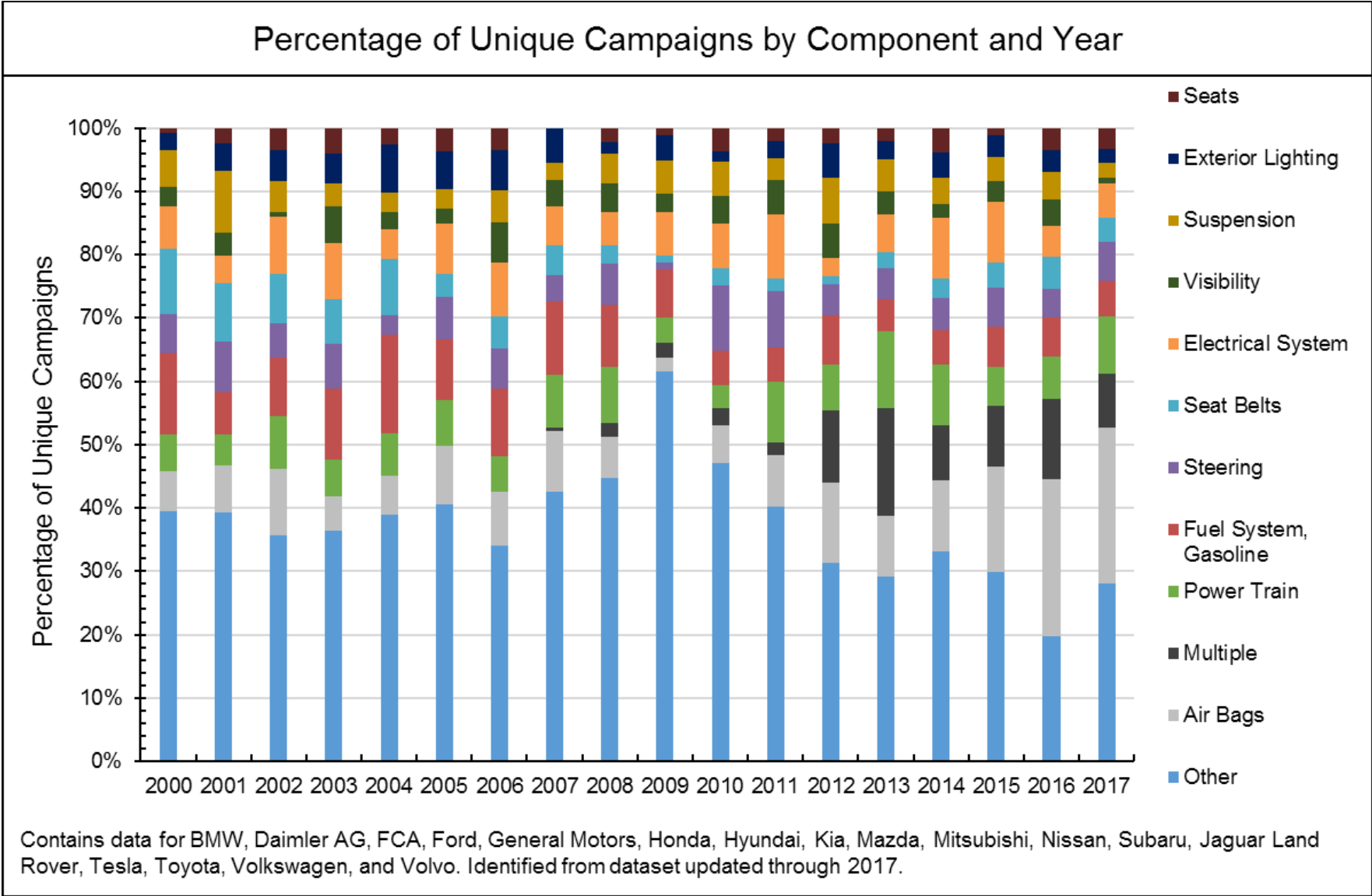
Recall Data Analysis: Process and Background

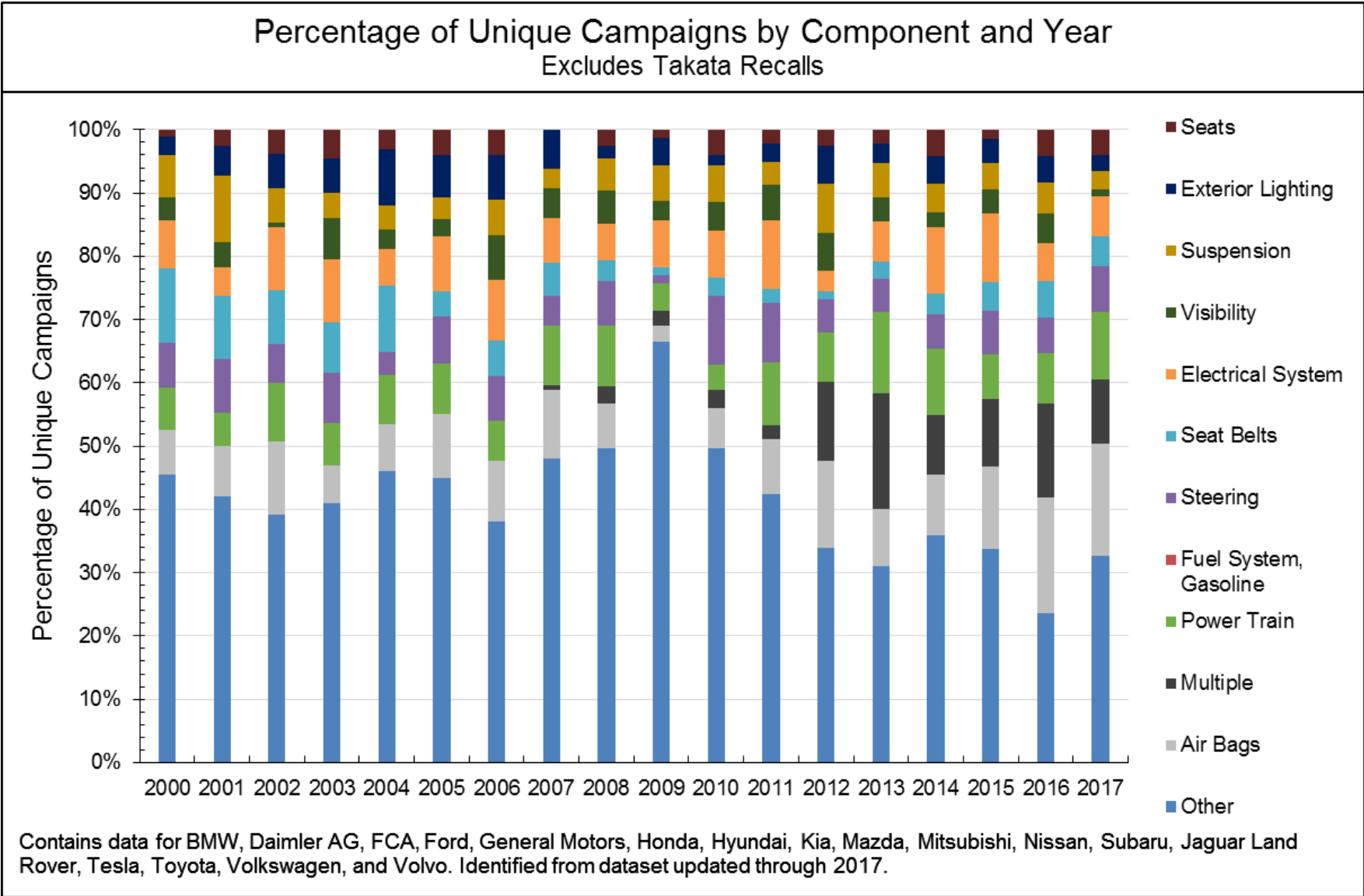
- Information downloaded from NHTSA website (www.nhtsa.gov) for historical recalls dating back to 1966
- NHTSA data provided detail regarding NHTSA campaign number, manufacturer, model and model year, component, total units affected, and certain additional fields
- Stout analyzed recall trends for OEMs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

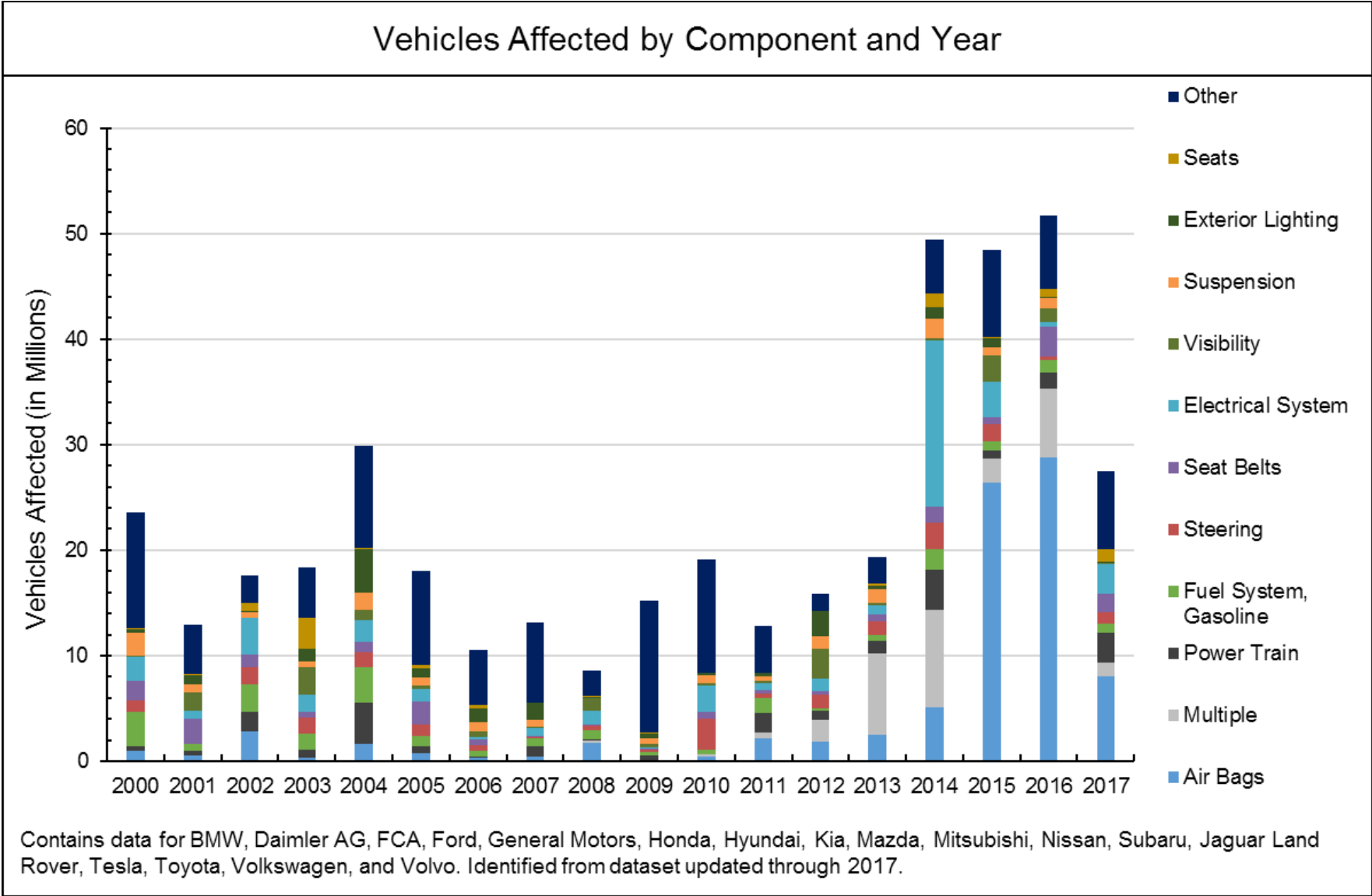


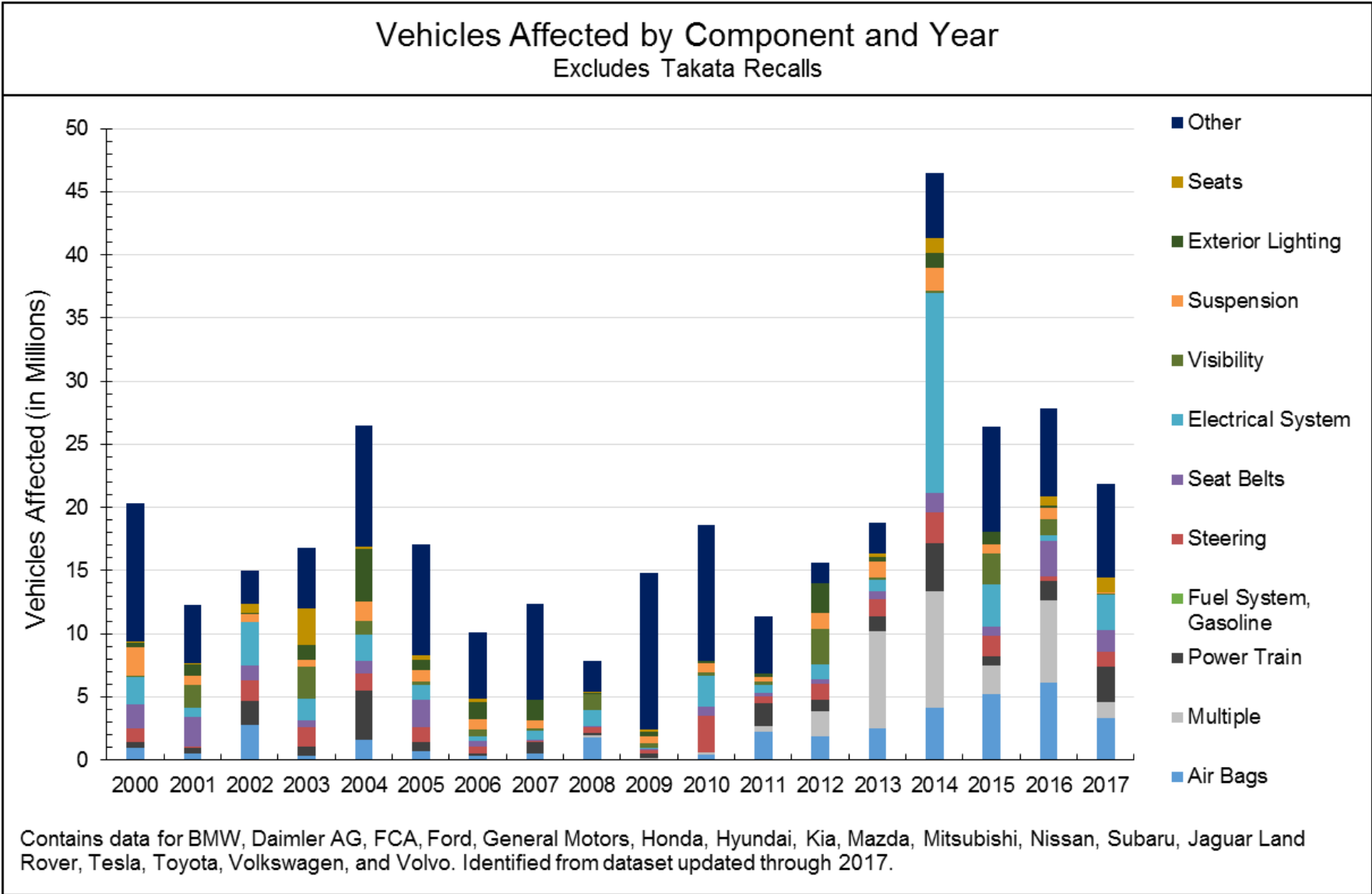


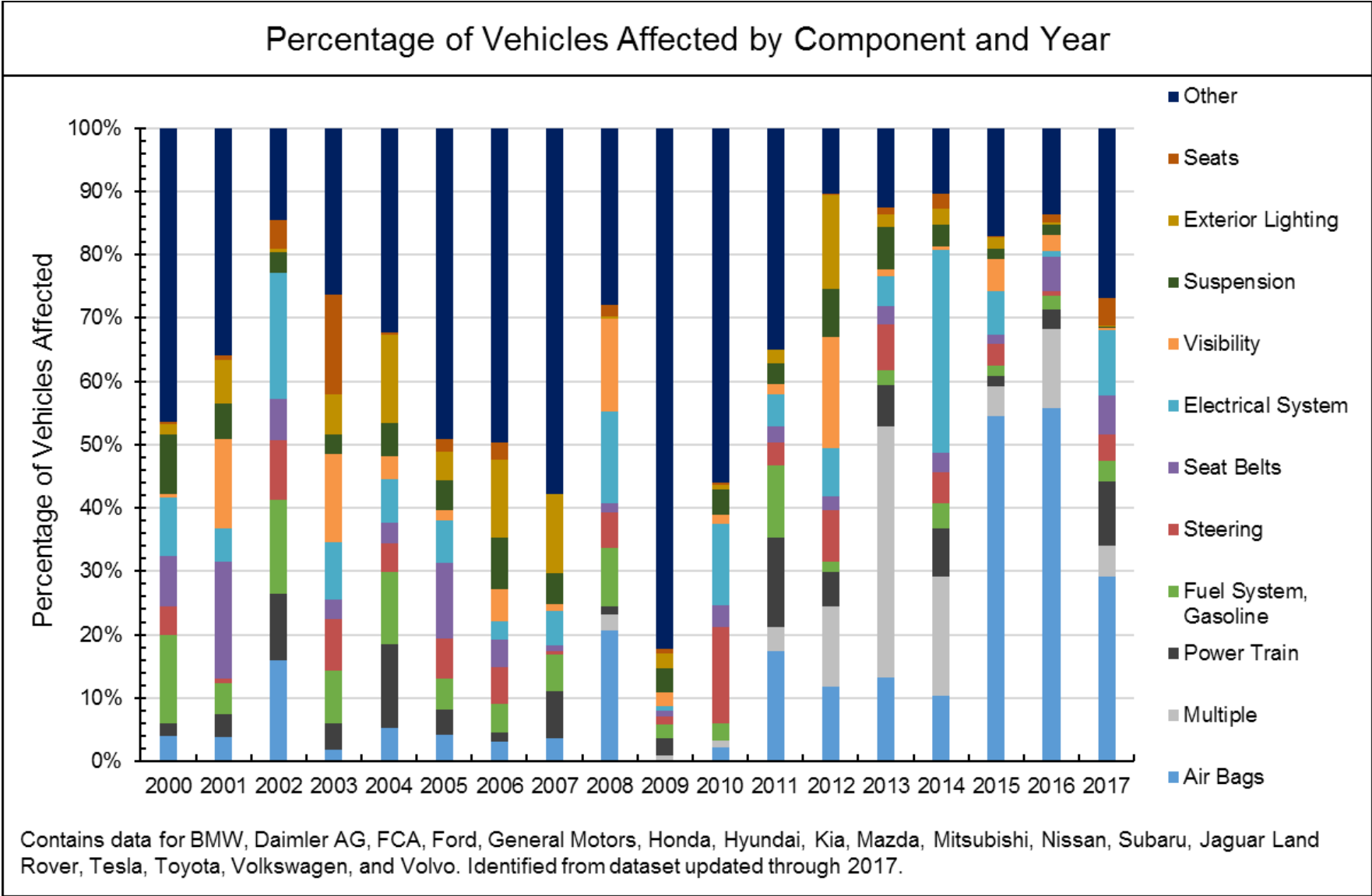


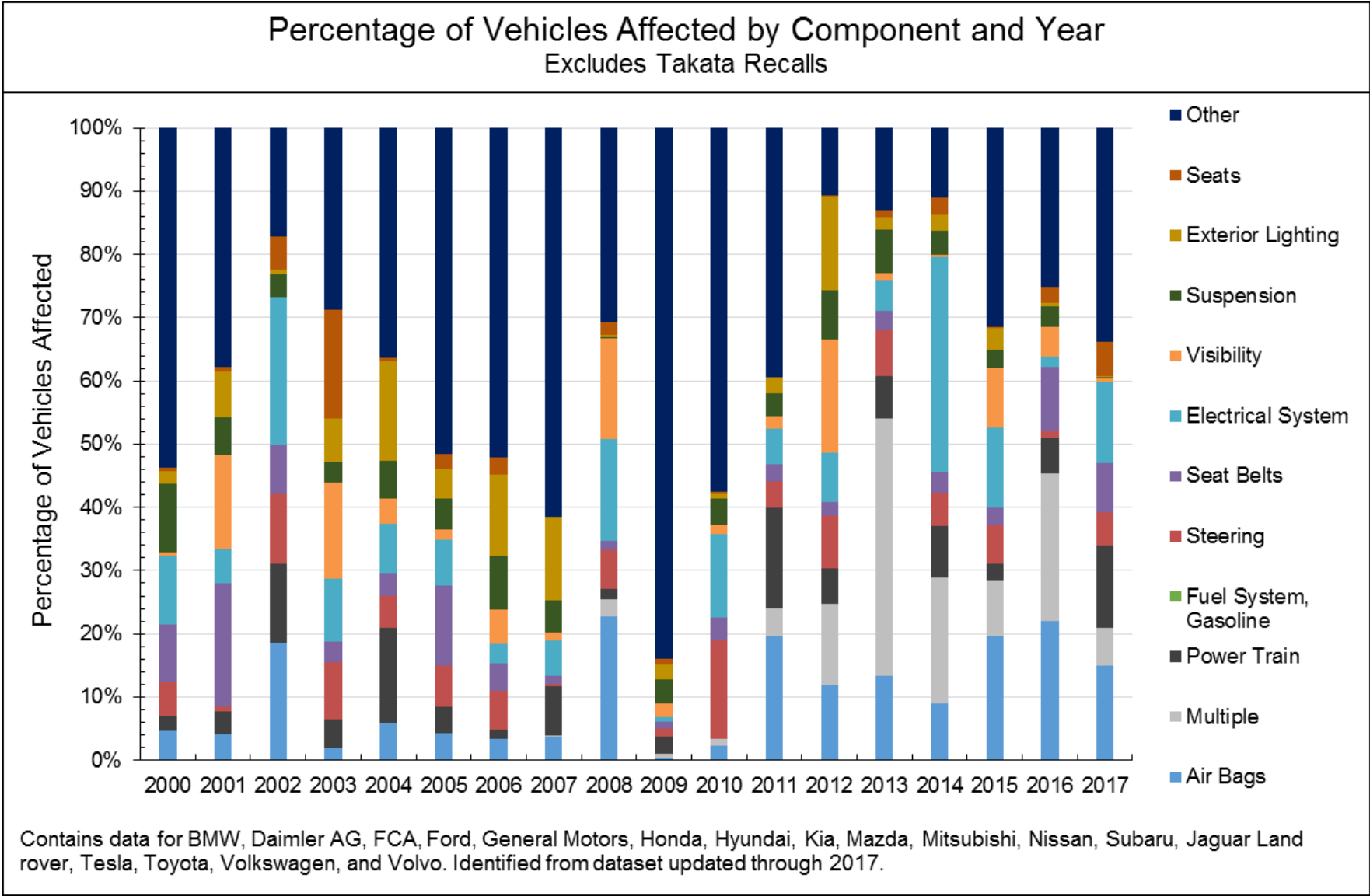










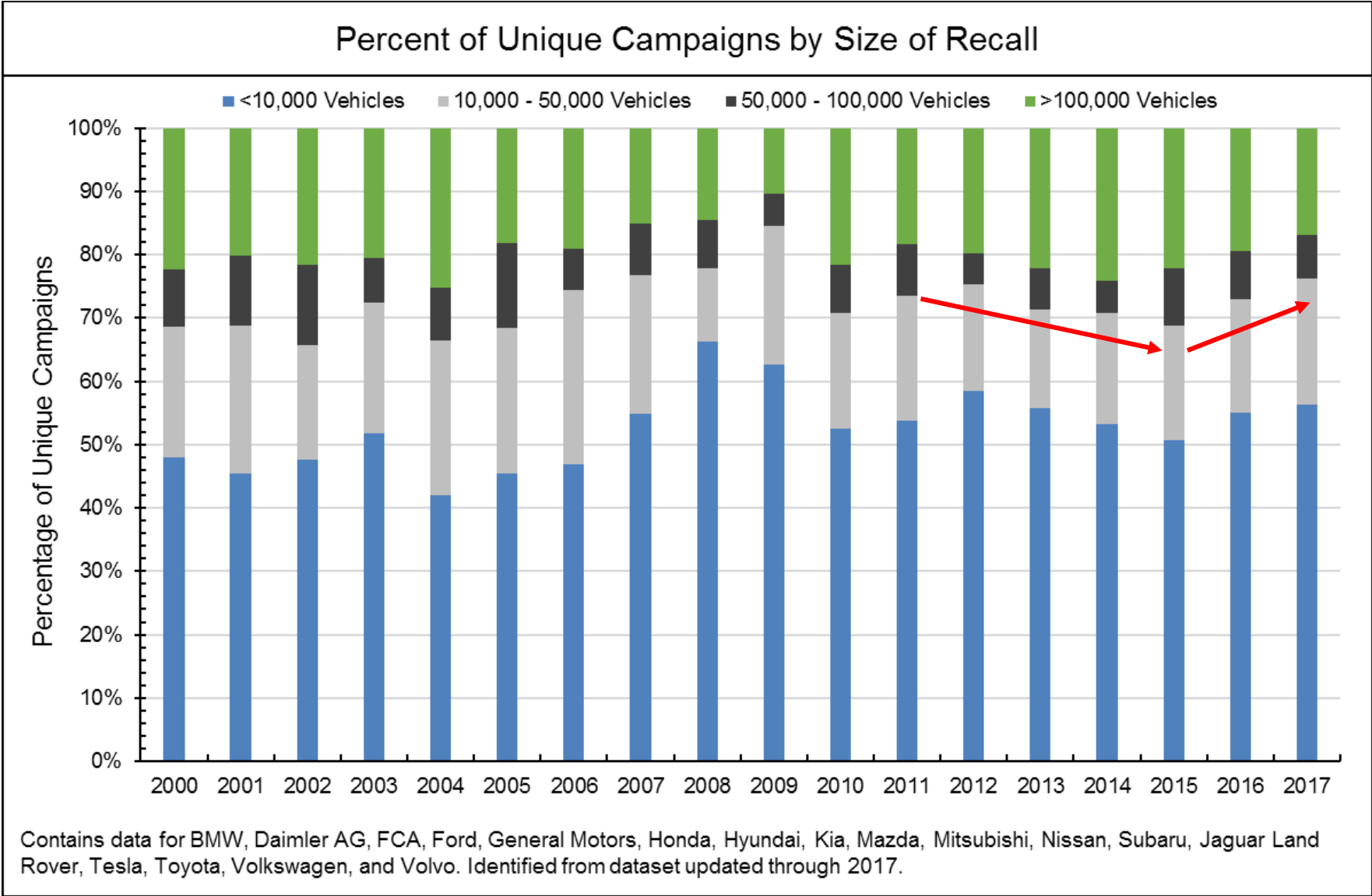


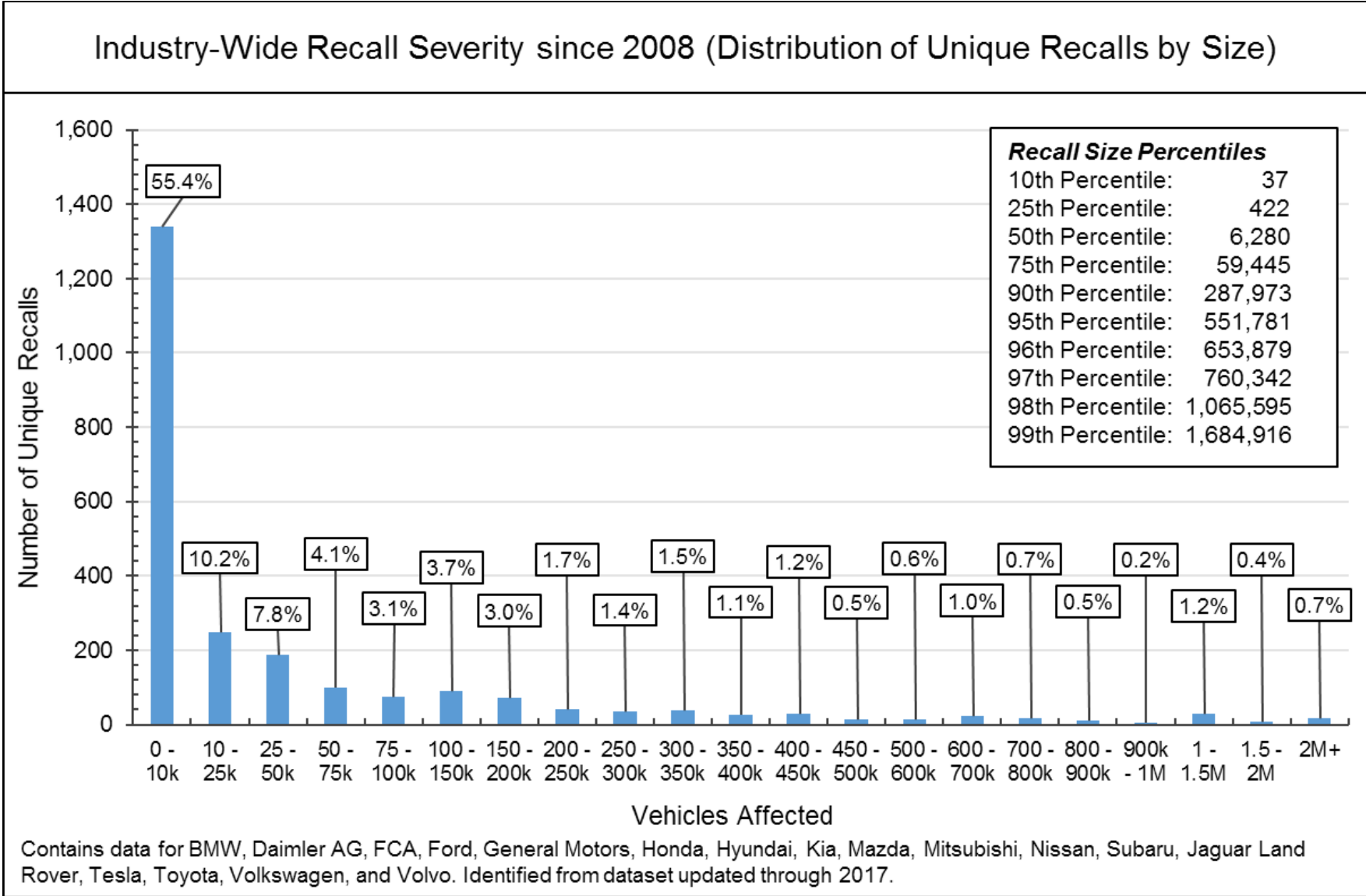
Year in Review: Returning to Normal?

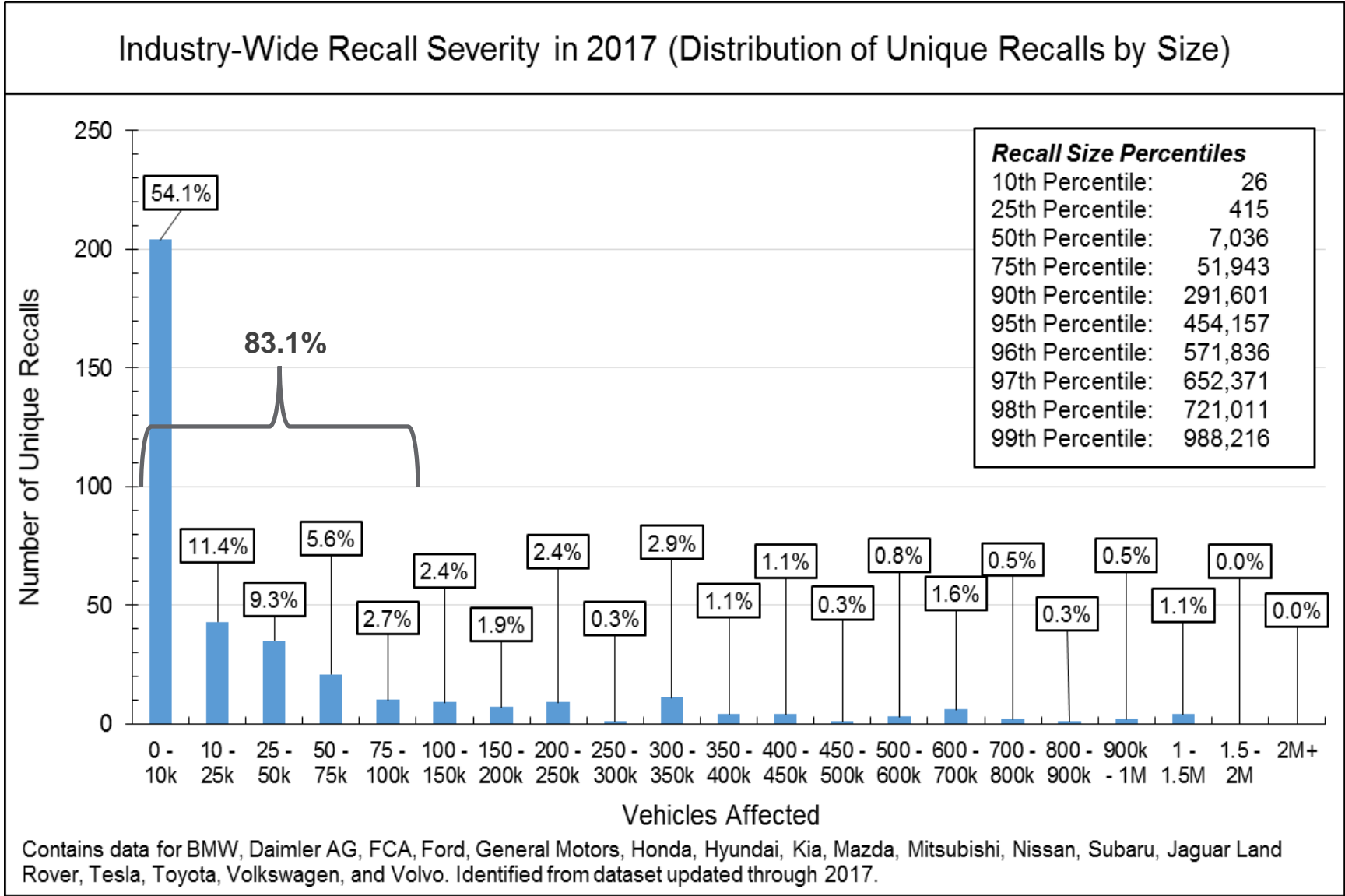
- Units affected by recalls in 2017 have declined to the lowest level since 2013
 - Approximately 23 million vehicles recalled for non-Takata inflator defects
- No multi-million unit recalls in 2017
- Air bag recalls not associated with defective Takata inflators still represent the greatest number of recalls, in terms of unique campaigns and vehicles affected

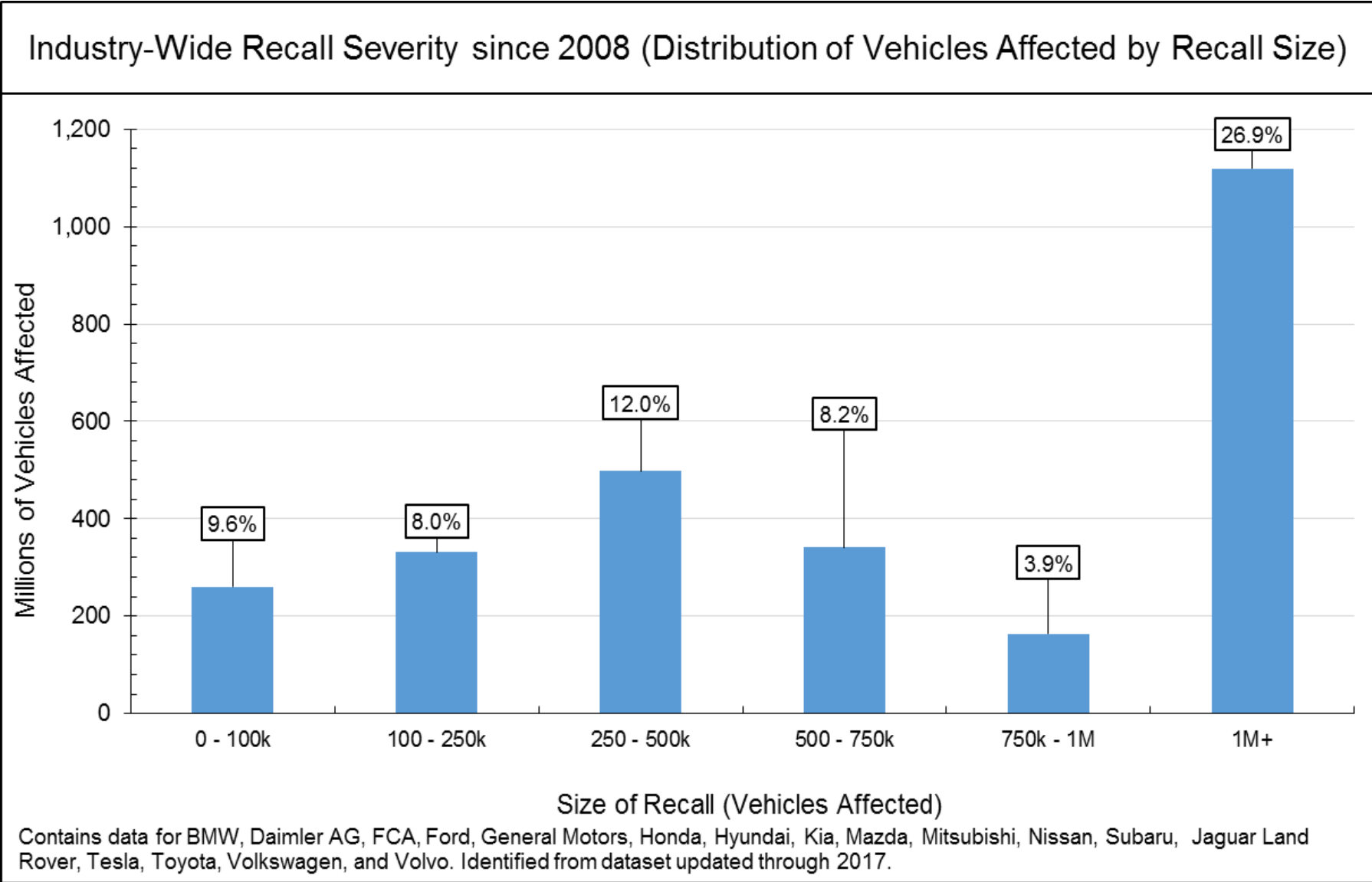
Analysis by Size of Recall

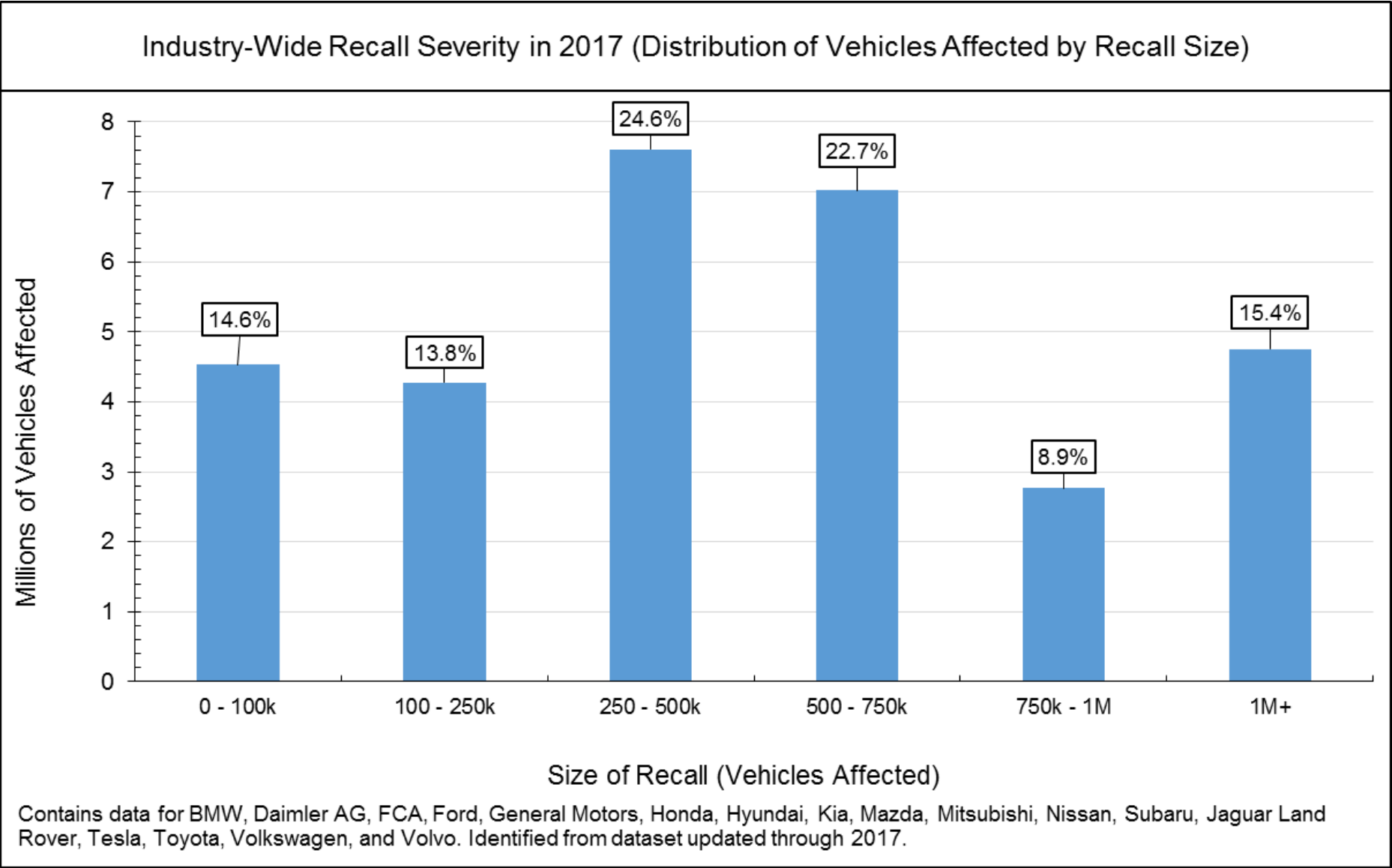
- Large recalls may be the most newsworthy, but historically have not been the most prevalent
 - 53% (on a unique campaign basis) involve fewer than 10,000 units, many with significantly less
- There has been a steady increase in the number of recalls involving fewer than 100,000 units since 2014
 - Recalls over 100,000 units represented less than 20% of all unique recalls since 2011.
- We observe certain differences for large recalls as compared to small recalls, such as
 - Differences in completion percentages
 - Differences in age of vehicles involved
 - Differences in frequency of suppliers being named in DIRs













Recall Completion Percentage Overview

Recall Completion Percentage Review

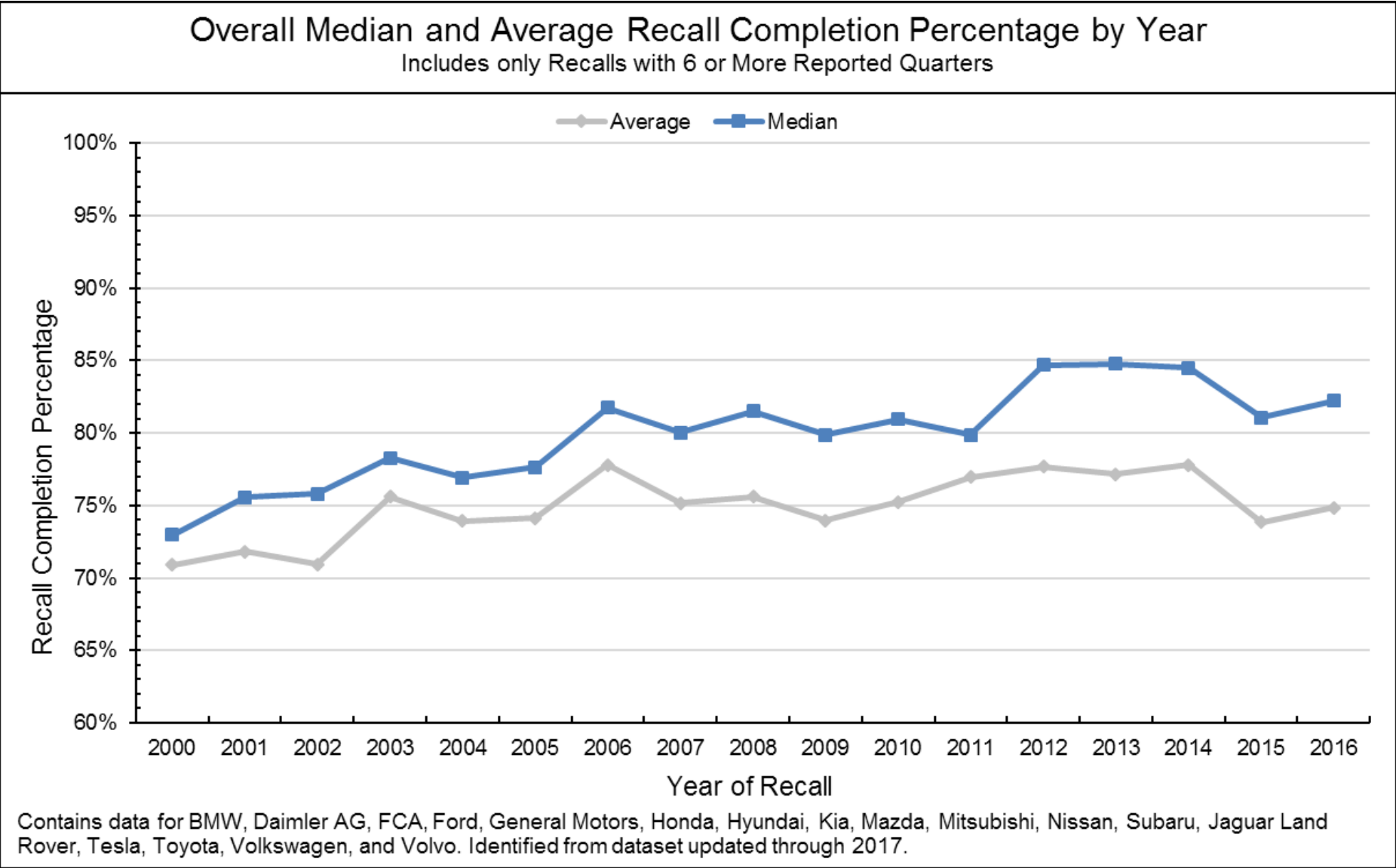
- NHTSA requires that beginning the quarter after the start of a recall, the manufacturer must submit a **Quarterly Progress Report** for **six** consecutive calendar quarters. The deadline for the report is the 30th day of the month following the quarter's end
- In analyzing this data, Stout linked 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

Recall Completion Percentage - Highlights

- Three recent campaigns achieved 100% completion:
 - Model Year 2017 Subaru Outback –
 - Improperly tightened brake bolts
 - 99 vehicles affected
 - Multiple Model Year 2015 – 2016 Honda Models –
 - Leaking fuel tanks
 - 39 vehicles affected
 - Model Year 2016 Mercedes Benz CLA45 AMG –
 - Defective clutch weld
 - 1 vehicle

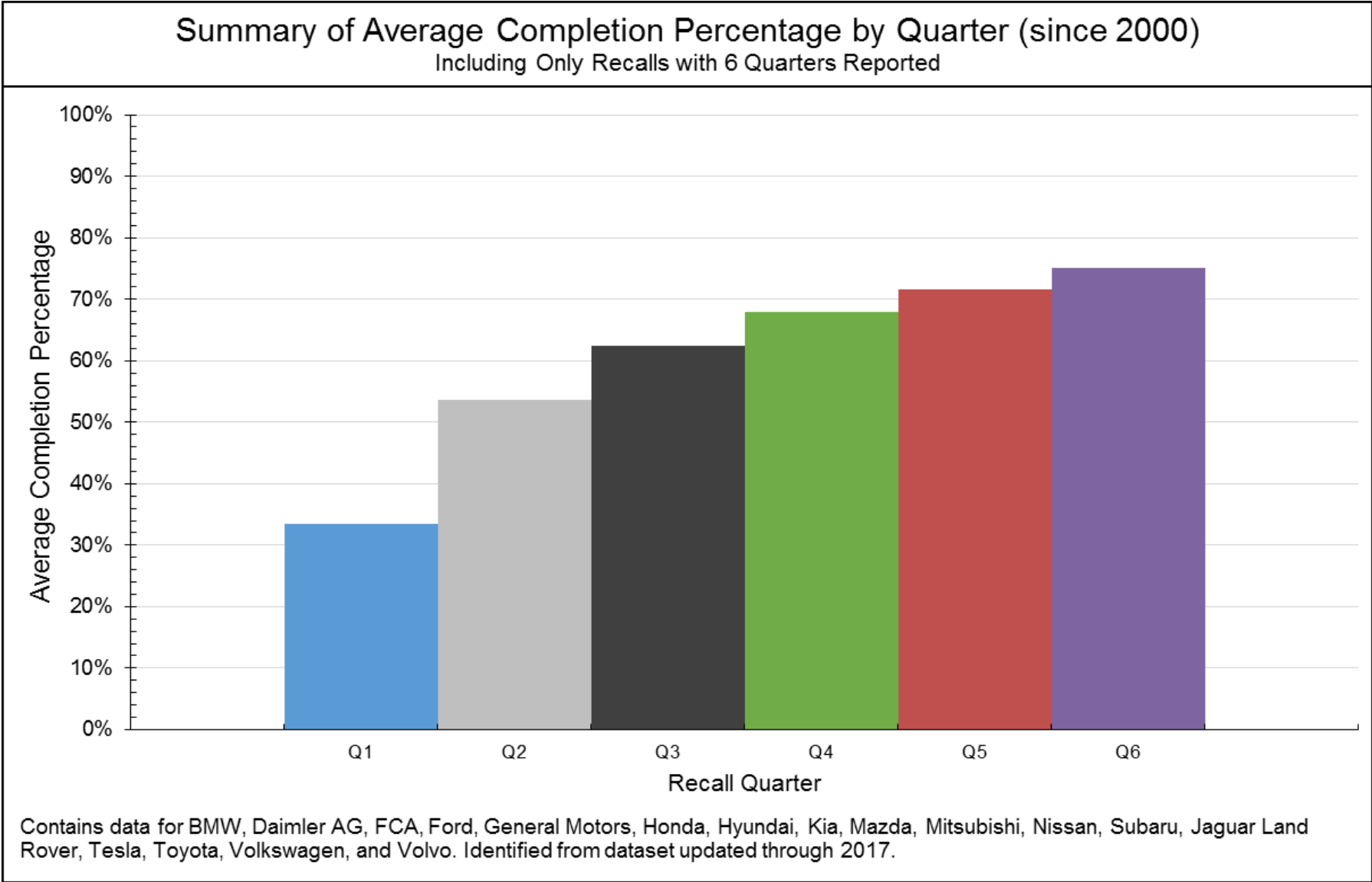
Recall Completion Percentage - Highlights

- Older and larger campaigns that have achieved notable completion percentages:
 - Model Year 2008 – 2013 Buick Enclave, GMC Acadia, Chevy Traverse, and Saturn Outlook vehicles –
 - Increased resistance at seat side impact air bag wiring harnesses may result in side impact air bag and seat belt pretensioners not deploying in a crash
 - Included among the ignition switch recalls
 - 1,176,407 vehicles affected
 - 1 – 6 years old at time of recall
 - 90.6% completion
 - Model Year 2005 – 2010 Toyota Avalon, Camry, Corolla, Highlander, RAV4, Sequoia, and Tundra vehicles–
 - Condensation on accelerator pedal may cause friction making pedal harder to depress, slower to return, or stuck in partially depressed position
 - Included among Toyota unintended acceleration recalls
 - 2,230,661 vehicles affected
 - 0 – 5 years old at time of recall
 - 87.5% completion

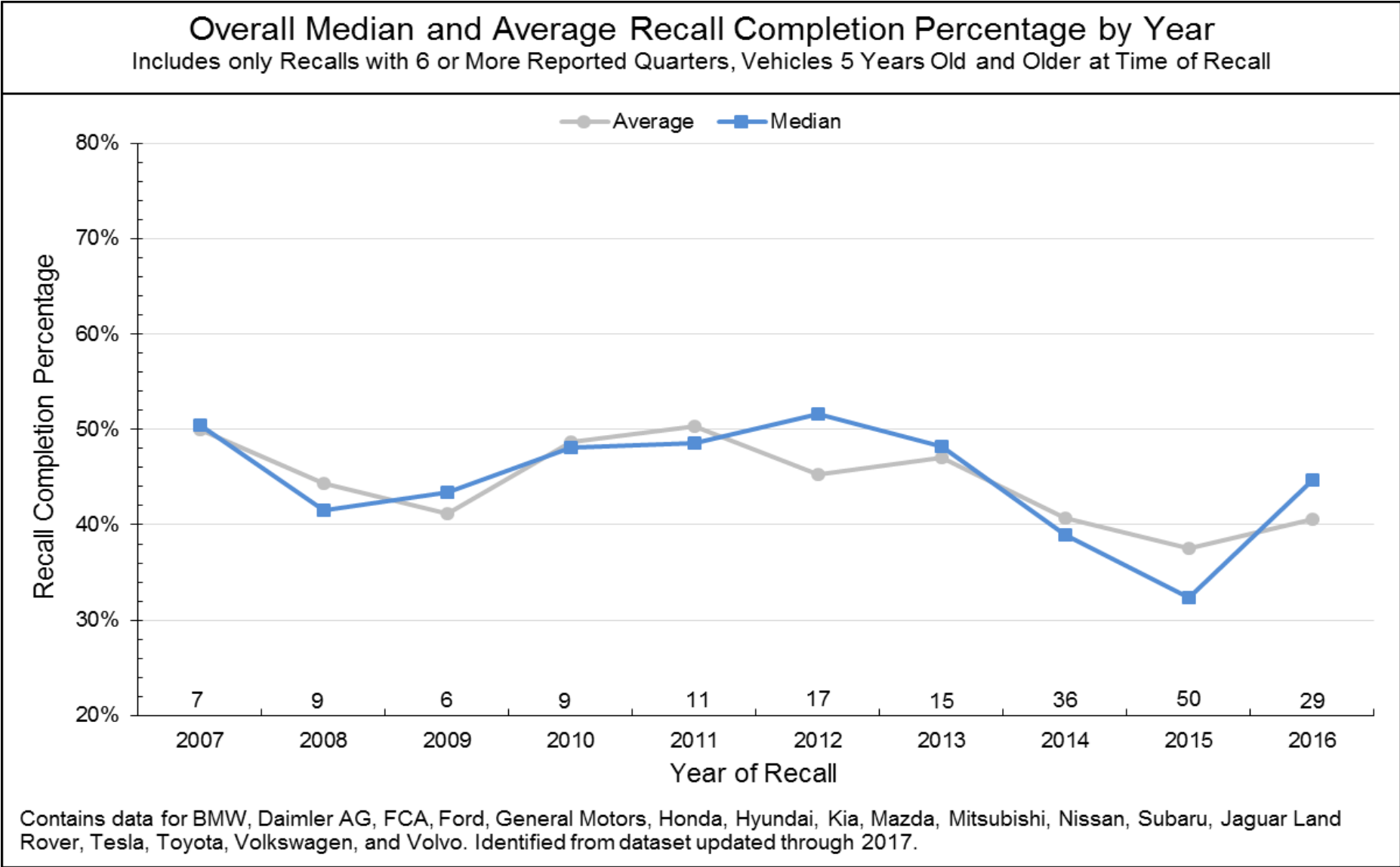


Recall Completion Percentage – Influential Factors

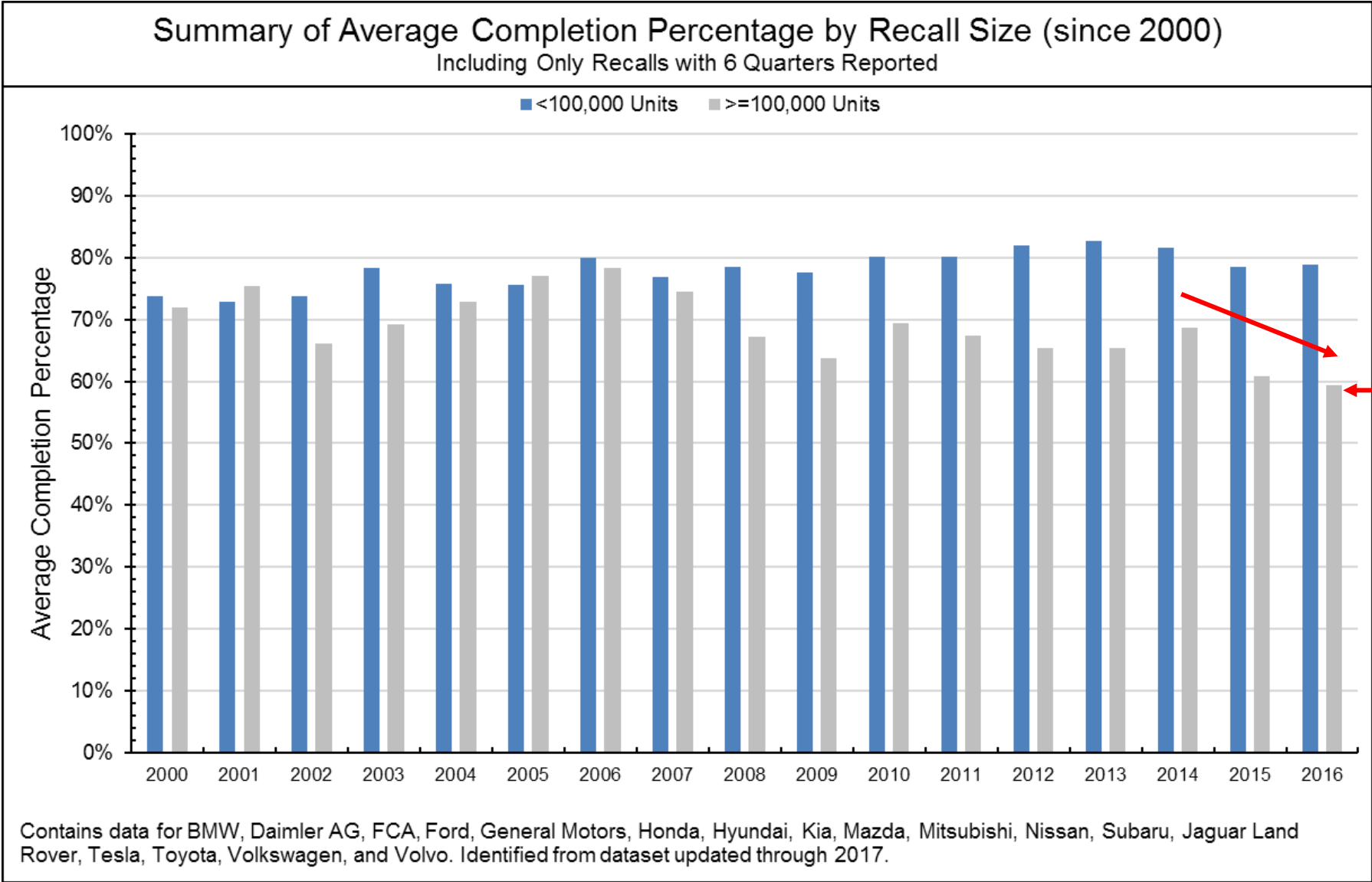
- In addition to specific differences observed for certain OEMs or component groups, certain factors appear to have a universal impact on the ultimate completion percentages for recalls:
 - Vehicle Age: Completion percentages for recalls involving older vehicles are generally lower, sometimes significantly. This impact becomes more pronounced as vehicles get older.
 - Recall Size: Completion percentages for larger recalls (>100,000 units) are often approximately 5-10% lower than for smaller-sized recalls.
 - Vehicle Type: Completion percentages 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 percentages may suffer.
 - Outreach Efforts: New ways of engaging with vehicle owners is demonstrating success – email, television advertising, print advertising, mobile apps, etc.



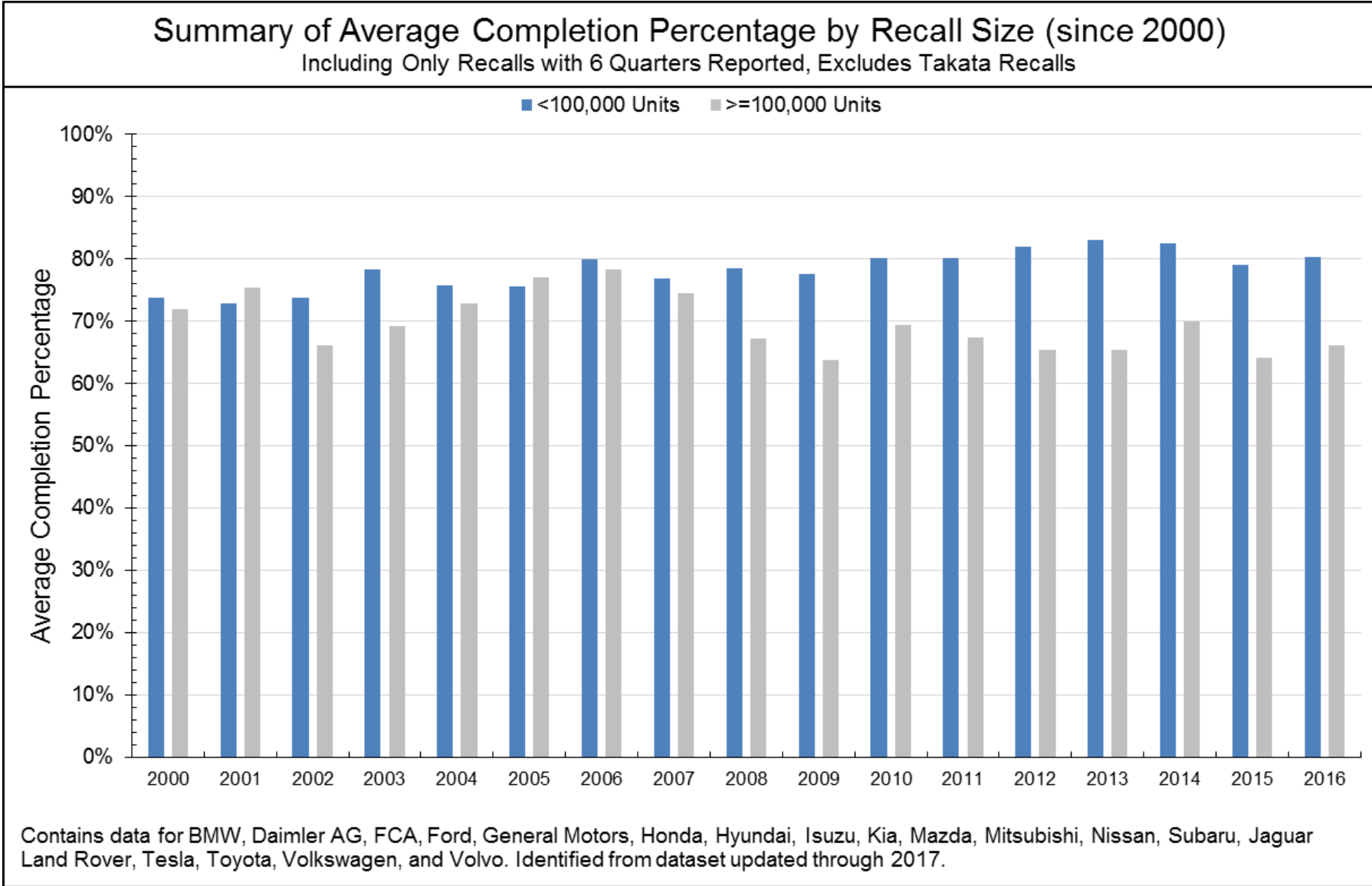
Recall Completion Percentage Overview

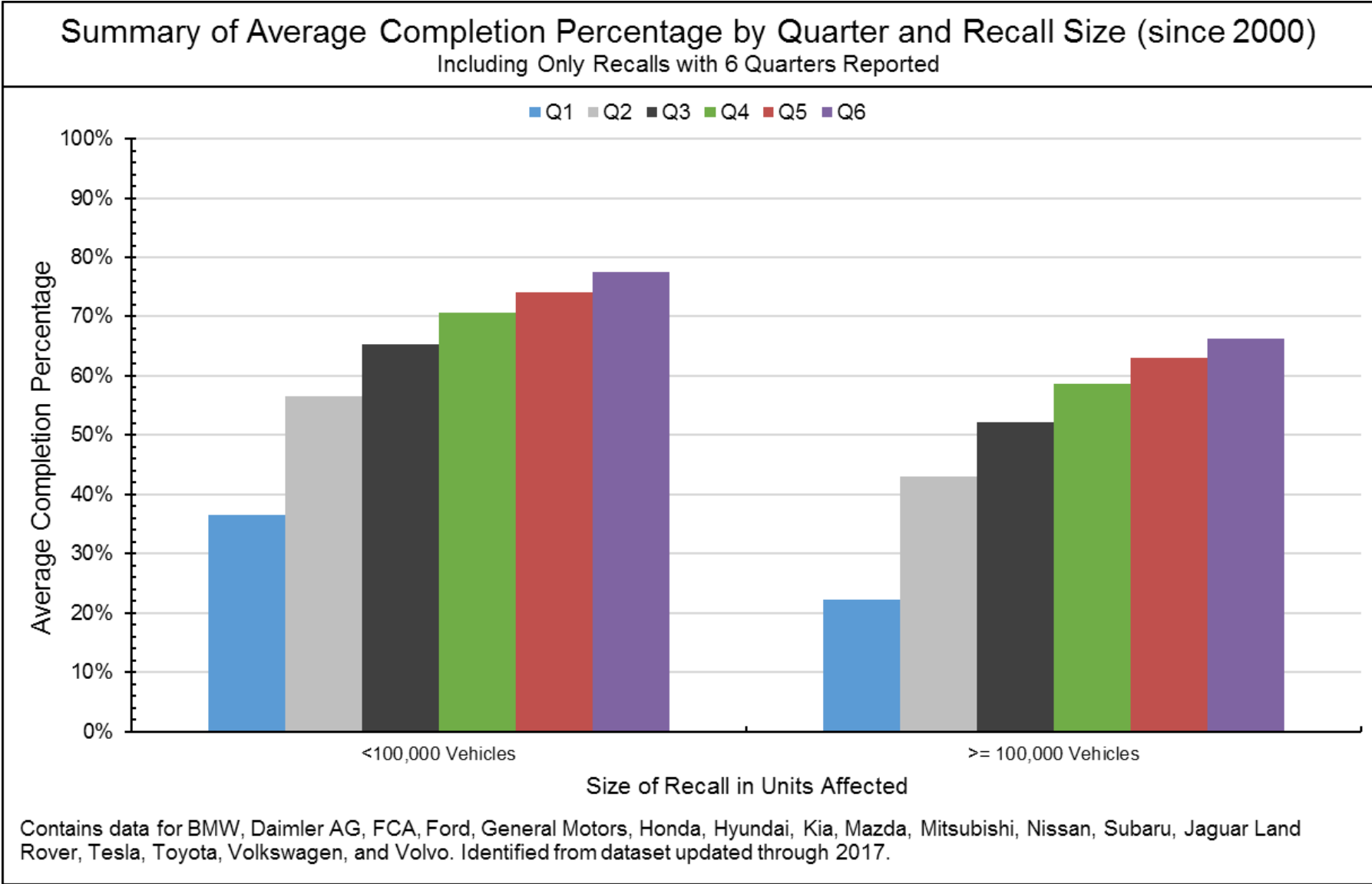


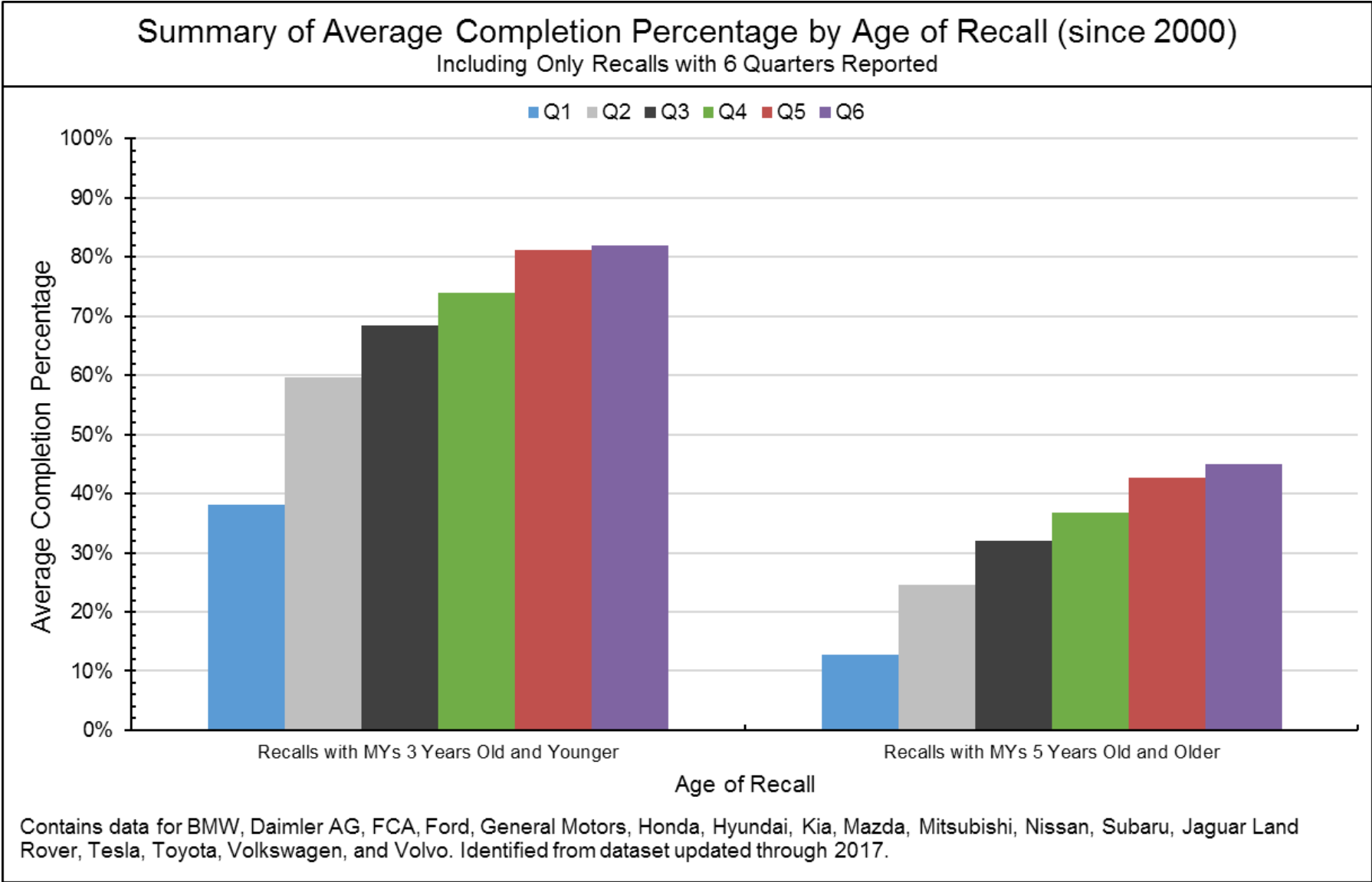
Recall Completion Percentage Overview

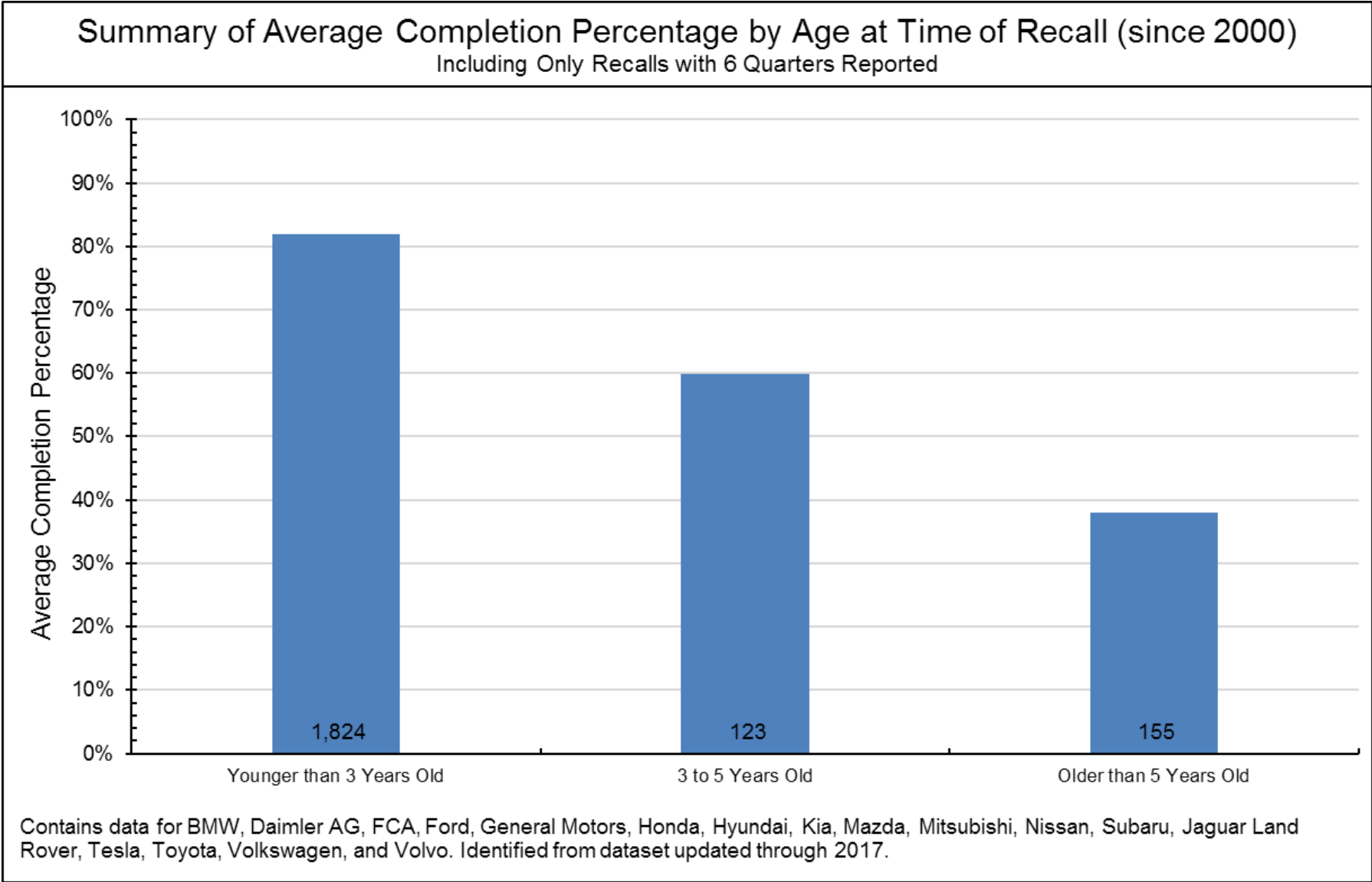


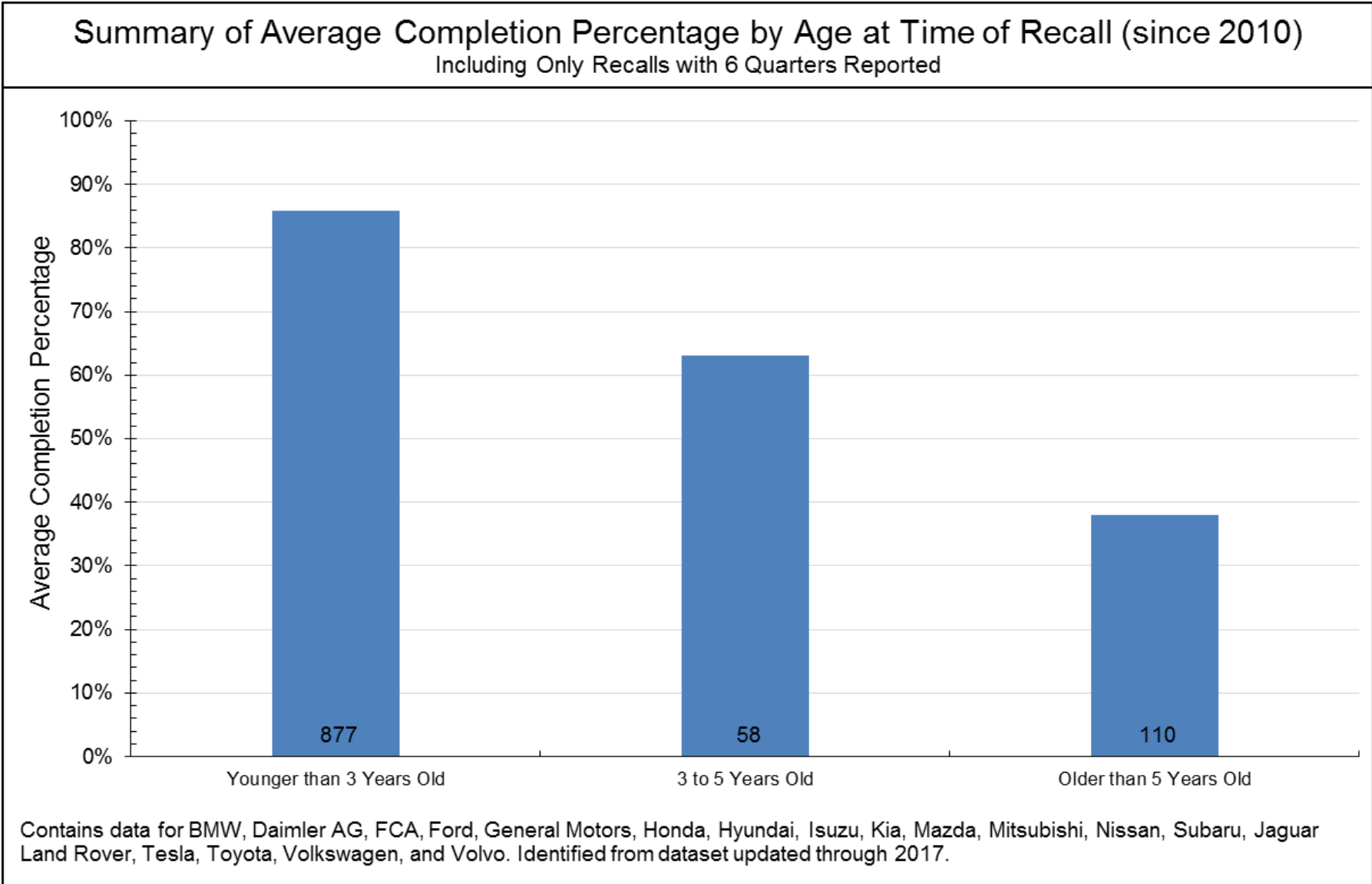
Lowest since 2000











Recall Completion Percentage – Observations for Success⁹

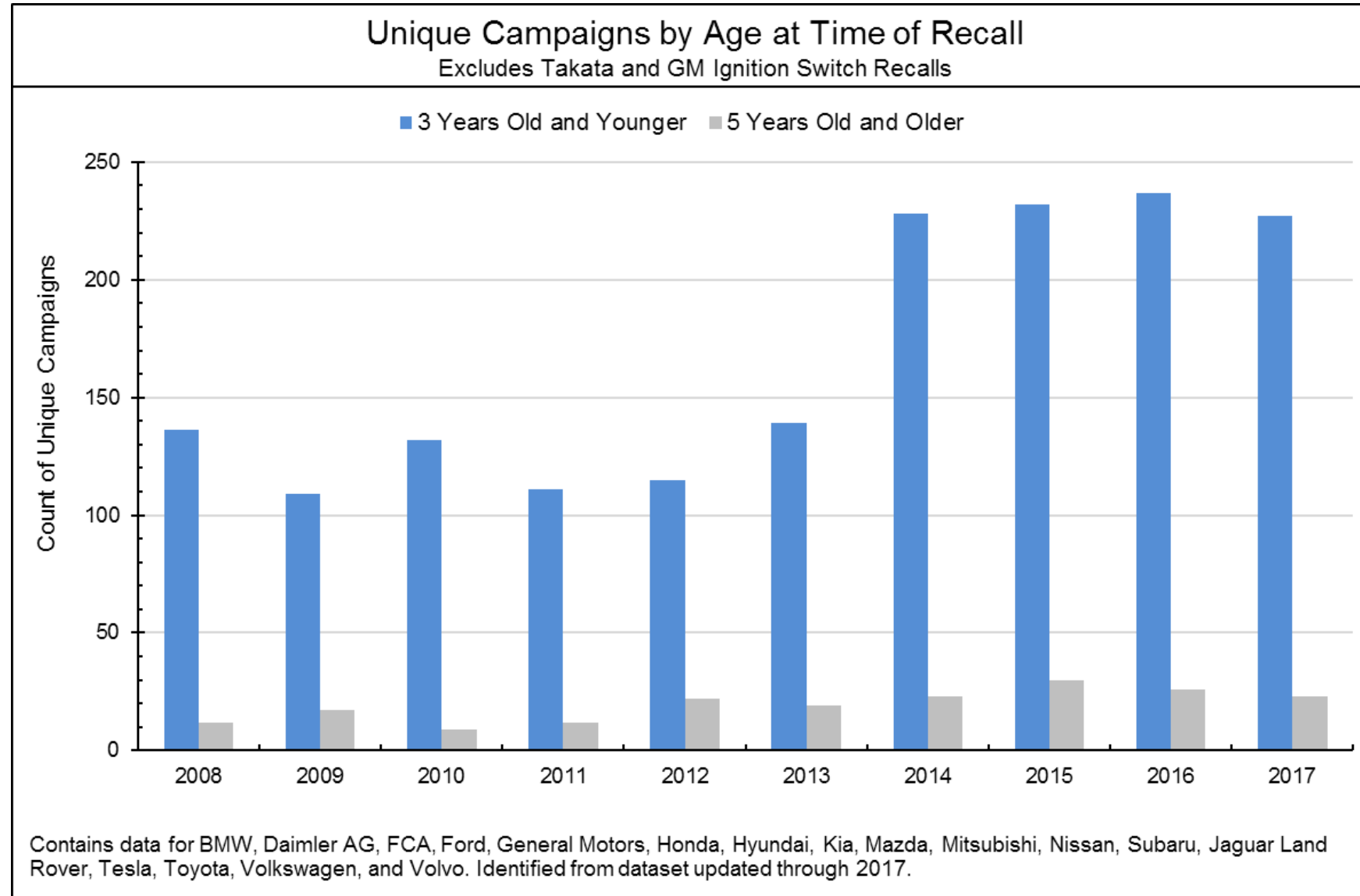
- In November 2017, The Independent Monitor of Takata and the Coordinated Remedy Program issued The State of the Takata Airbag Recalls. The report assesses the state of the Takata recalls, as well as initiatives the industry has implemented to repair affected vehicles. The Monitor's observations for success include the following activities being pursued by the industry:
 - Coordinated Communications: Frequent, multi-channel outreach that clearly describes the dangers of the defect and 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, ensuring dealer recognition, accountability, expanding dealer reimbursement policies, evaluating technician training requirements, and hosting dealer roundtables.
 - Scale and Resources: Transitioning 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.

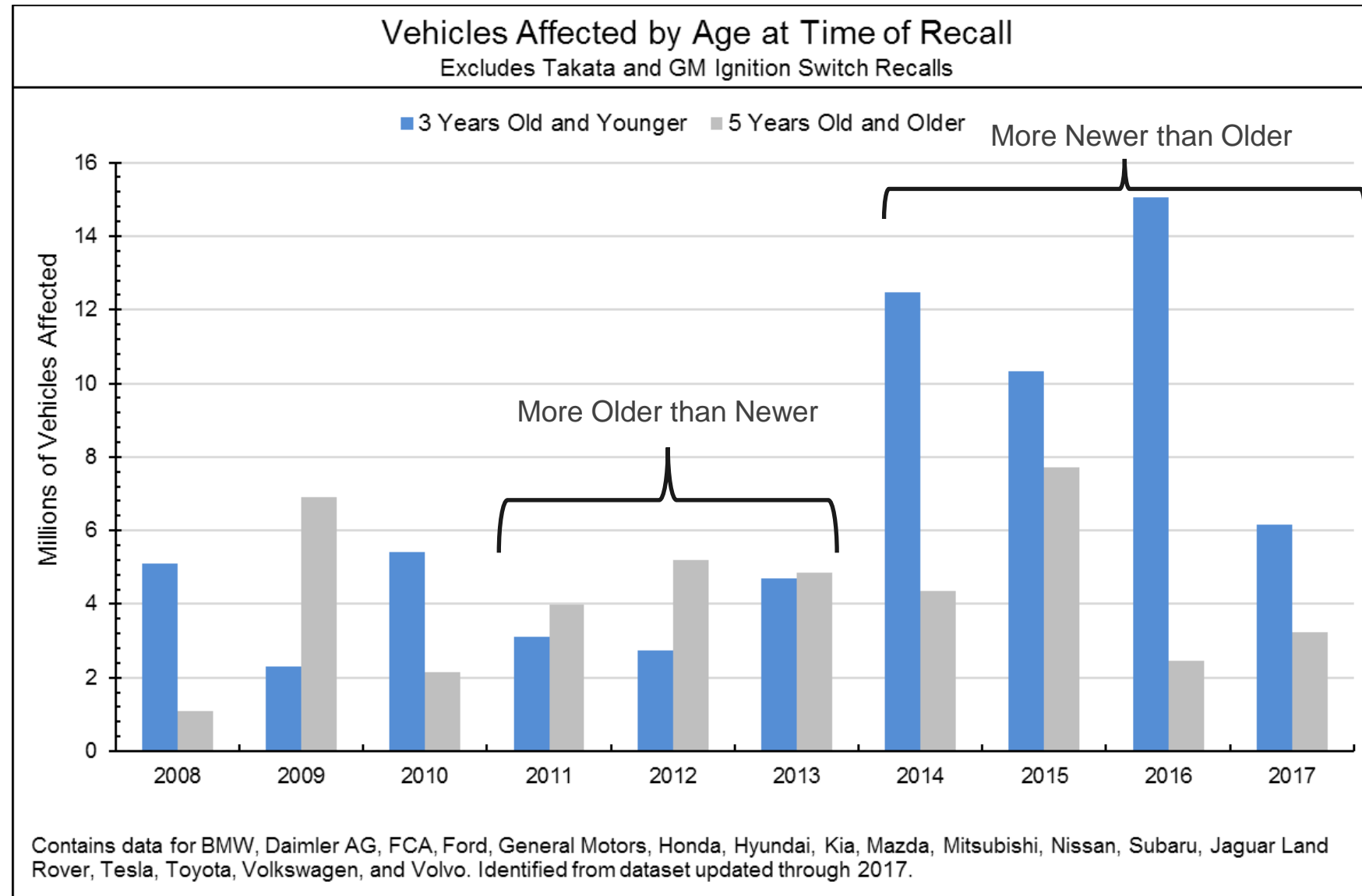


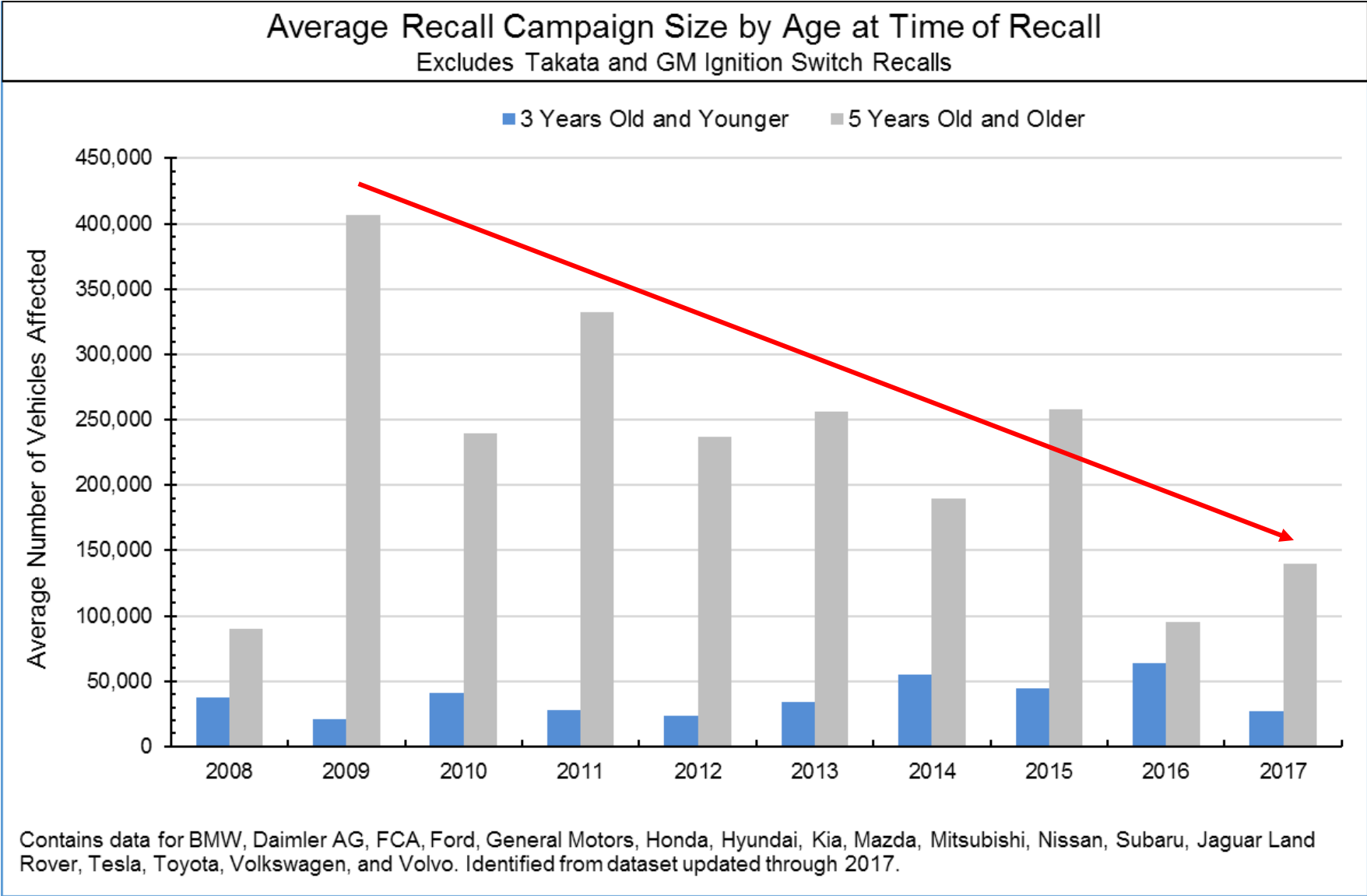
Analysis of Older Vehicle Recalls

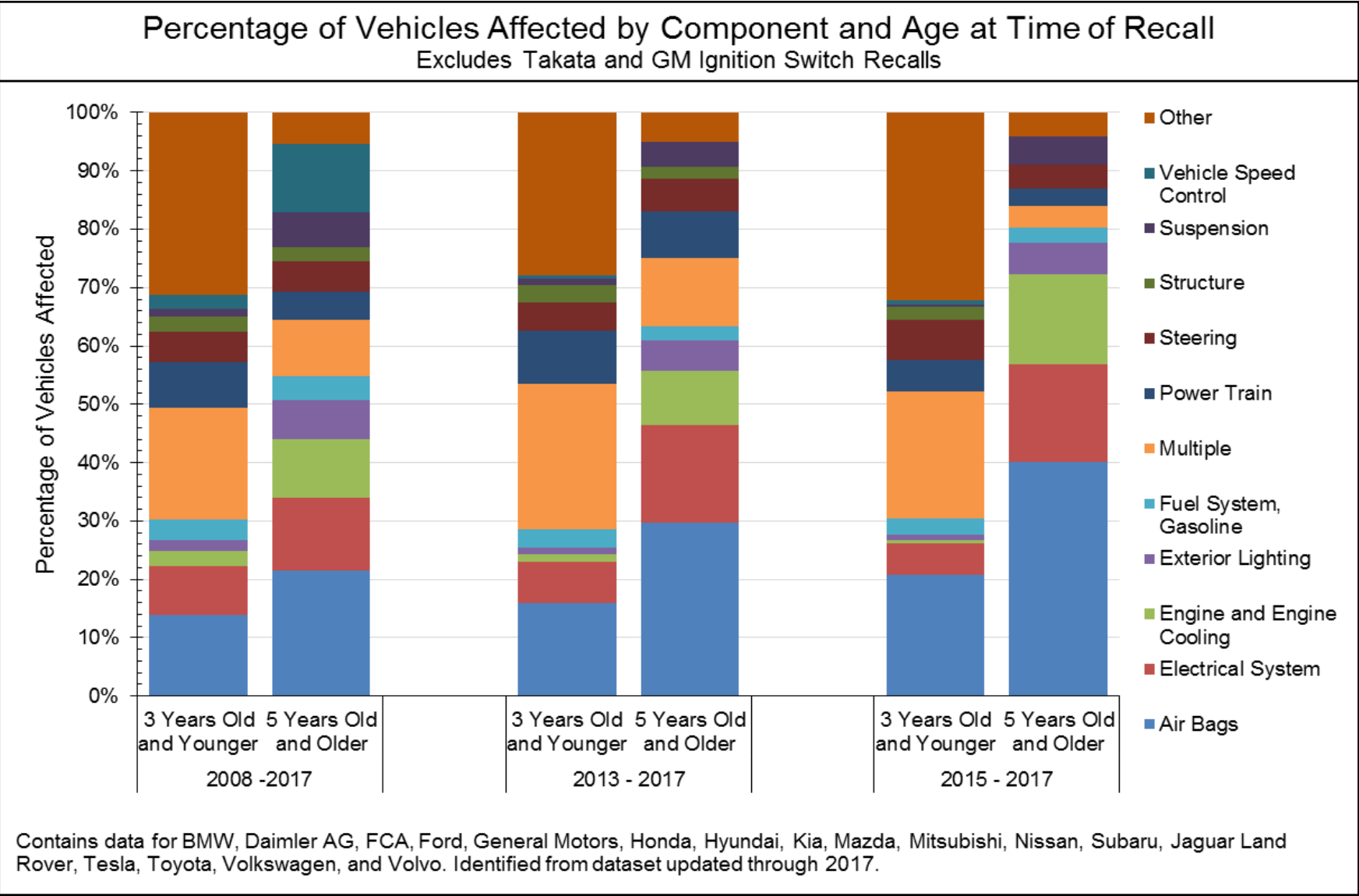
Older Vehicles: Background

- The average age of light vehicles in operation in the U.S. has been steadily increasing for decades
 - All-time high of 11.6 years in 2016¹⁰
- Recalls of older vehicles, as compared to newer vehicles have unique characteristics related to recall completion percentages, population size, components affected, etc.
- As the U.S. passenger vehicle fleet ages, it is important to understand what makes older vehicles unique in order to better understand what defects they may face and how to target those vehicles when defects are identified









Older Vehicles: Observations and Conclusions

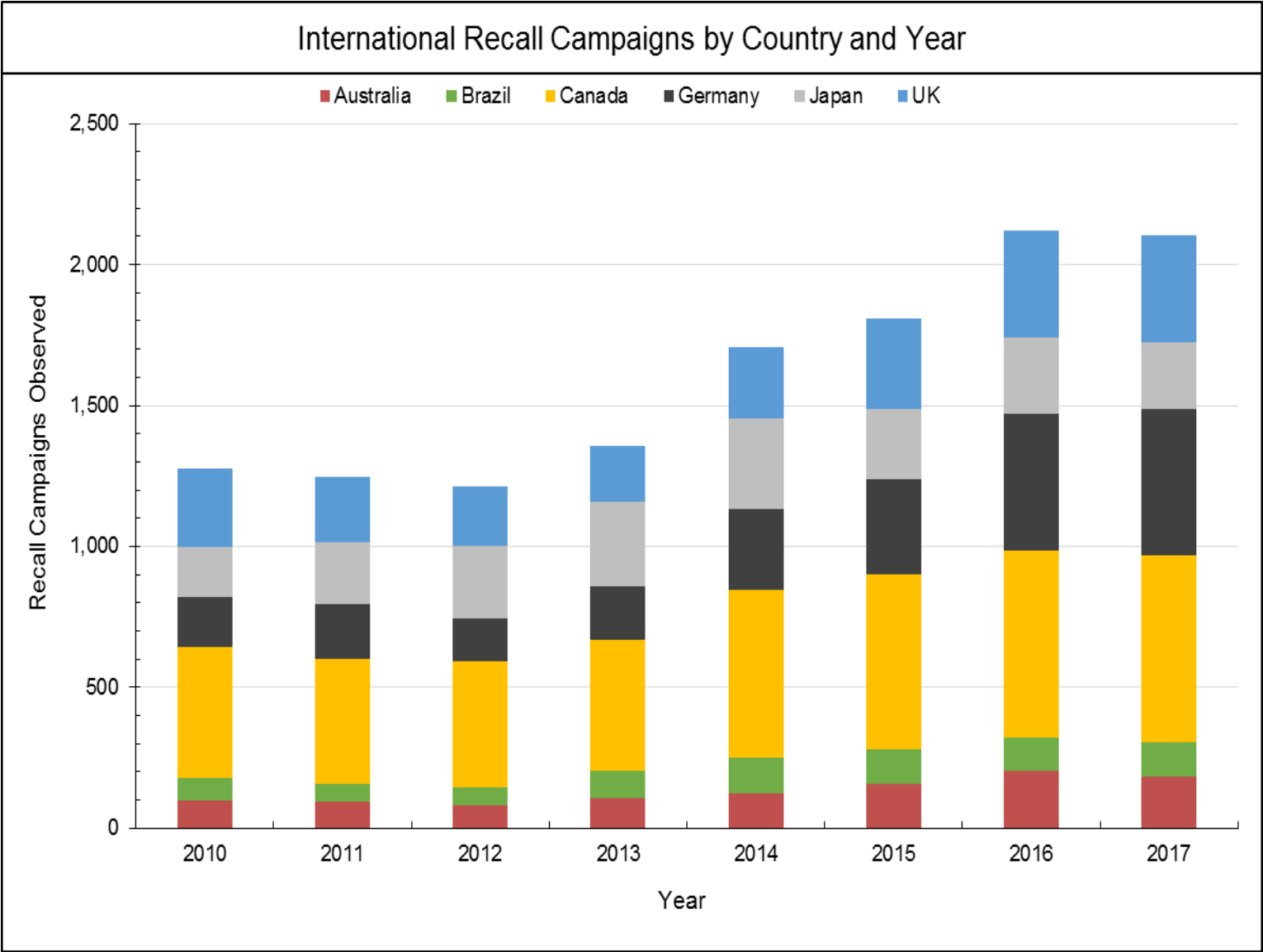
- Recalls of older vehicles represent a consistent and smaller number of unique campaigns than newer vehicles.
- The average sizes of older vehicle recalls are significantly larger than newer vehicle recalls but have declined significantly in the last 8 years.
- Older vehicle recalls are substantially more likely to involve Air Bags, Engine and Engine Cooling, Electrical Systems, and Exterior Lighting components than newer vehicles.

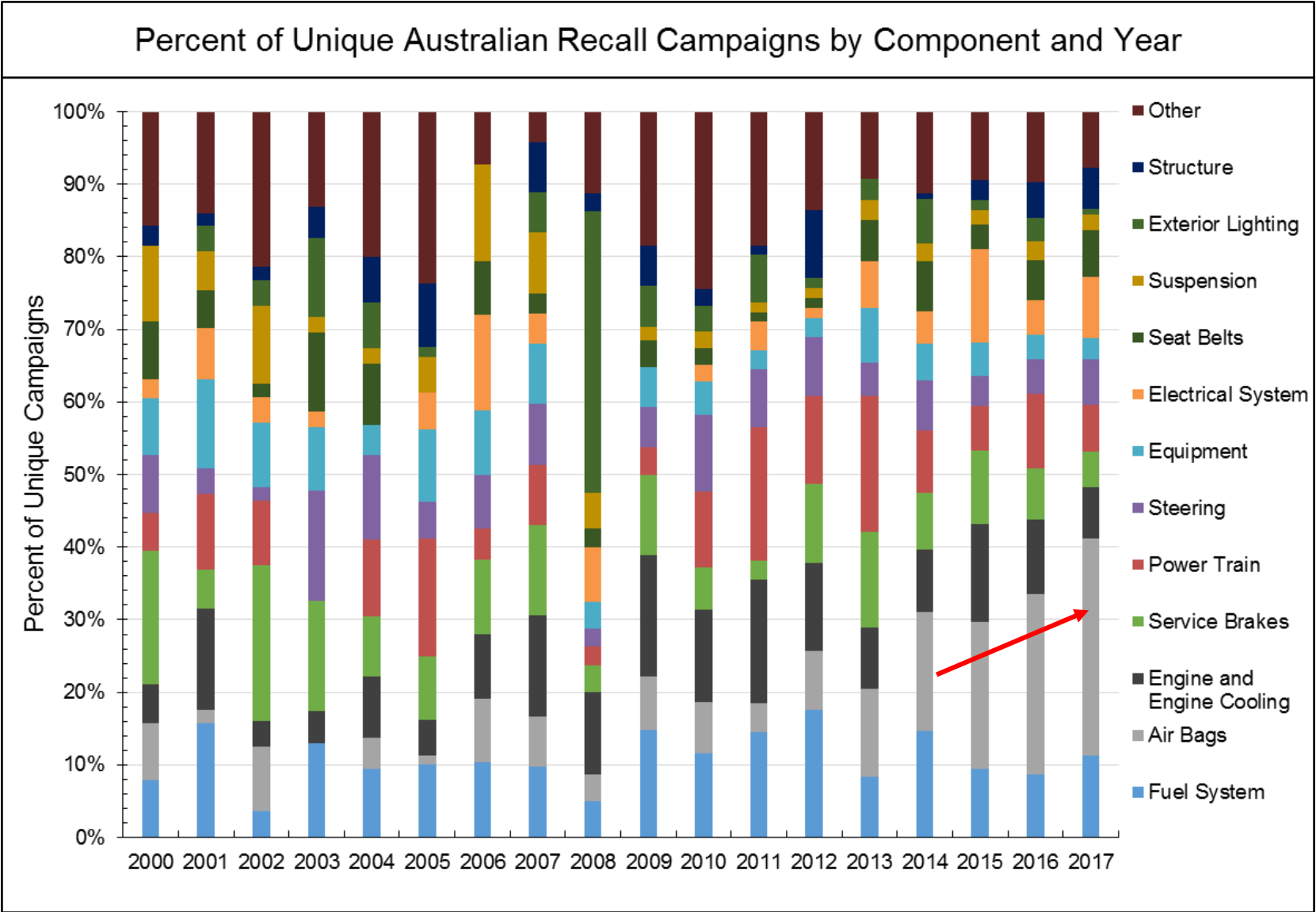


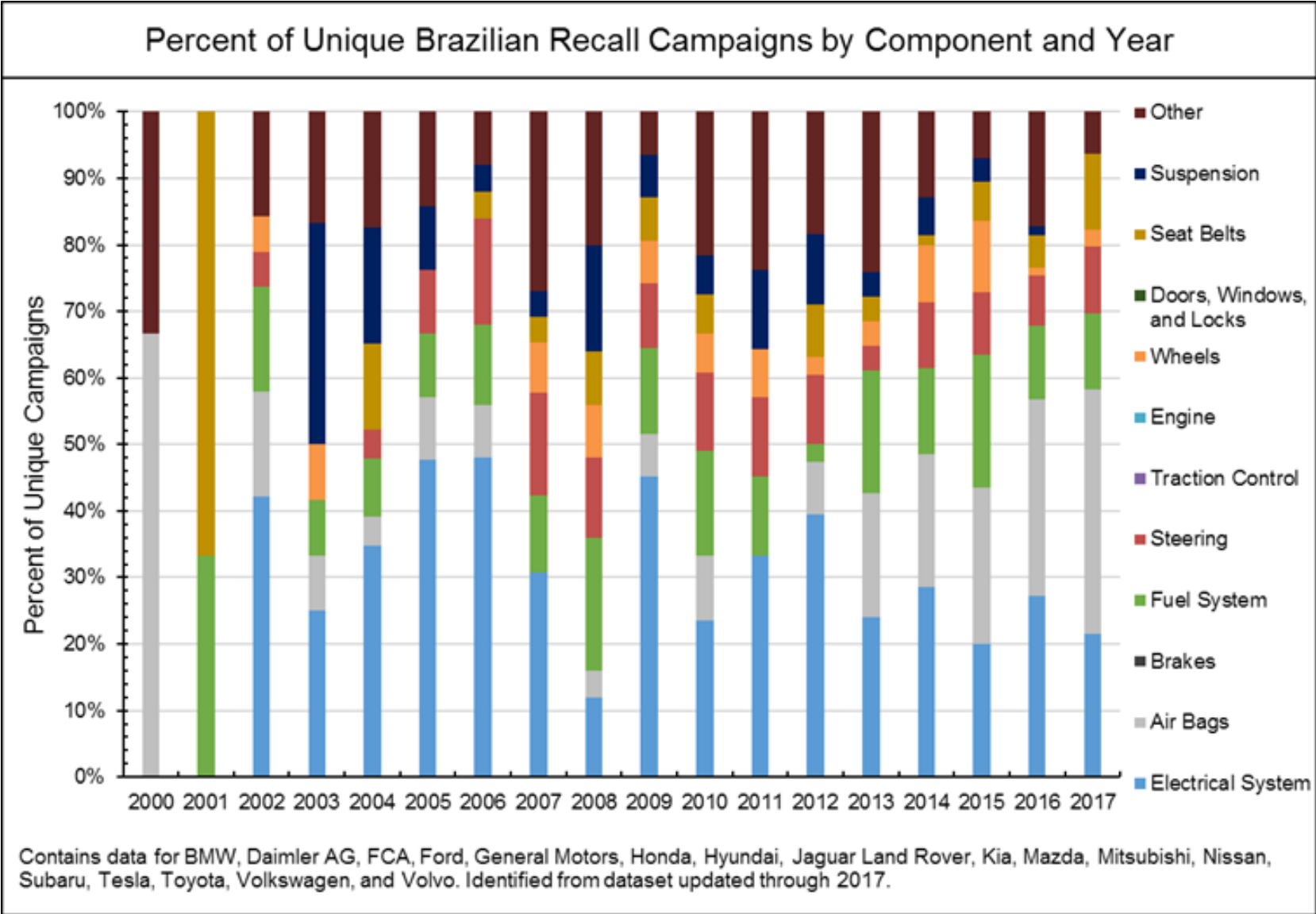
International Recalls

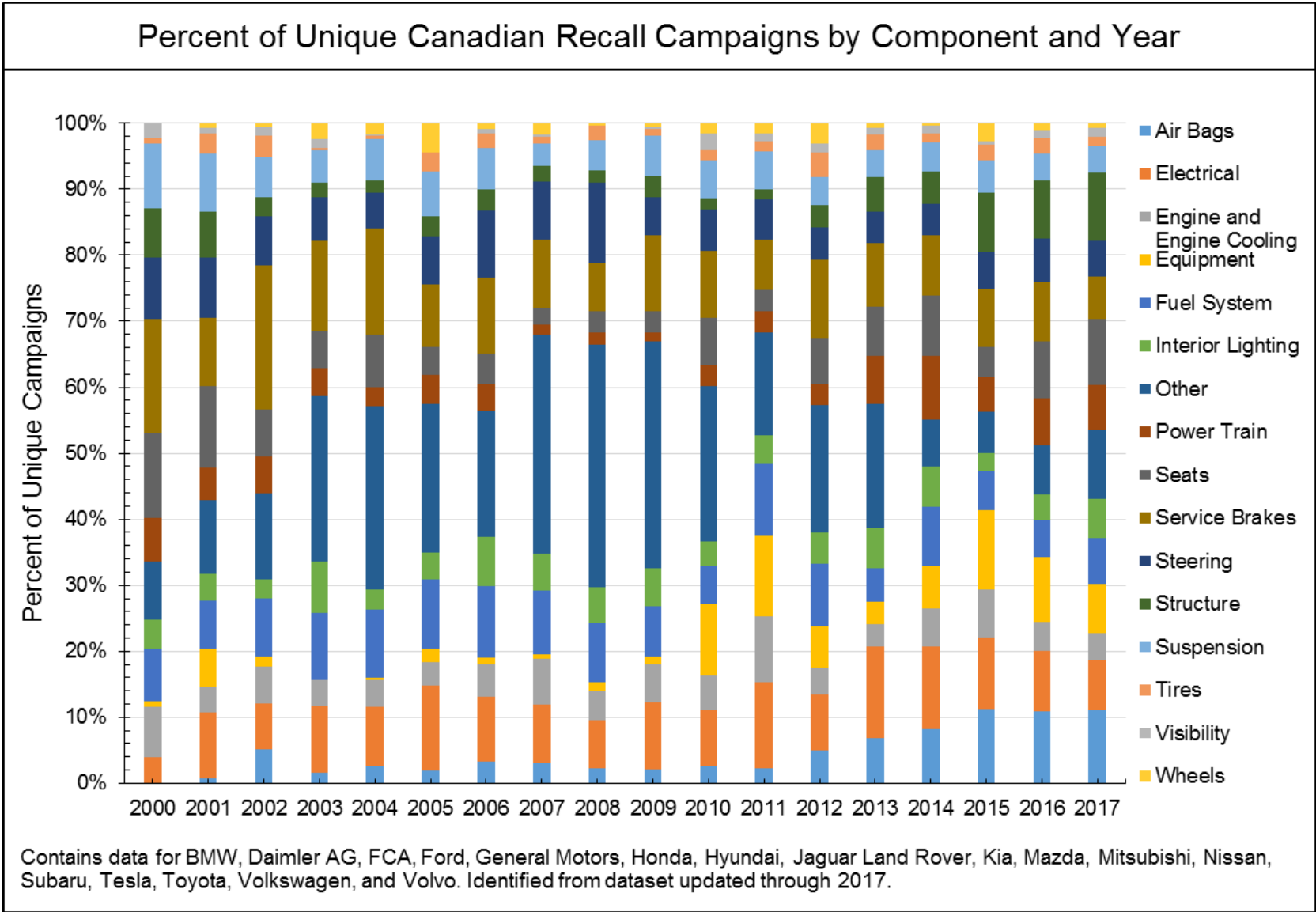
International Campaigns – Stout International Recall Database

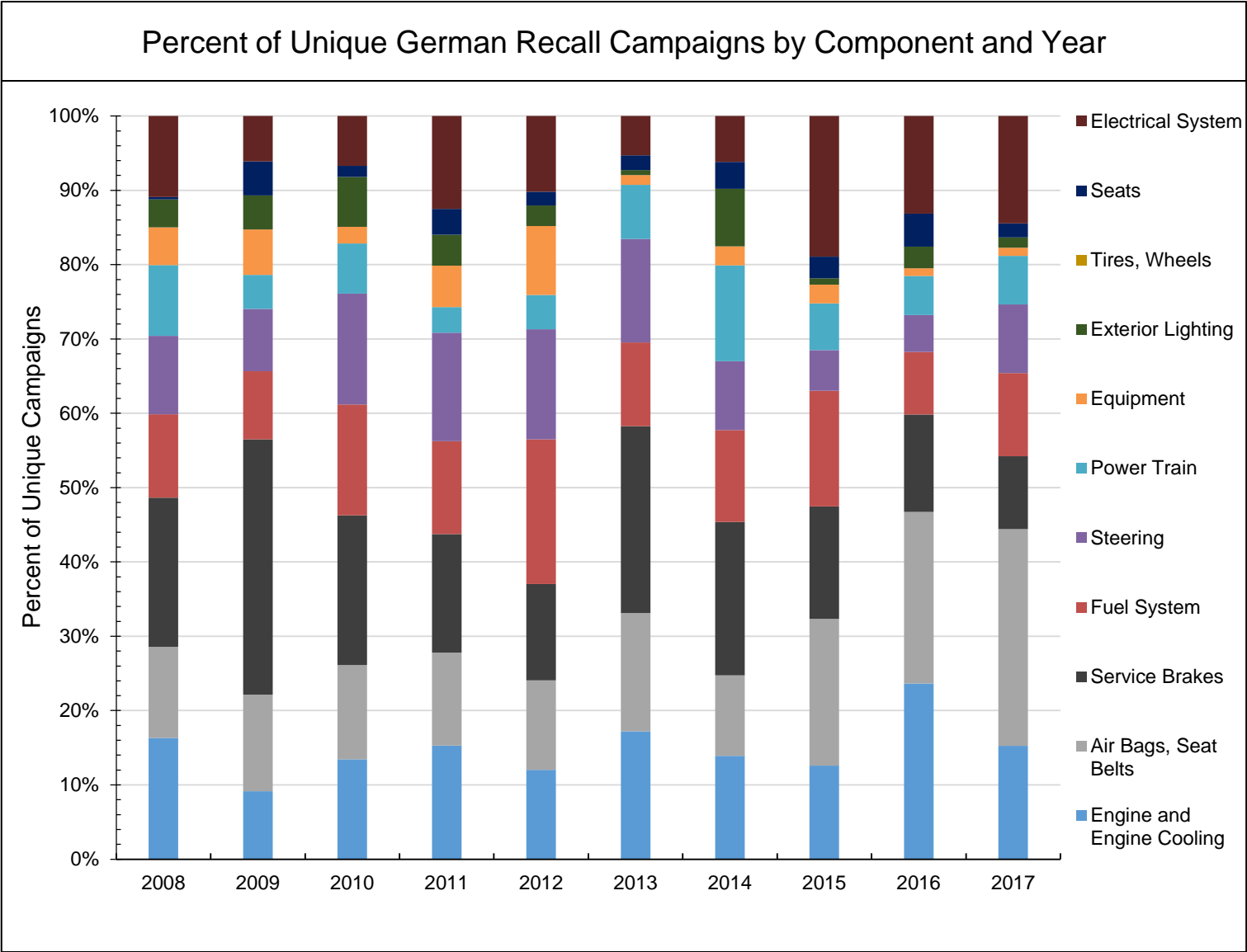
- Stout has compiled all available automotive recall data for six countries in addition to the United States, including:
 - Australia
 - Brazil
 - Canada
 - Germany
 - Japan
 - United Kingdom
- As each locale has its own requirements for reporting, the information contained in the data collected by Stout varies by country. Generally, each country provides information indicating the make, model, and model years affected, number of vehicles potentially affected, and the defect description. Because of the variation in the availability and accessibility of this data, Stout's analysis relies upon manual review of the information provided by each country.

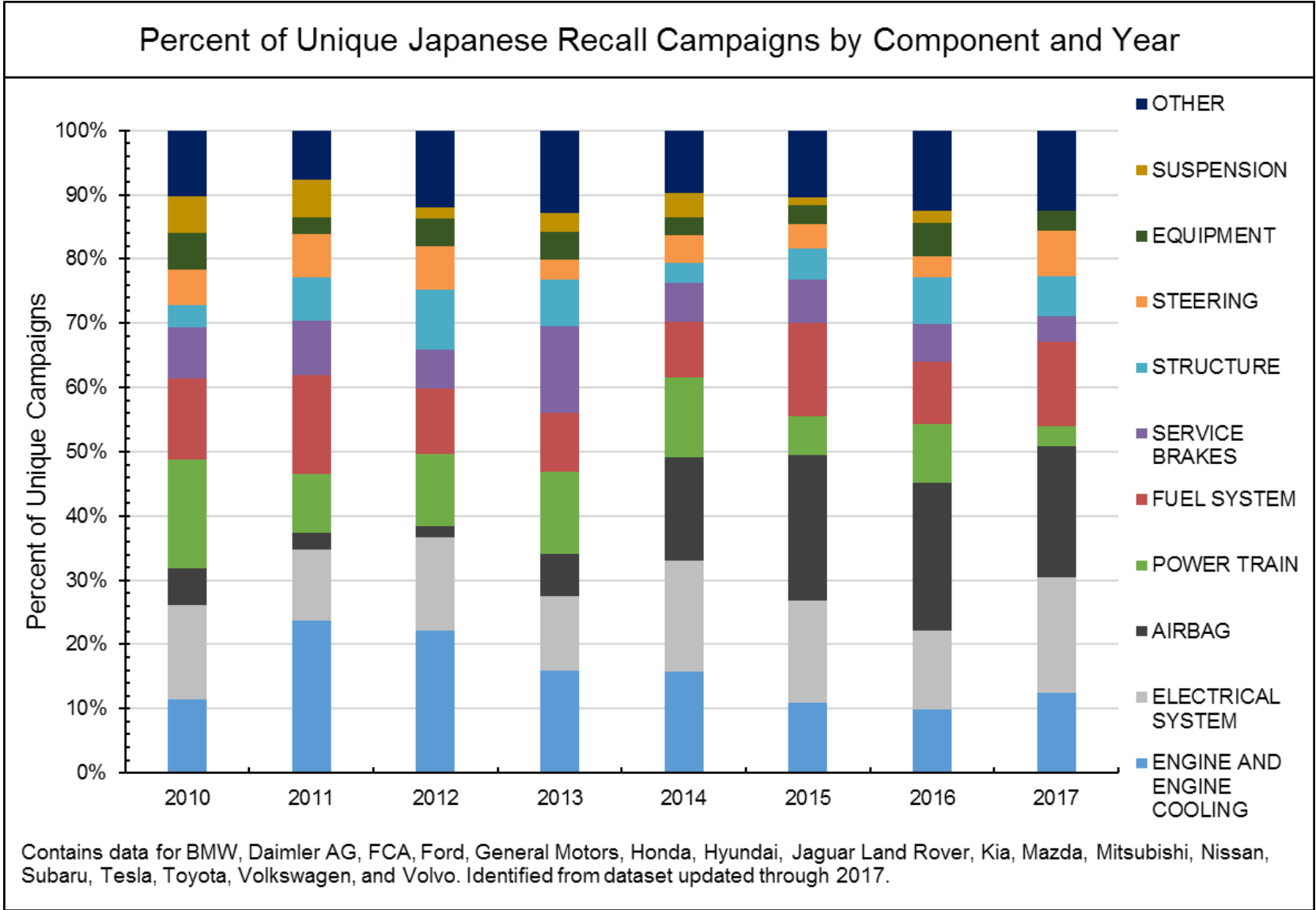


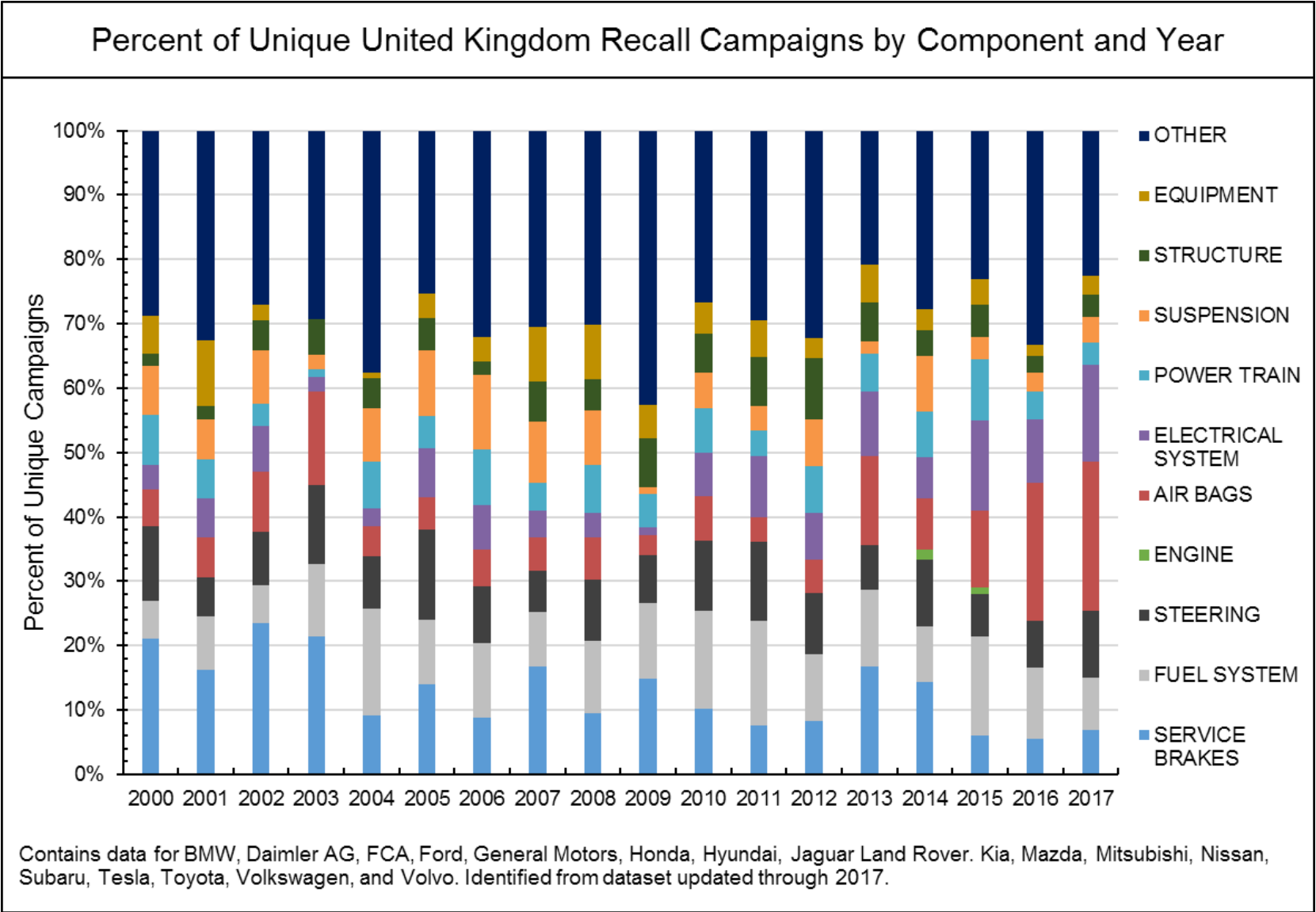


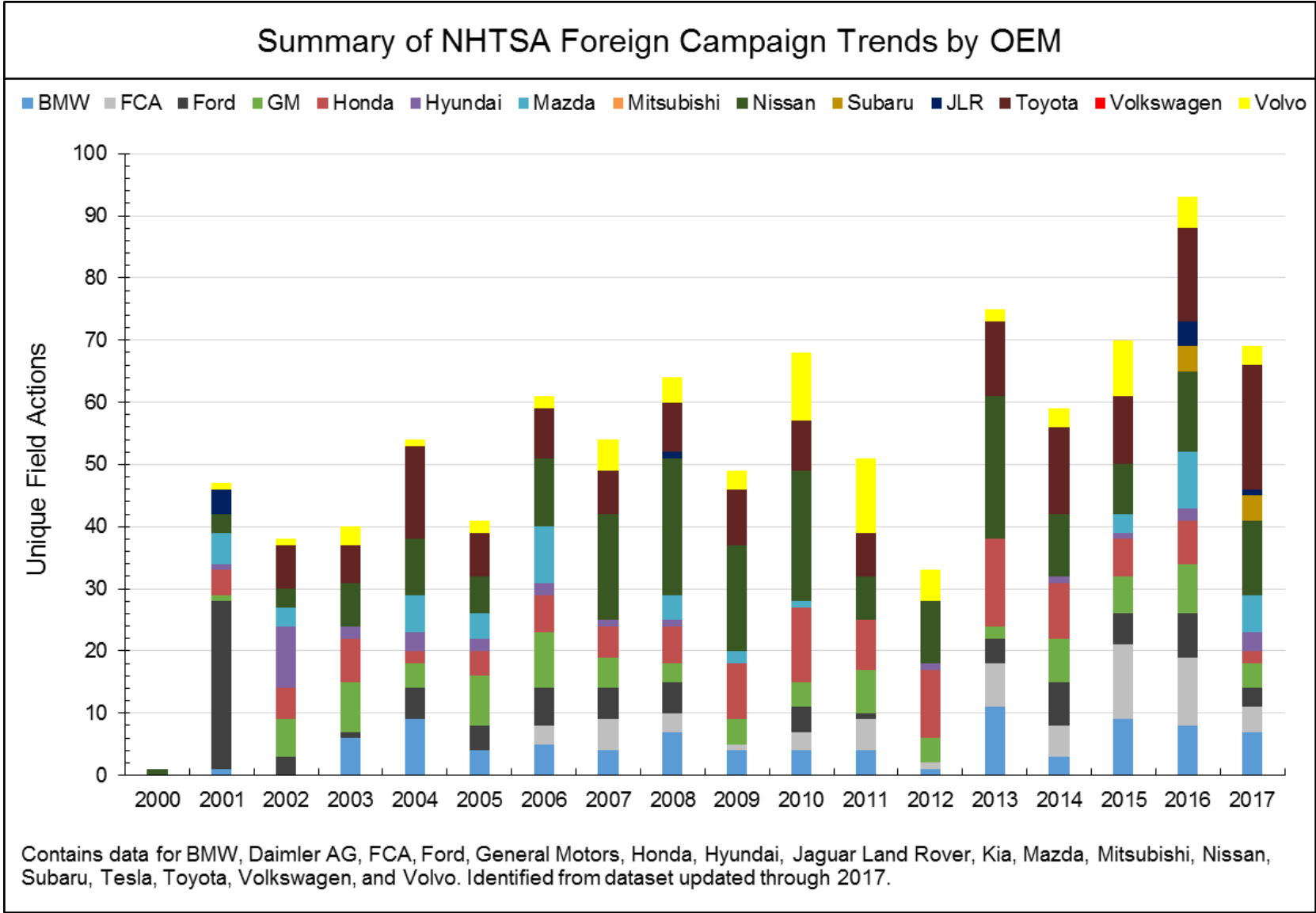


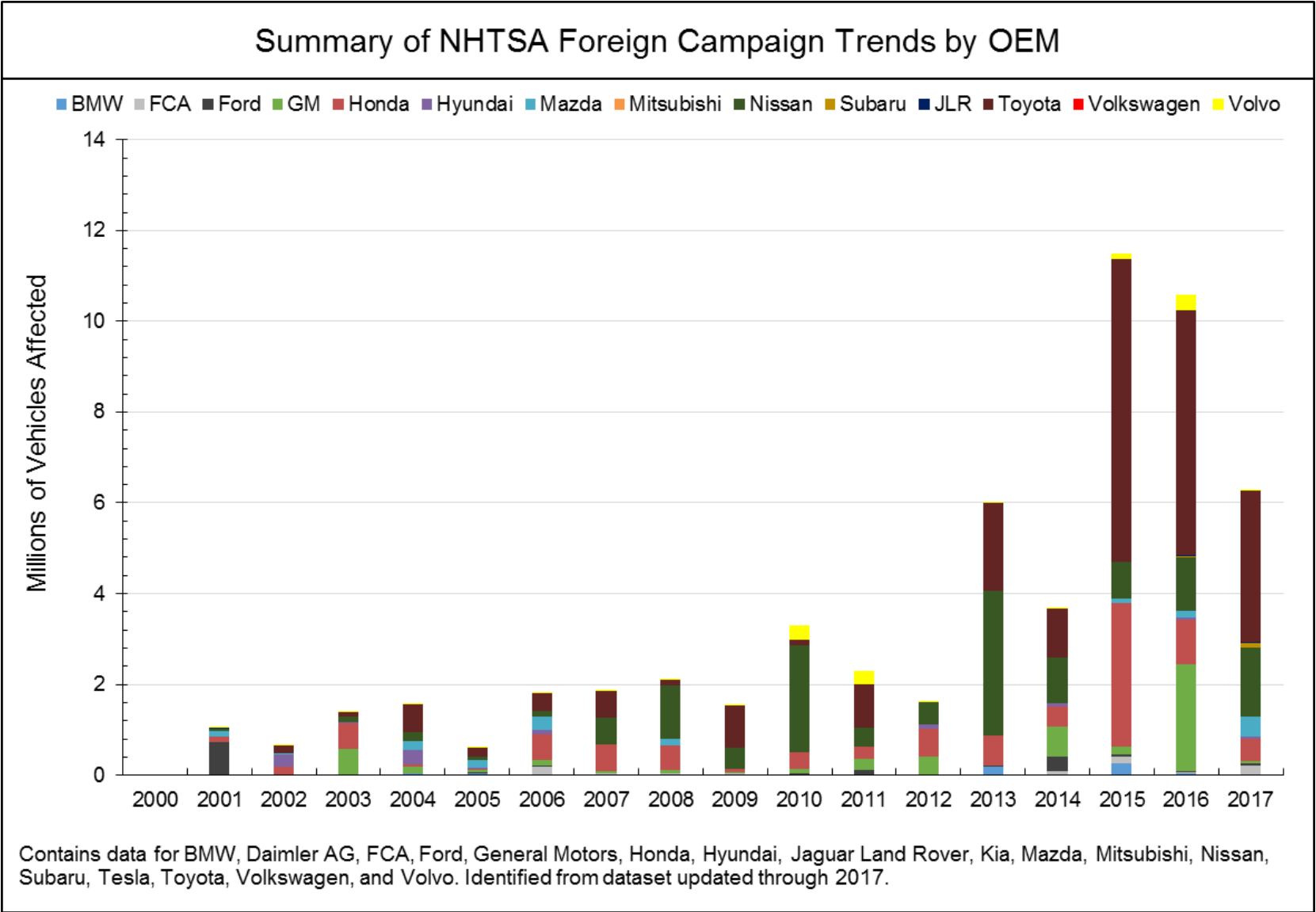












International Campaign Data - Observations

- 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 air bag recall activity, with and without Takata inflator activity
 - Volkswagen emissions defect
- Identification of globally pervasive defects is expected to continue in 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

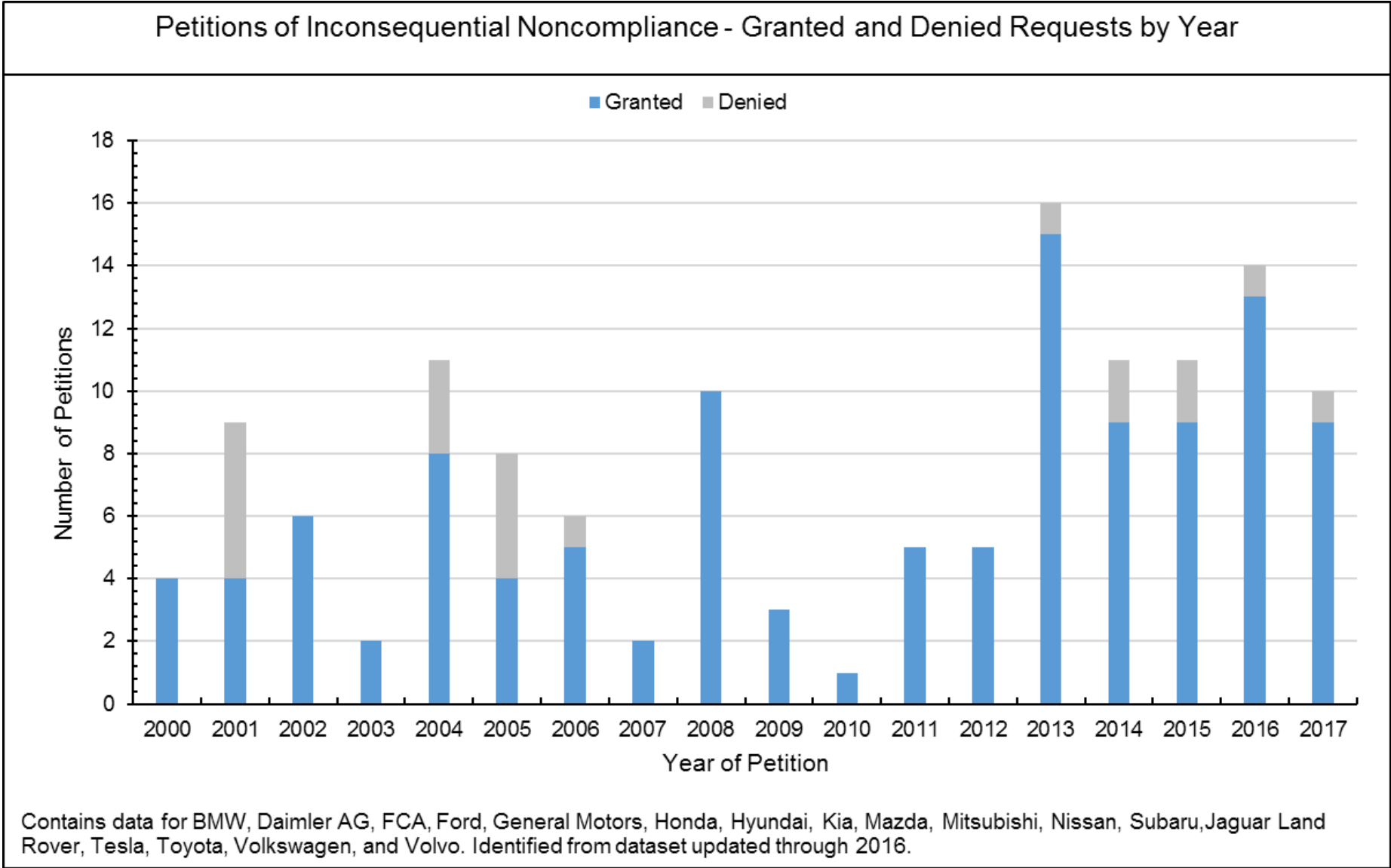


Petitions for Inconsequential Noncompliance

Petitions for Inconsequential Noncompliance (PIN)

- Manufacturers can petition NHTSA to alert them 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 determined by the manufacturer or by an initial determination of NHTSA's
- 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

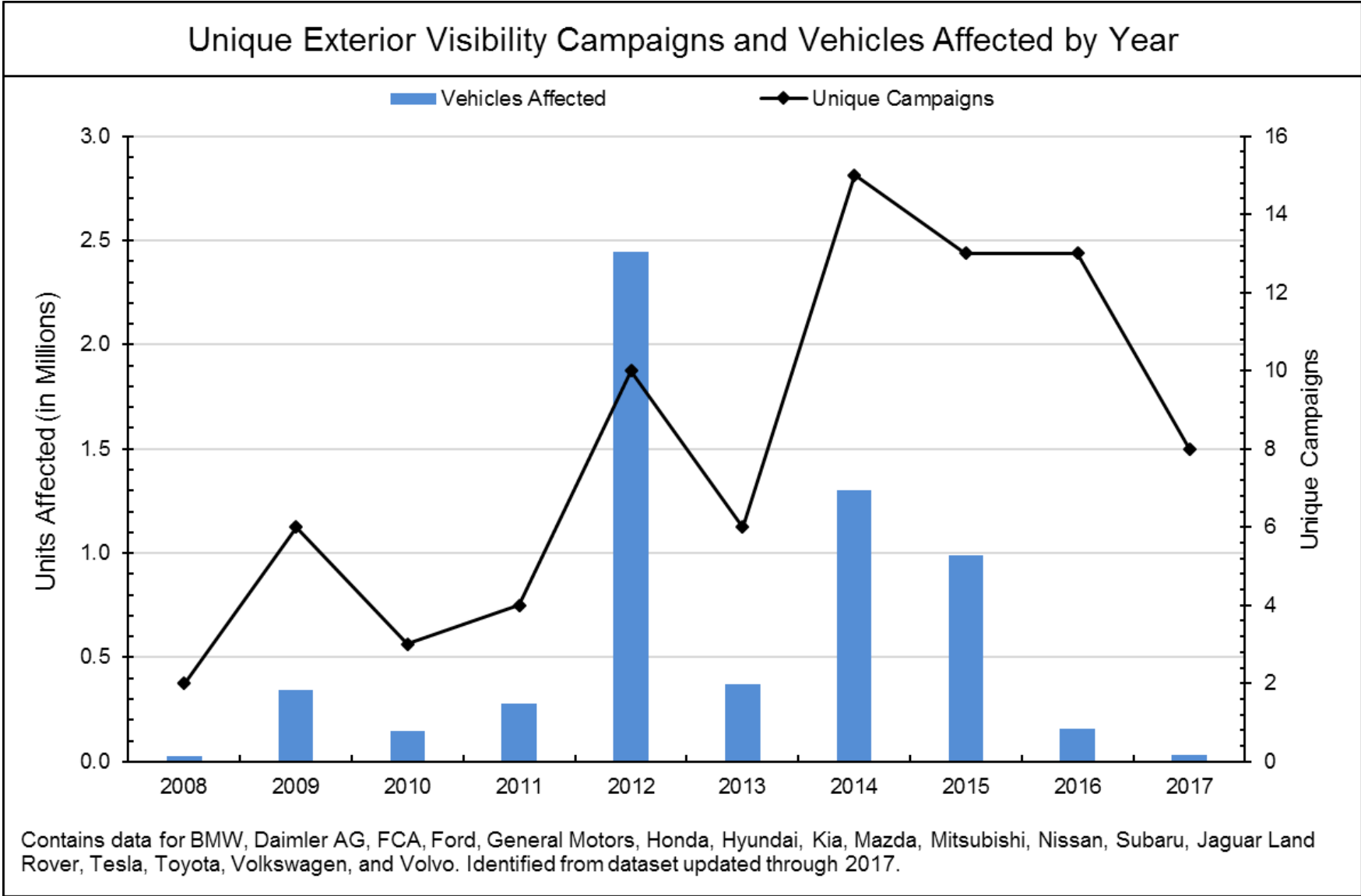


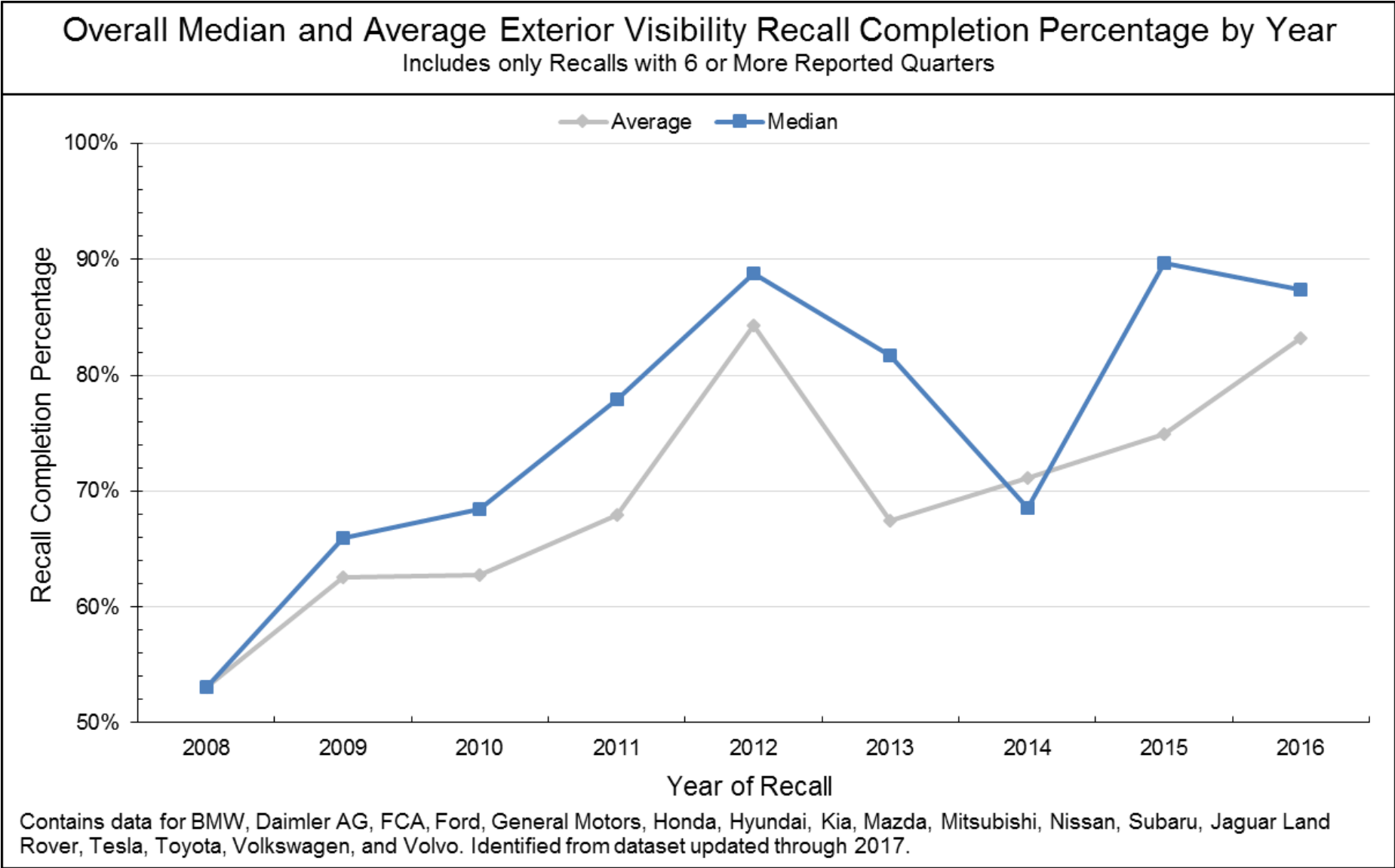
Petitions for Inconsequential Noncompliance (PIN)

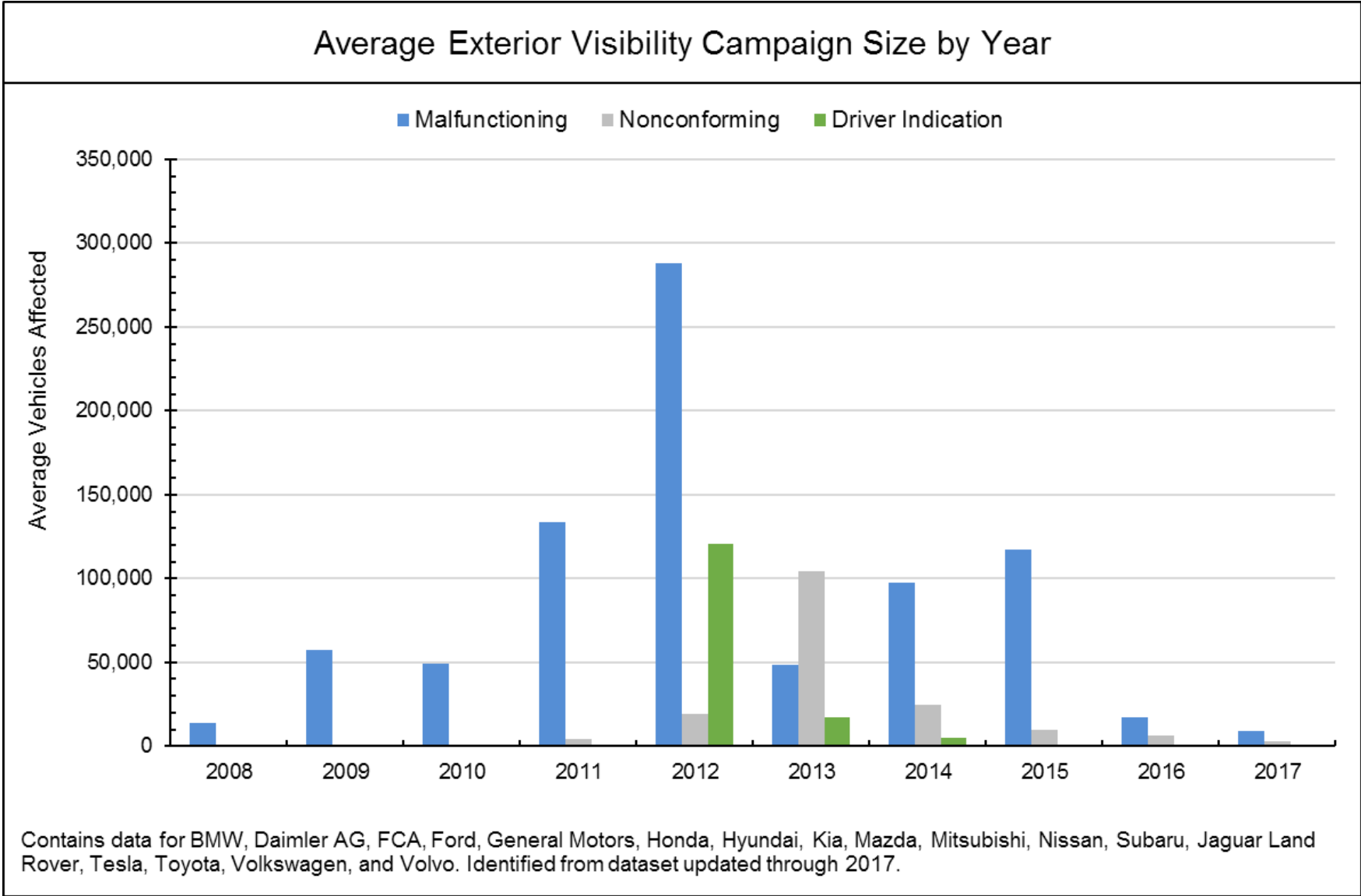
- NHTSA has only denied 7 Petitions for Inconsequential Noncompliance in the last 5 years:
 - In 2013 NHTSA denied a Ford petition related to the formation of air bubbles in the windshield of F-Series trucks when subjected to high temperatures
 - In 2014 NHTSA denied a Daimler (Mercedes Benz) petition related to a tire pressure monitoring system software mis-programming 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**
 - In 2017 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
- Recent denials indicate that NHTSA may have a lower threshold for defects related to visibility, signals, and lighting.
- We have reviewed the recall activity related to exterior visibility components to identify other trends or insights.

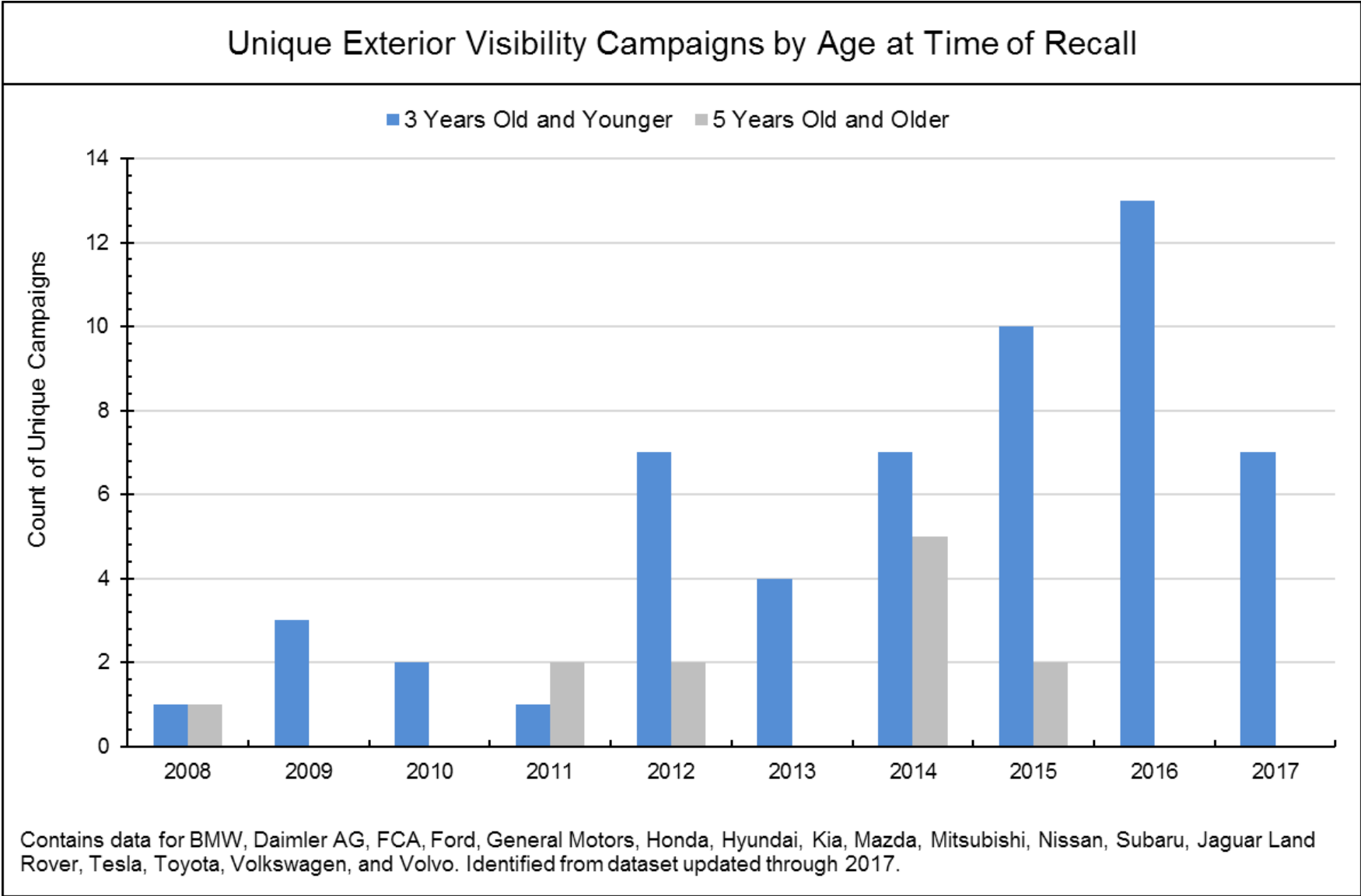
Petitions for Inconsequential Noncompliance (PIN): Exterior Visibility

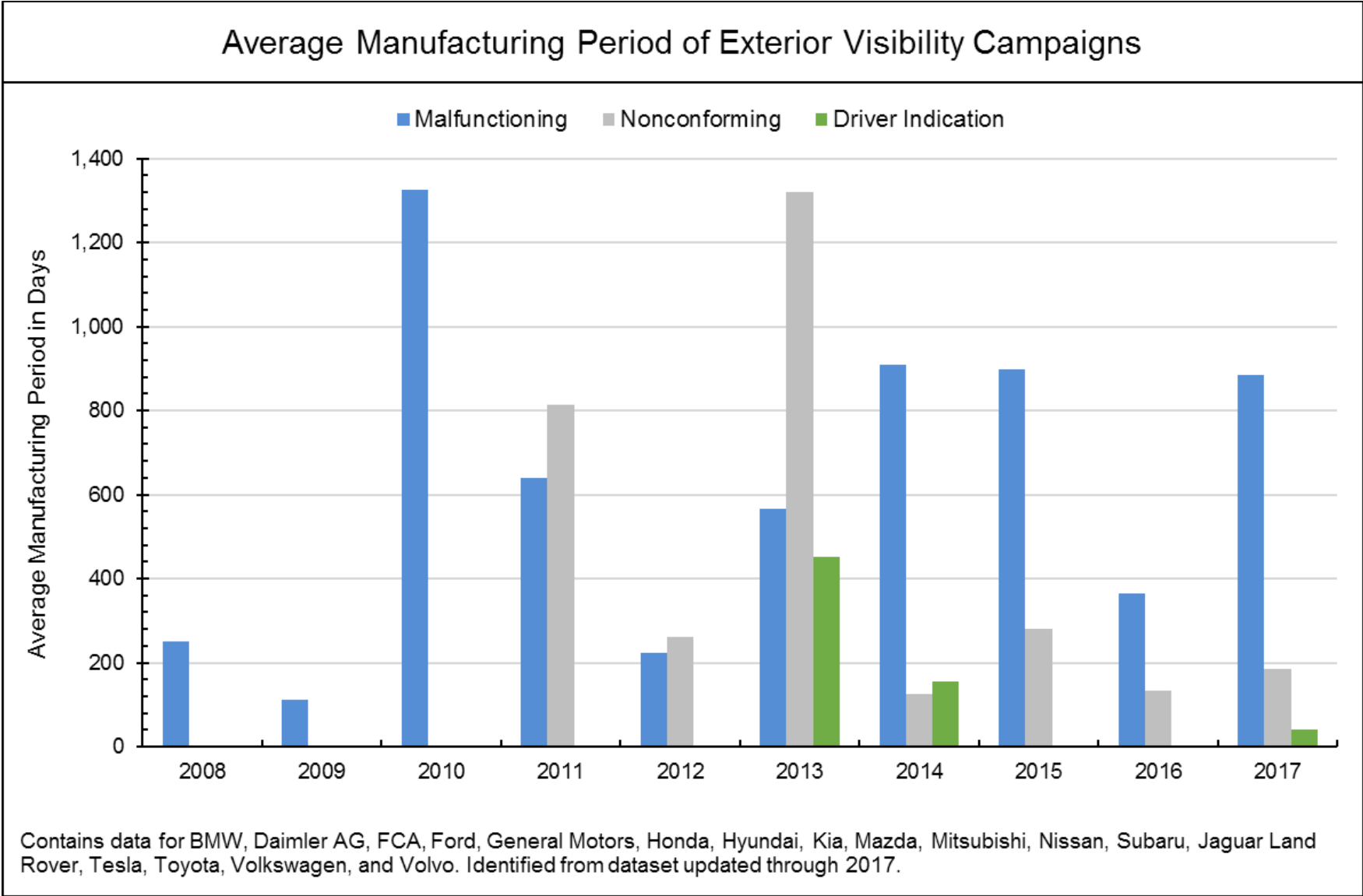
- We have reviewed the recall activity related to exterior visibility components to identify other trends or insights
- Stout performed keyword searches of the recall data to identify those recalls with defect descriptions containing the words “reflector” “photometric” “reflective”, etc.
- Within those 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)











Visibility Components

- Recall data indicates a declining number of unique campaigns and vehicles affected by recalls associated with visibility defects
 - May be related to NHTSA's denial of petitions for inconsequential noncompliance in recent years
- Visibility related recalls have demonstrated completion percentages consistent with or slightly above those observed industry wide
- Generally represent smaller campaigns involving newer vehicles; however recalls of malfunctioning visibility components include longer production periods, often times more than two years.



Electronic Recalls and Software Defects

Electronic Components: Background

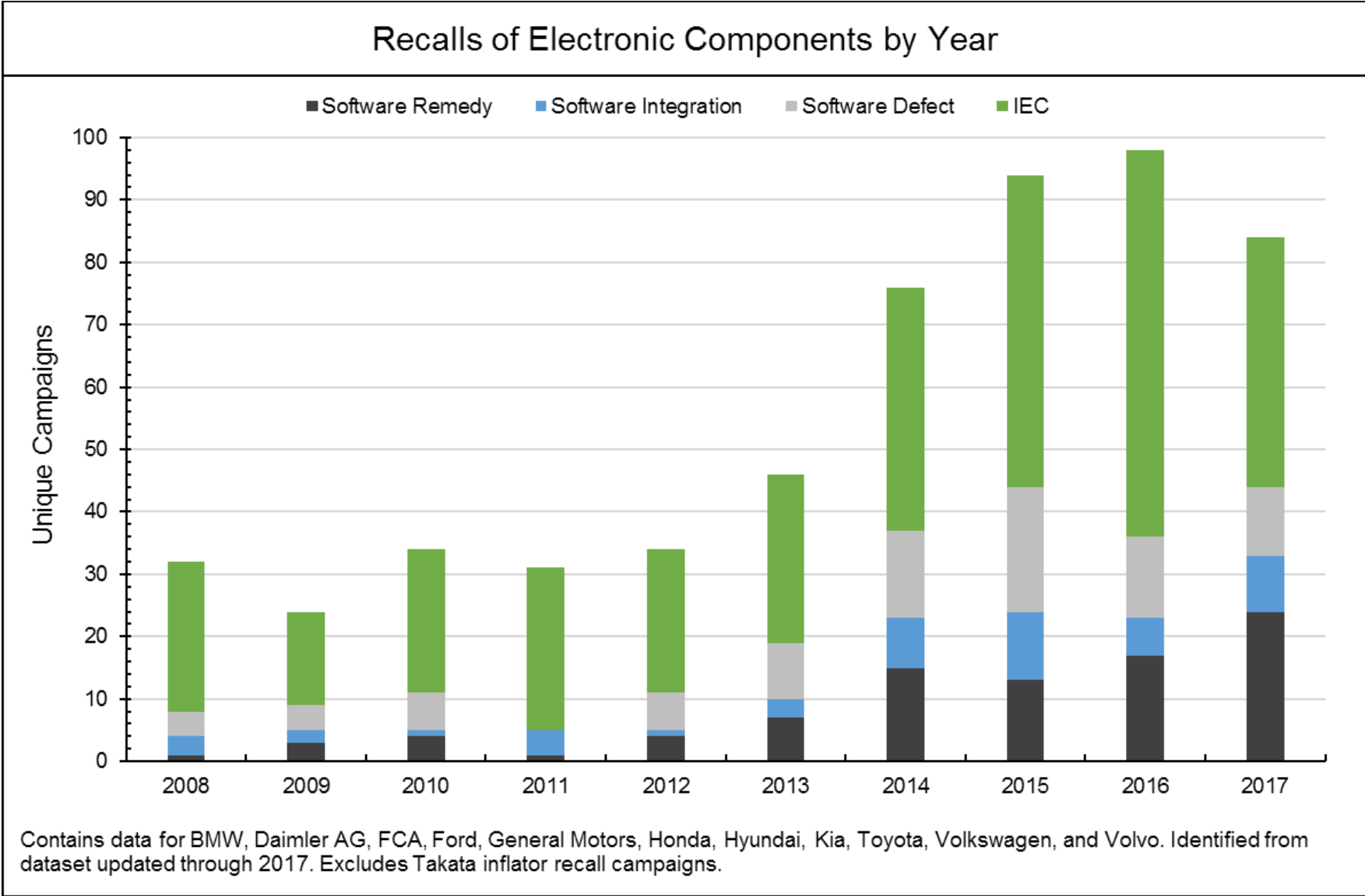
- Electronic components continue to become increasingly important aspects of vehicle safety and customer satisfaction, as these systems become more sophisticated and integrated into vehicles and consumer devices
- Accordingly, electronic components represent an increasingly valuable share of the automotive industry:
 - *“The global automotive ECU market is expected to reach an estimated \$58.4 billion by 2023 and it is forecasted to grow at a CAGR of 6.0% from 2018 to 2023.”¹¹*
 - *“The drivetrain now accounts for 30 percent of all semiconductor content in an automobile, or a market of about \$7 billion a year.”¹²*
 - *“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.”¹²*
- By 2030, electronics are expected to represent 50% of the total cost of a vehicle¹³

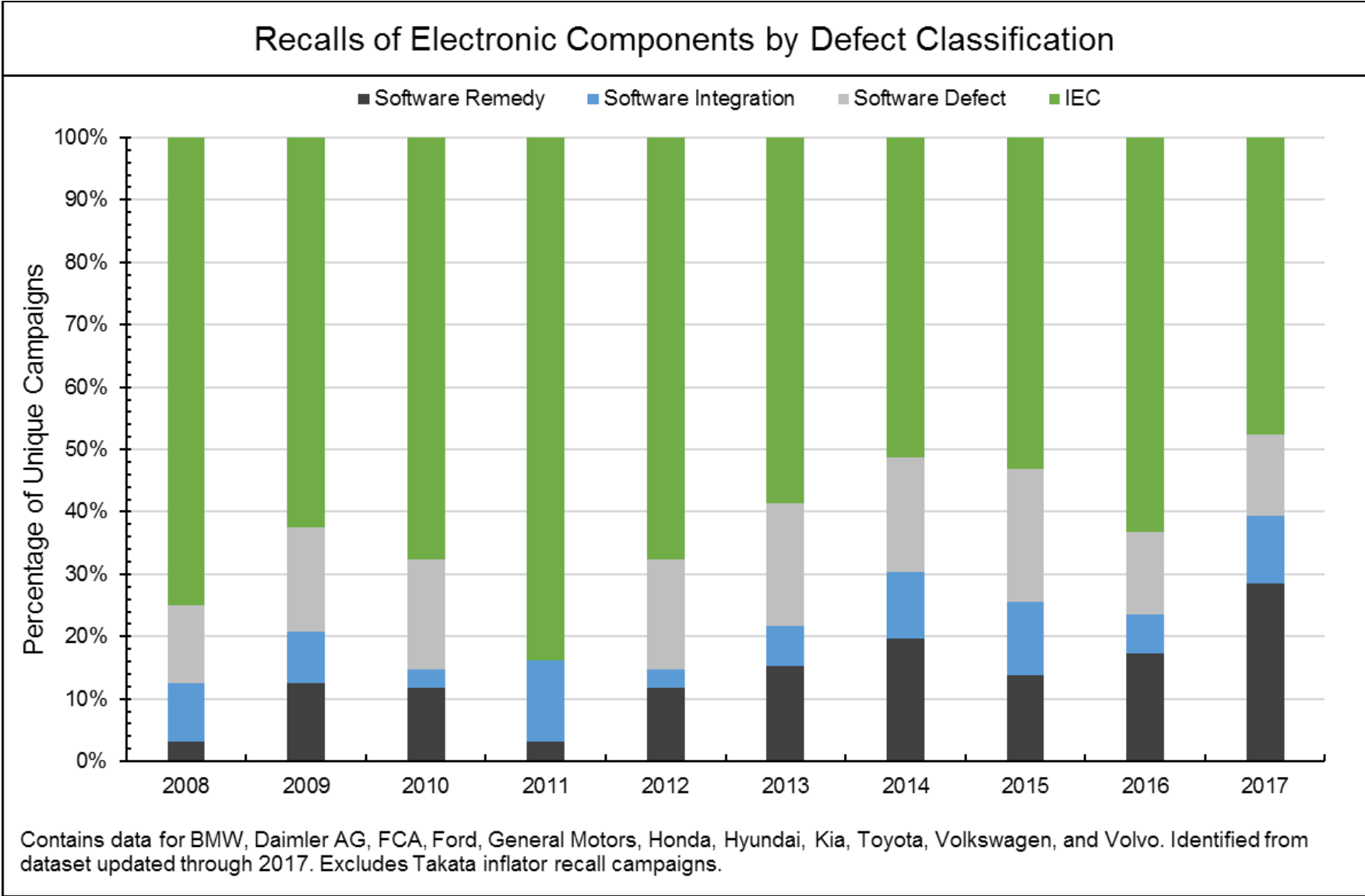
Electronic Components: Background

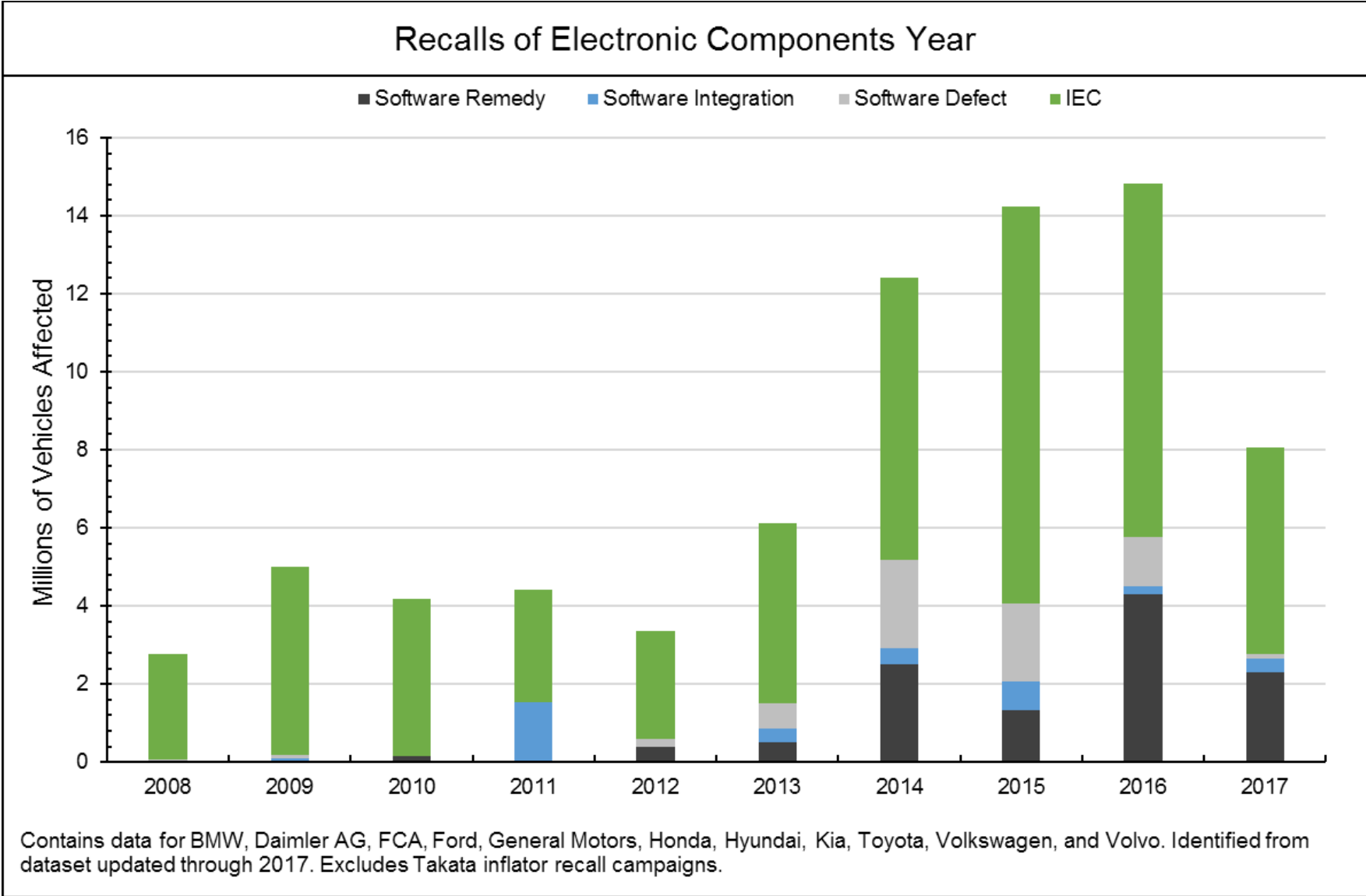
- Vulnerabilities in electronic components and operating software have been the subject of increased attention by manufacturers, NHTSA, and the public.
- On March 18, 2018, an Uber self-driving vehicle struck and killed a pedestrian¹⁵
 - First pedestrian death related to an autonomous vehicle
 - Currently unknown whether this was the result of faulty sensors, software, the vehicle's computer, or some other factor
- GM announced in March of 2018 that it will invest \$100 million to upgrade facilities to build self-driving vehicles¹⁴
 - In January, GM filed a petition seeking approval for a fully autonomous vehicle to enter its first commercial ride sharing fleet in 2019
 - Vehicle would not have a steering wheel, brake pedal, or accelerator pedal

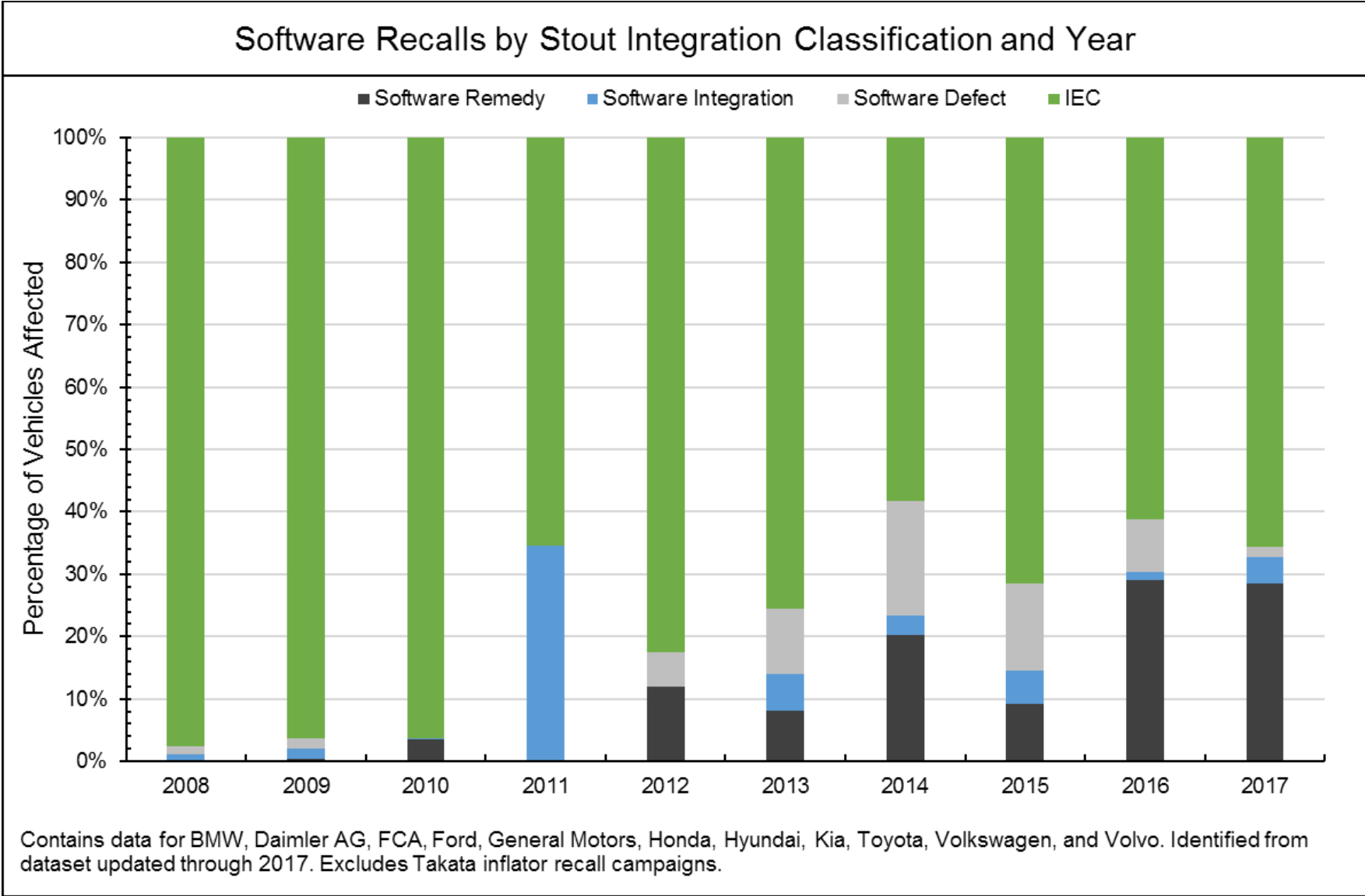
Electronic Components: Analysis

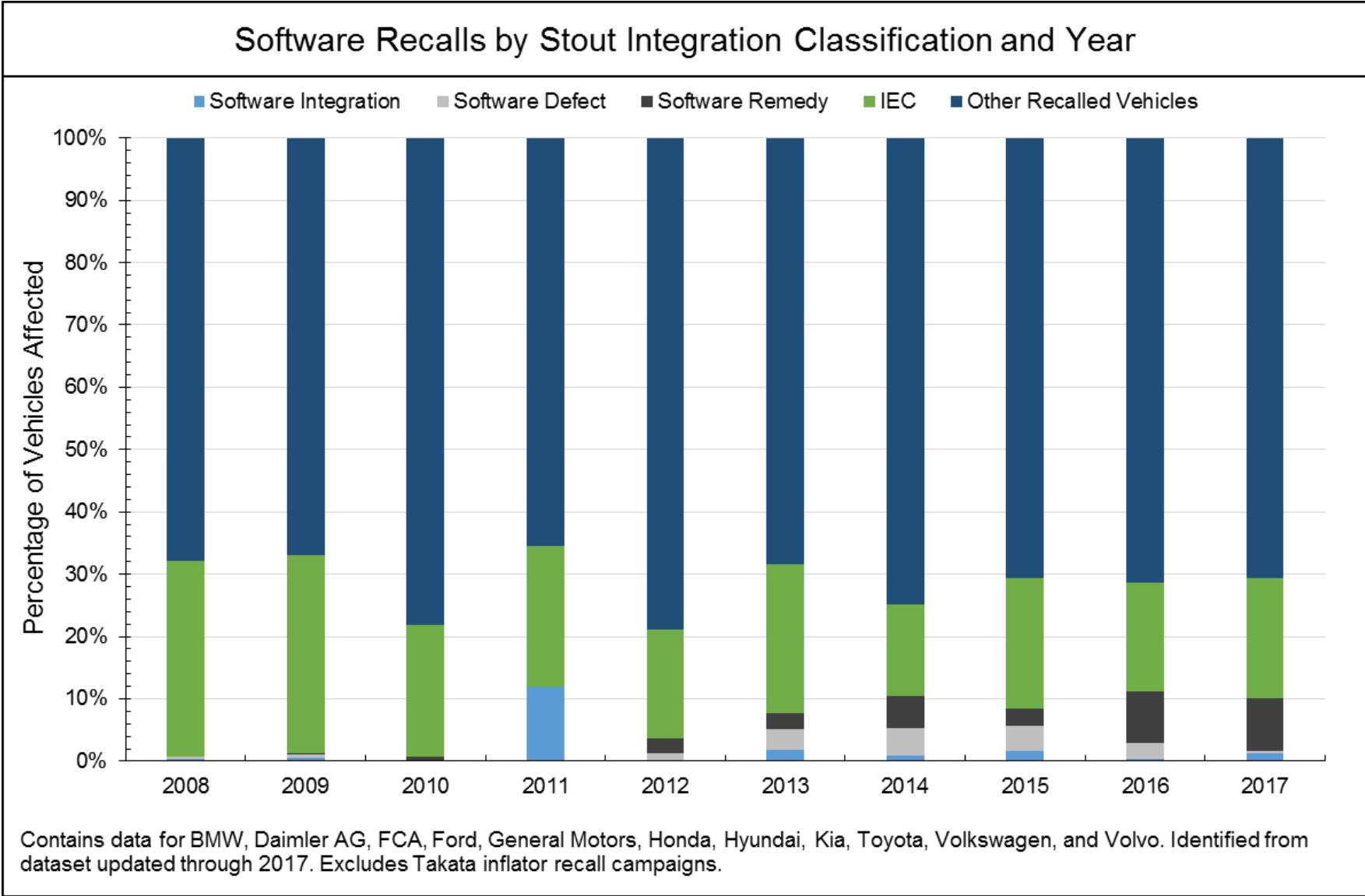
- Our analysis of automotive electronics highlights the role of software in the failure or remedy of electronic defects.
- Stout's analysis has focused on the following categories of defects:
 - Integrated Electrical Components (“IECs”) – Failure of electrical components due to physical defect. Includes 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: Advanced Driver Assistance Systems (ADAS)

- On September 6, 2017, the House passed the Safely Ensuring Lives Future Deployment and Research in Vehicle Evolution (“SELF Drive”) Act. Included in the SELF Drive Act are provisions which¹⁶:
 - Expands NHTSA’s authority and state preemption for autonomous vehicles
 - Updates the federal motor vehicle safety standards for highly automated vehicles
 - Establishes a requirement that OEMs develop a cybersecurity plan
 - Amends general exemptions and testing requirements in FMVSS
 - Requires the Secretary of Transportation to perform a study and initiate a rulemaking proceeding to require manufactures to inform consumers of the capabilities and limitations of autonomous vehicles, and
 - Establishes a Highly Automated Vehicle Advisory Council in NHTSA.
- A similar bill, called the SELF DRIVE Act has been introduced in the Senate

Electronic Components: Advanced Driver Assistance Systems (ADAS)

- 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 includes¹⁸:
 - Voluntary Guidance for Automated Driving Systems – Details 12 priority safety design elements for the testing and deployment of Automated Driving Systems, including cyber security, 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 ADSs
- NHTSA held several sessions seeking public feedback through fall 2017^{19 20}
- The U.S. DOT continues to review these policies and plans to release version 3.0 of the document in 2018¹⁷

Electronic Components: Indicators of ADAS Defects

- Limited number of recalls, service bulletins, investigations, etc. which indicate defects associated with autonomous vehicle or driver assistance systems
 - Consistent with fitment of technology across vehicle population and premium availability of related options
- NHTSA added component designation for Lane Departure systems in 2017 associated with two recalls:
 - Instrument panel installed on 2016-2017 Mercedes-Benz Metris vans does not support Blind Spot Monitoring function equipment (37 vehicles affected)
 - Automatic brake interventions on 2017 Mercedes-Benz and Freightliner Sprinter 3500 vehicles might not be activated in strong crosswinds (2,177 vehicles affected)
- As driver assistance systems continue to be positioned as safety critical features, they will become standard equipment on more vehicles likely come under more scrutiny

Electronic Components: Observations and Conclusions

- Rapid growth in deployment of electronic components is expected to continue into the foreseeable future
- Recalls of electronic components have decreased in 2017, consistent with overall industry recall activity
- Recalls involving software based remedies have steadily increased in terms of the number of campaigns and proportion of electronic component recalls in recent years.
 - This could ultimately result in less costly repairs
 - Over-the-air software updates may provide for greater owner convenience and enhanced recall completion percentages
- NHTSA has recently added new component categories related to Lane Departure and Cybersecurity signaling increased focus on these components in future years



Environmental Conditions and Materials Recalls

Environmental Conditions and Vehicle Defects: Background

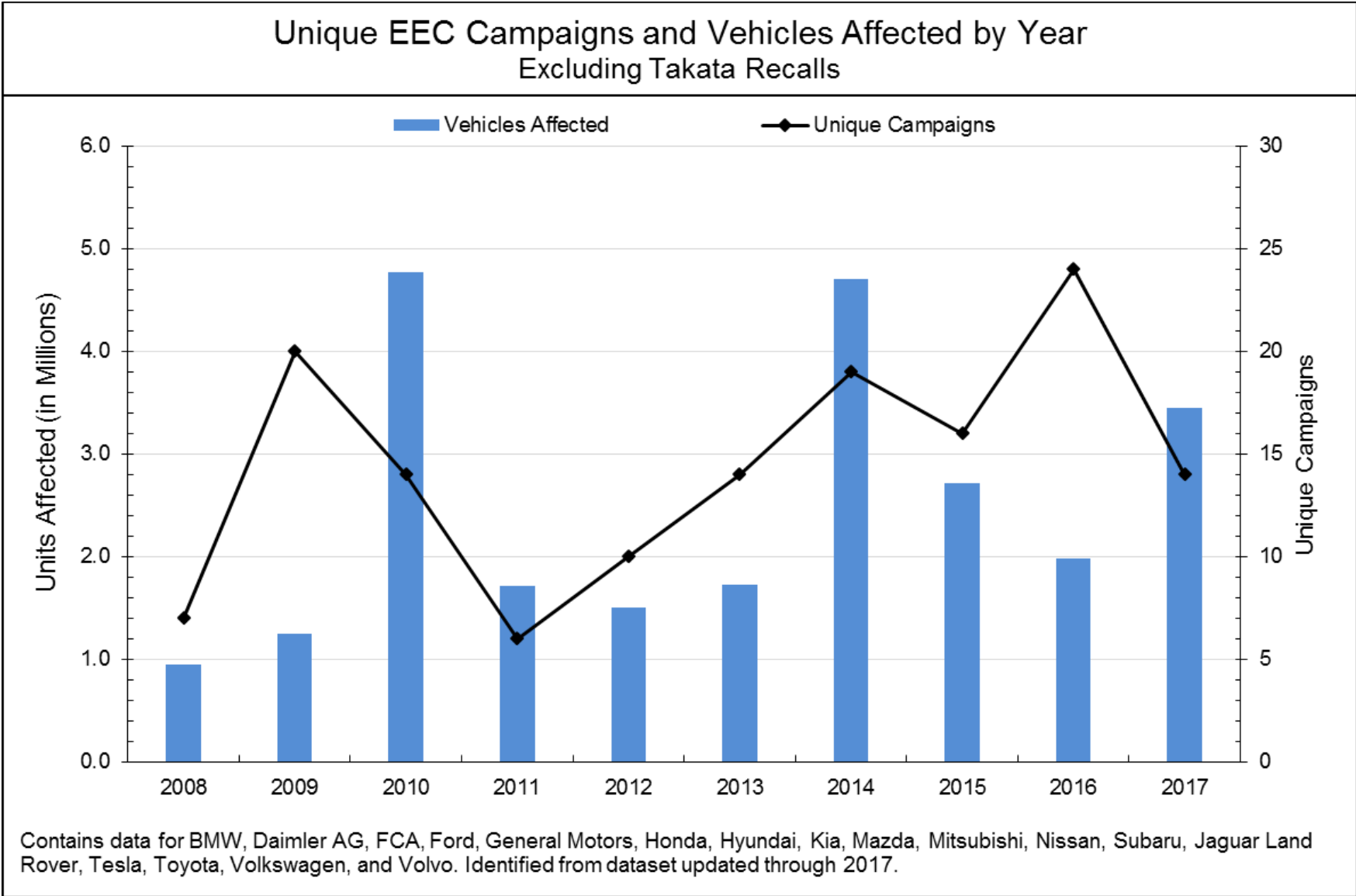
- Motor vehicles are exposed to climate extremes related to temperature, precipitation, moisture, and solar radiation. Vehicles are also subjected to other destructive elements in their environment including dust, debris, salts, etc.
- This may include vehicle exposure to extreme weather events. Up to 1 million vehicles are estimated to have been damaged or destroyed by flooding related to hurricanes Harvey and Irma in 2017.²¹
- According to AAA, 70% of American drivers have been affected by rust issues associated with de-icing salts and solutions, spending \$3 billion annually to repair damage caused by rust.²²

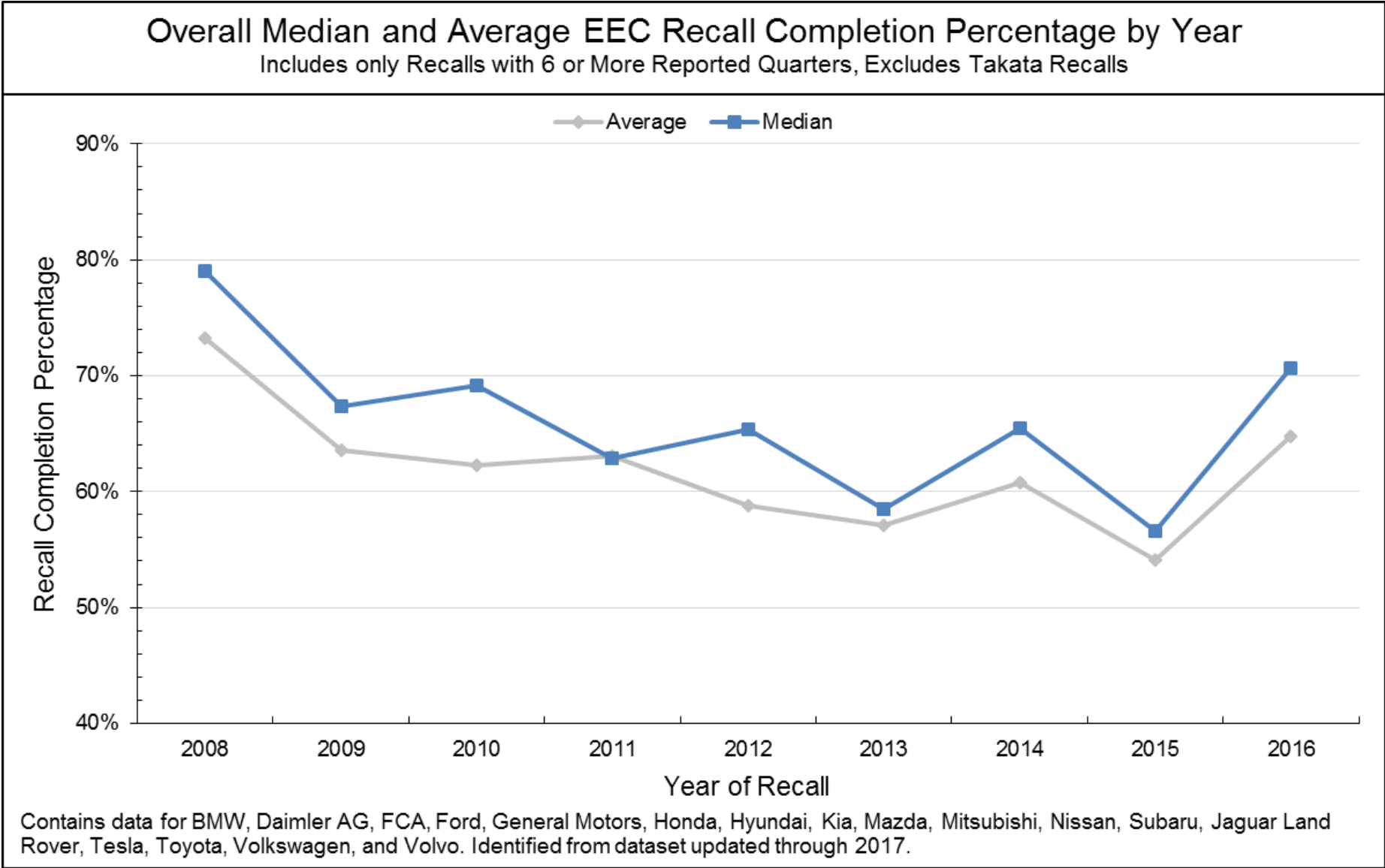
Environmental Conditions and Vehicle Defects: Background

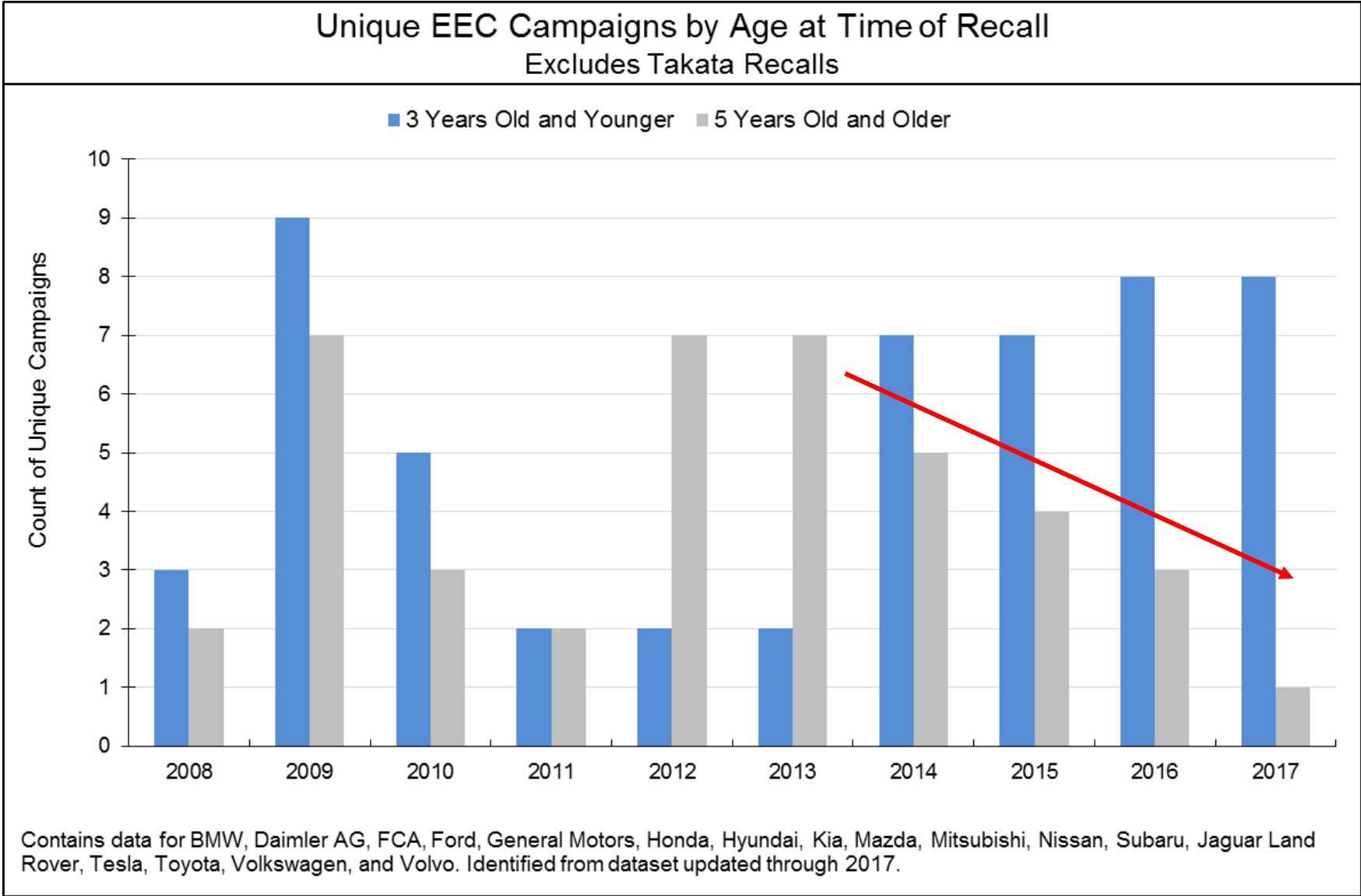
- Vehicles are designed to withstand some of the most extreme conditions, however defects often exist within vehicles that allow environmental conditions to cause component failures. Such defects may result in significant recalls:
 - Honda recalled 1.1 million vehicles in 2017 as a result of water entering the battery sensor case and potentially causing an electrical short
 - Ford recalled 1.5 million vehicles in 2017 related to freezing door latches
 - Toyota recalled 2.2 million vehicles in 2010 due to rough or slow accelerator pedal movement caused by exposure to condensation or long periods of humidity

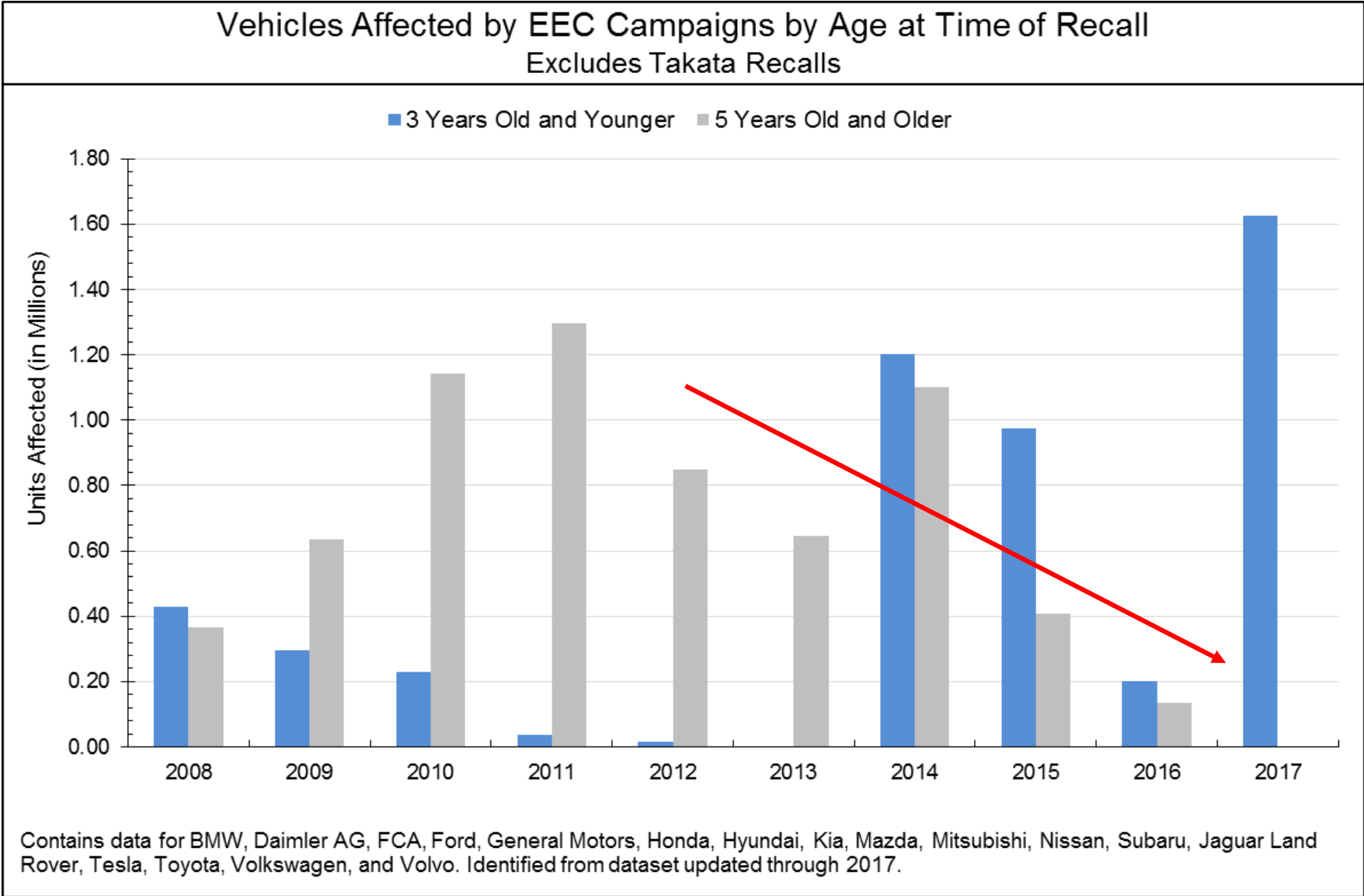
Environmental Conditions and Vehicle Defects: Analysis

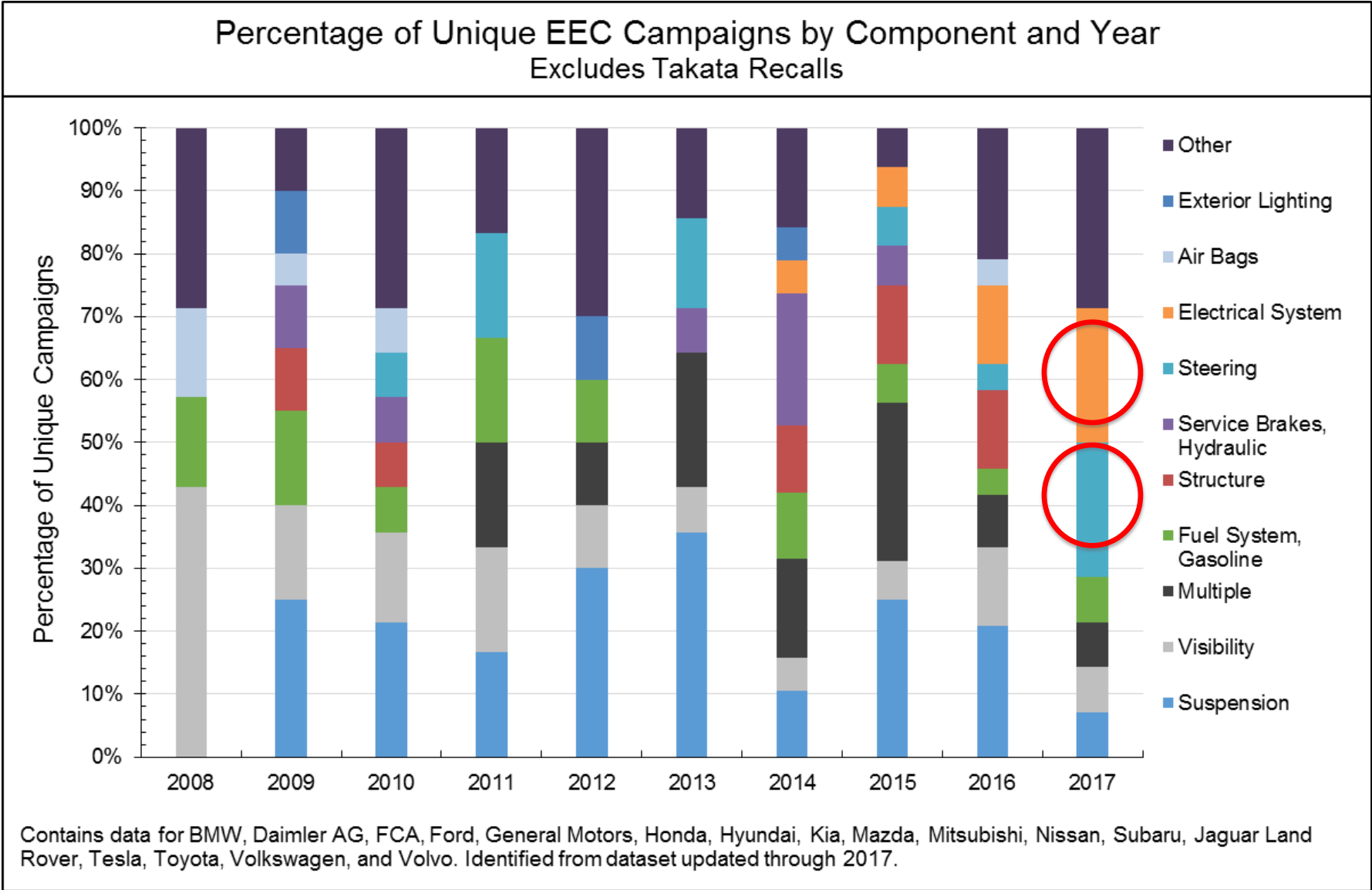
- Stout's analysis of component failures related to Environmental Exposure and Corrosion ("EEC") examines recalls where various environmental or climate related conditions are identified in the defect descriptions. We have isolated those defects with descriptions including:
 - Climate
 - Environmental
 - Corrosion
 - Debris
 - Salt
 - Moisture
 - Intrusion
- These recalls have been analyzed to understand key features including frequency and scale of recalls, completion percentages, ages of affected vehicles, and location on the vehicle and components affected

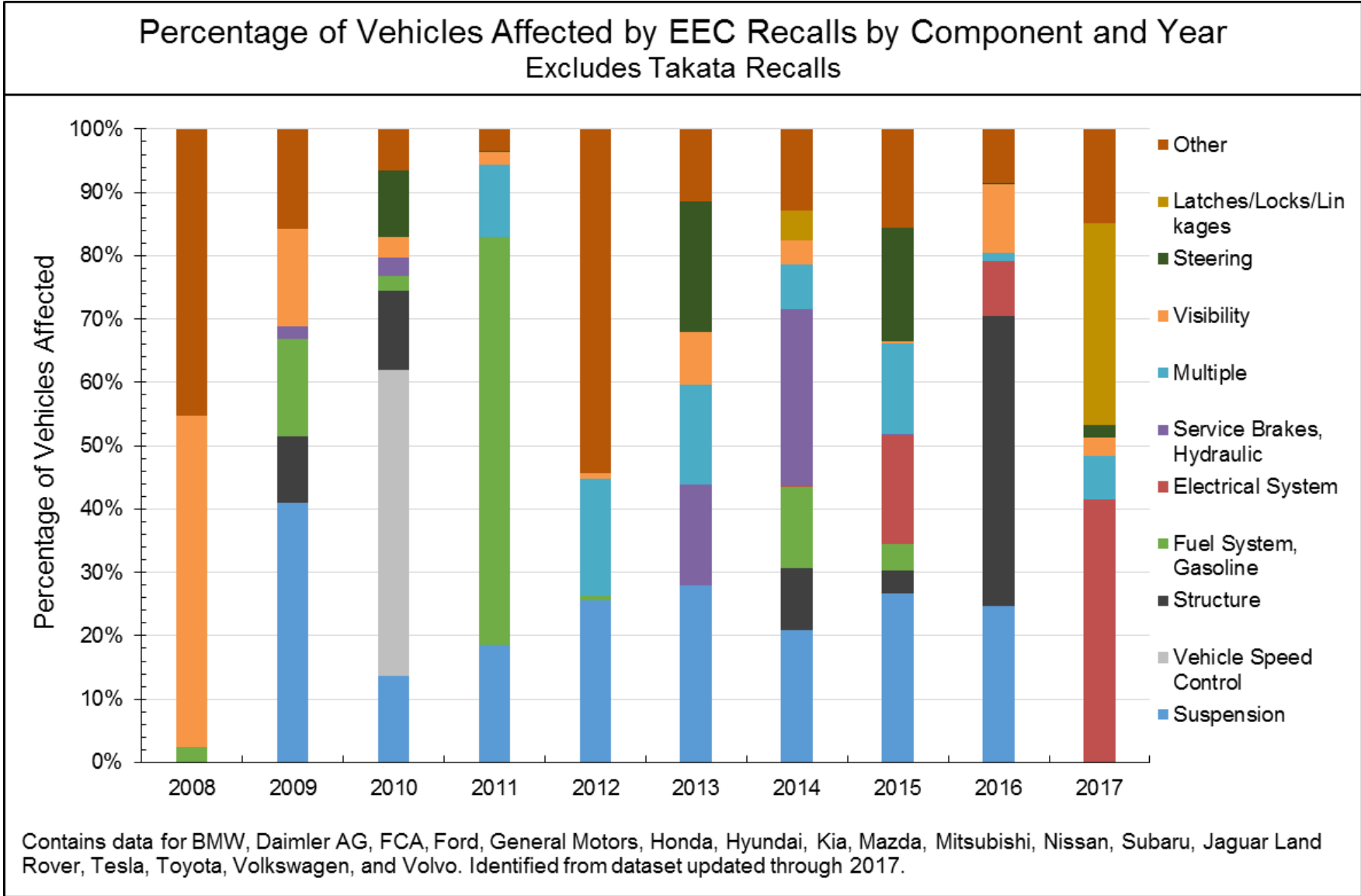












Environmental Conditions and Vehicle Defects: Observations and Conclusions

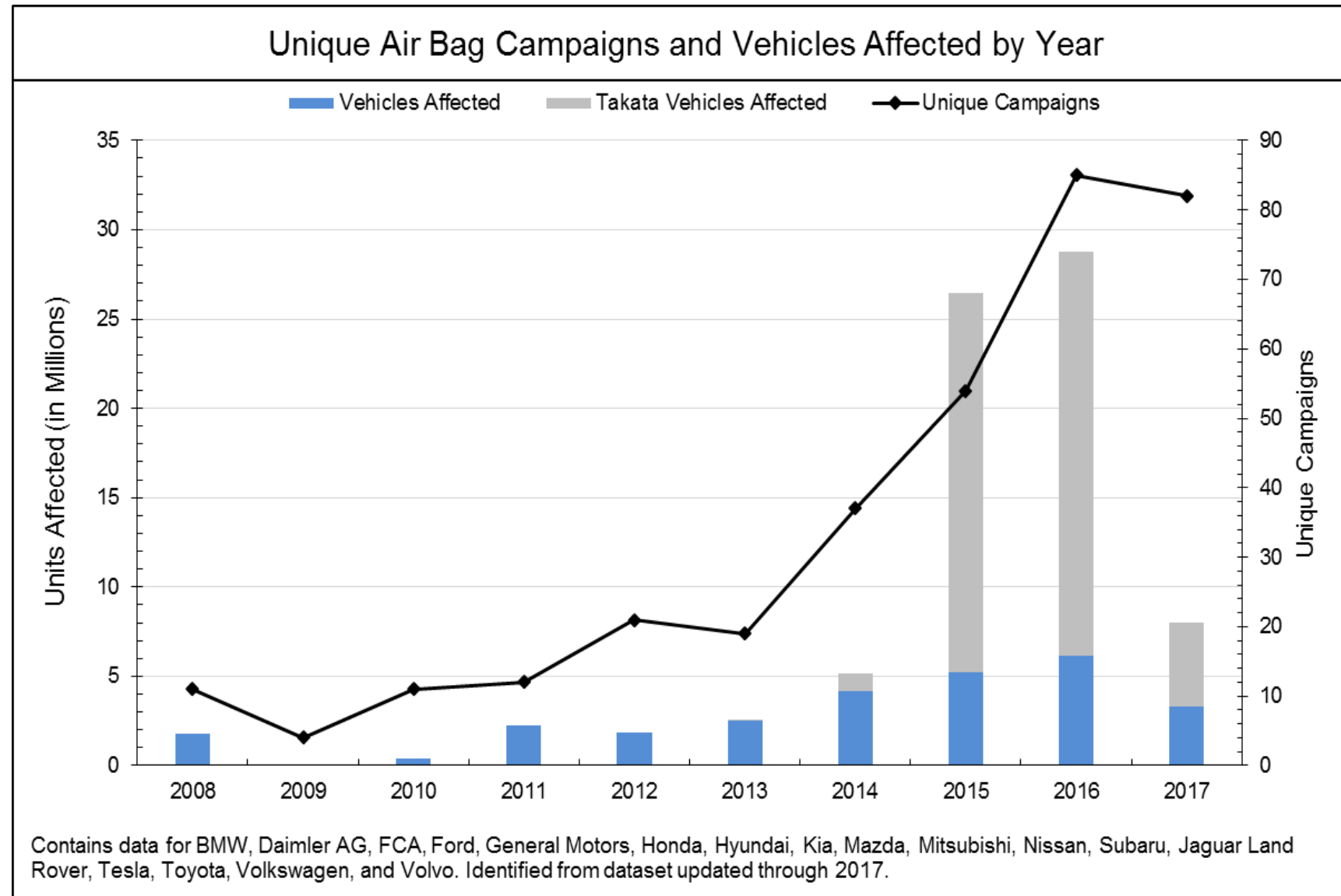
- Significant number of vehicles affected by defects associated with environmental conditions over the past 10 years
 - Approximately 25 million vehicles associated with 144 unique campaigns, excluding Takata recalls
- Completion percentages perform below industry average
- Majority of vehicles affected have historically been older vehicles, however recent activity includes a significant proportion of newer vehicles
- Majority of affected vehicles relate to defects outside of the vehicle (suspension, structure, fuel tanks)

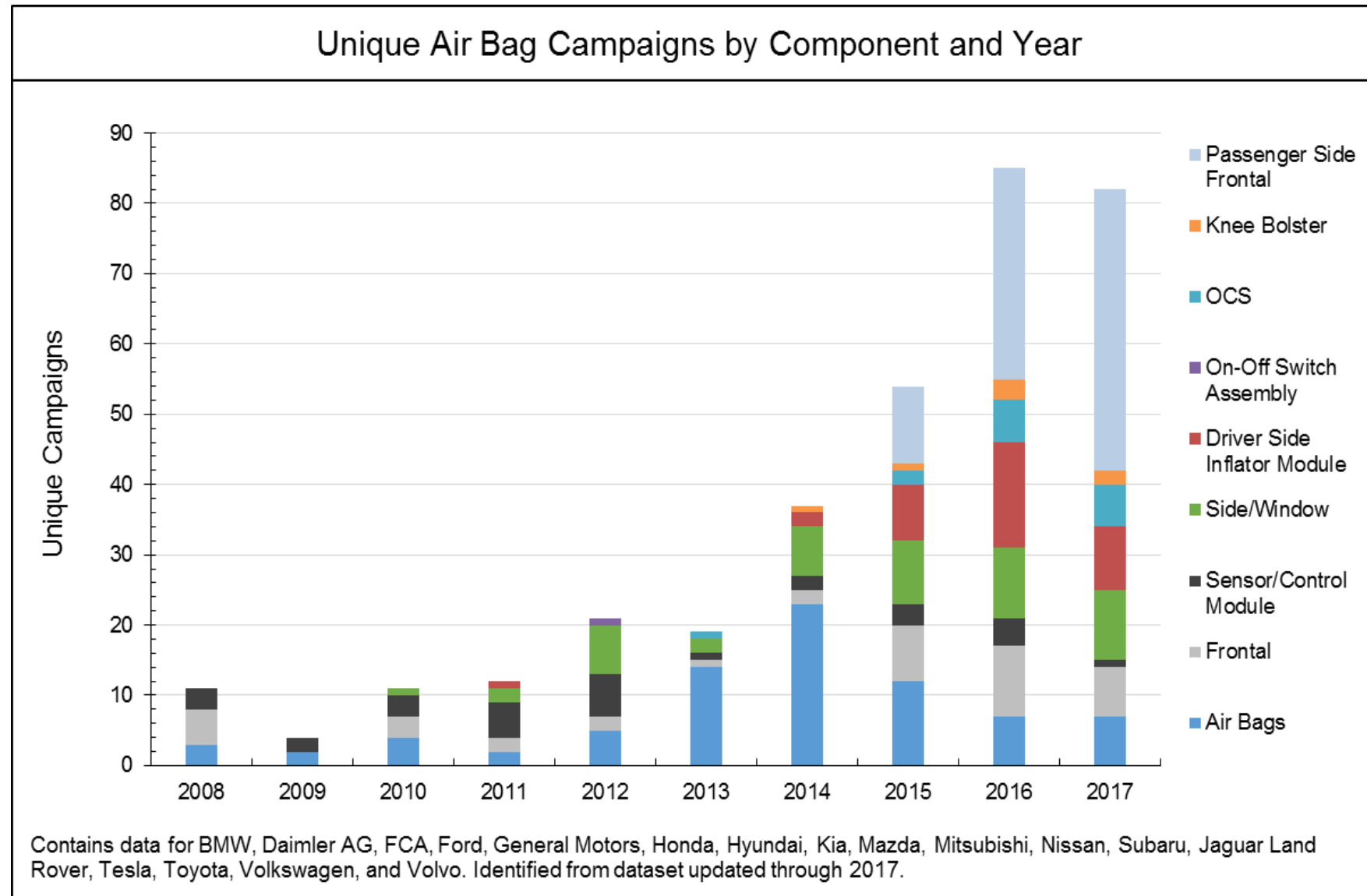


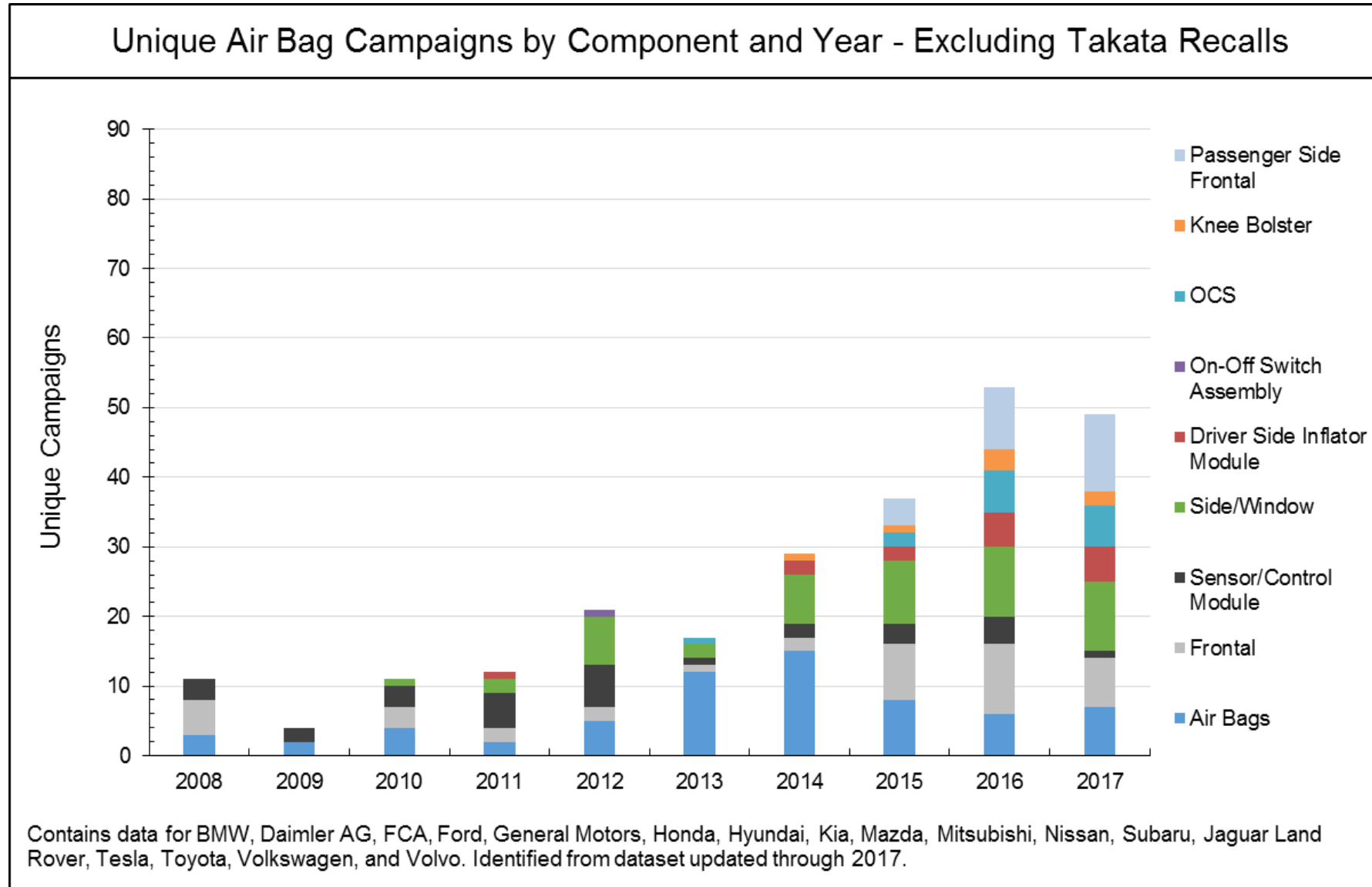
Air Bag Component Defects

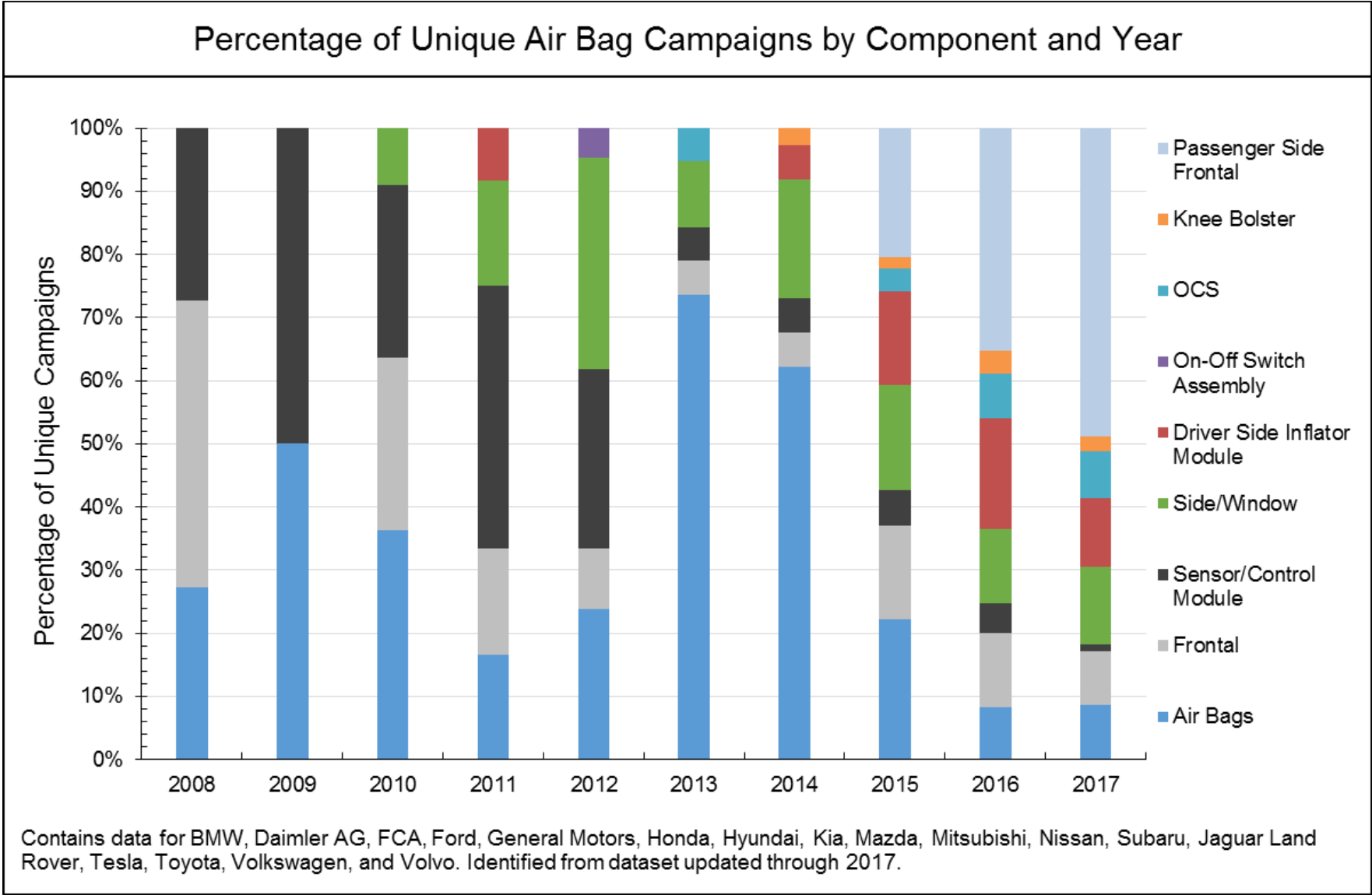
Air Bag Components: Background

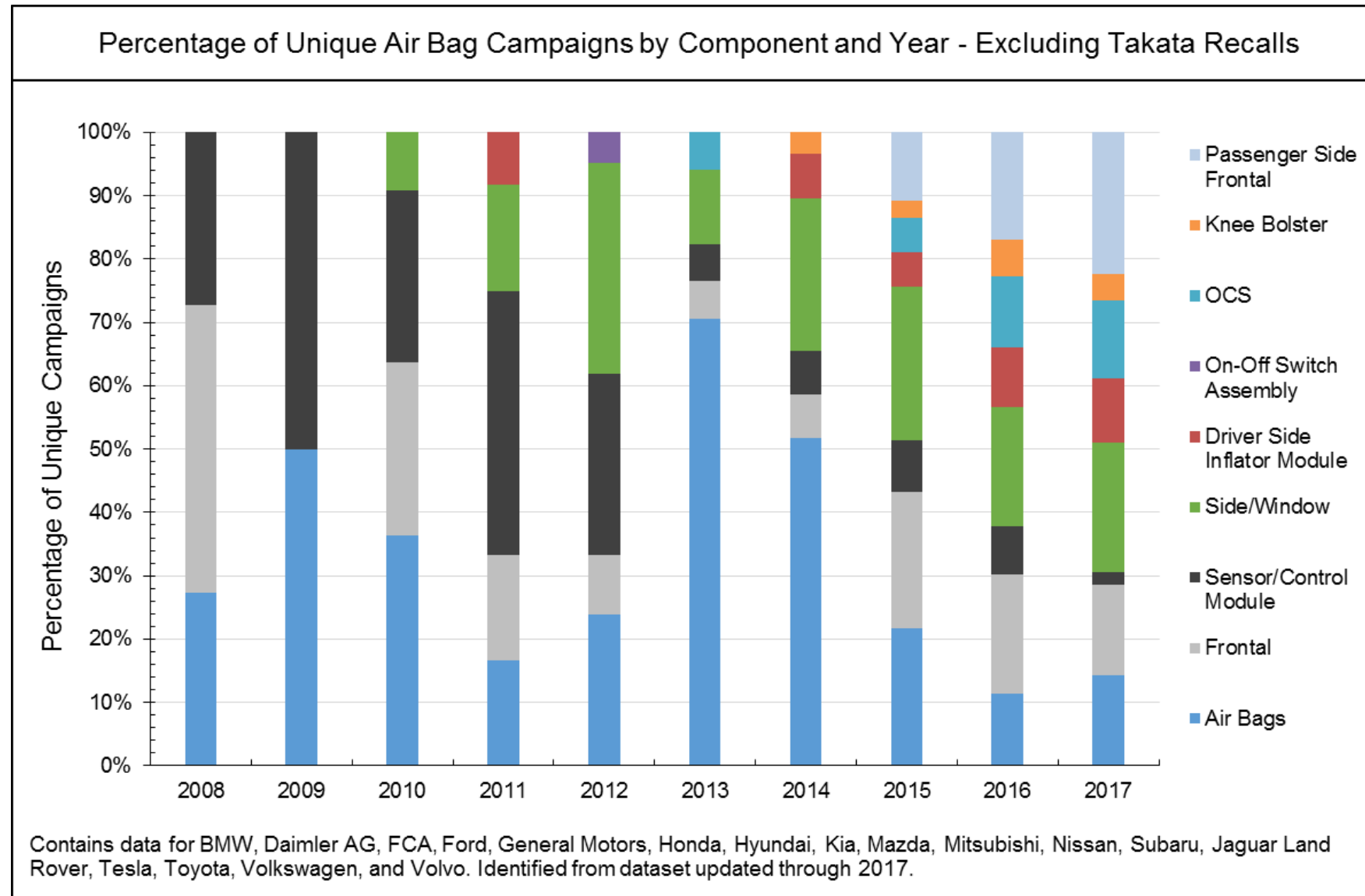
- Air bag components have recently received significant attention related to high profile recalls:
 - Takata inflator ruptures (estimated 37 million vehicles to date)
 - Nissan Occupant Classification System (3.3 million vehicles)
 - Toyota inflator electrical connections (1.5 million vehicles)
- In addition to such high profile recalls, air bag components have historically been among the most frequently recalled:
 - Critical safety equipment
 - Complex systems
 - Standard equipment on all cars since model 1998, and SUVs pickups and vans since model year 1999
- While much of the recent focus has been on the inflator module, air bags contain a number of individual components with unique defect profiles

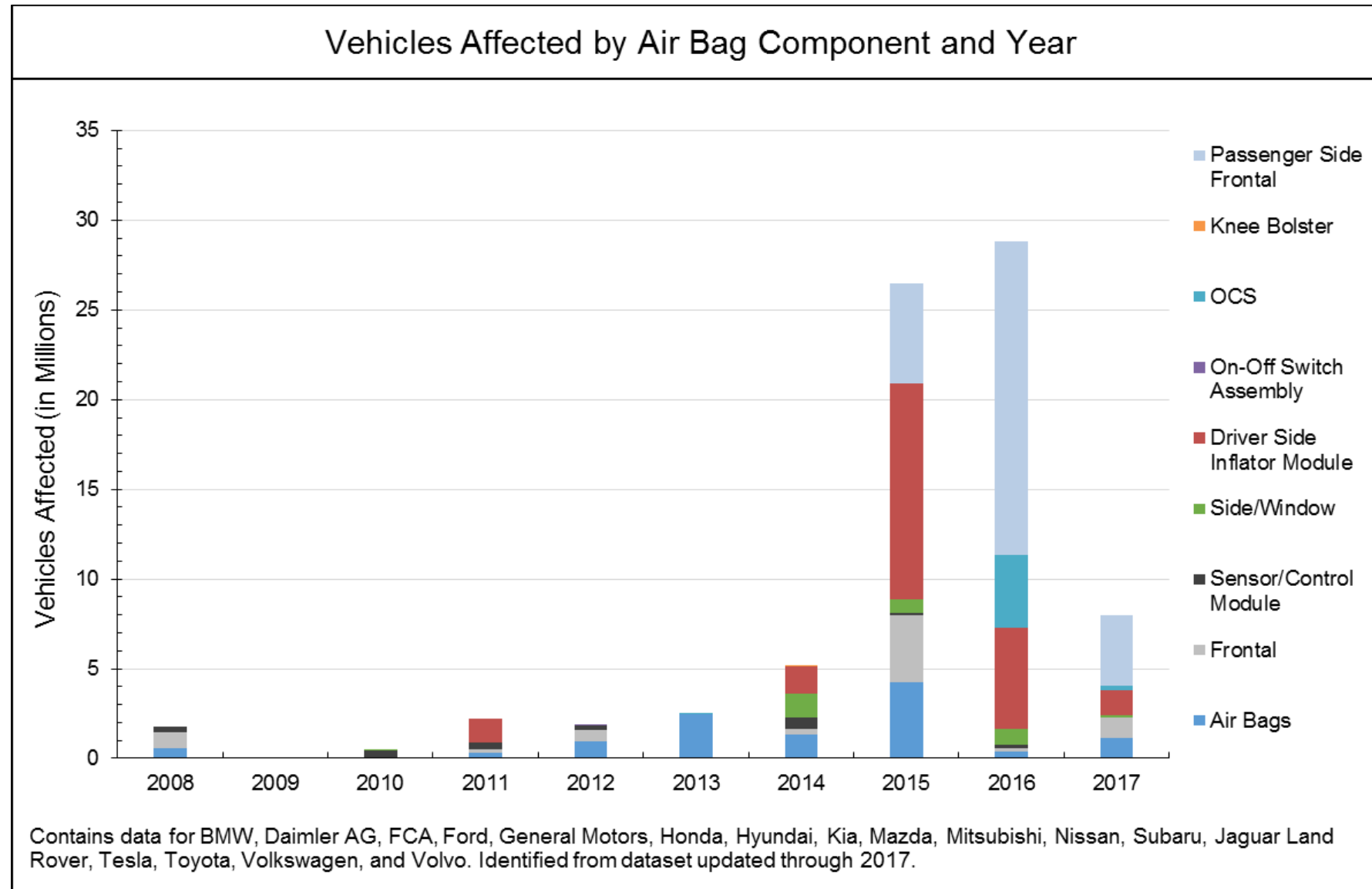


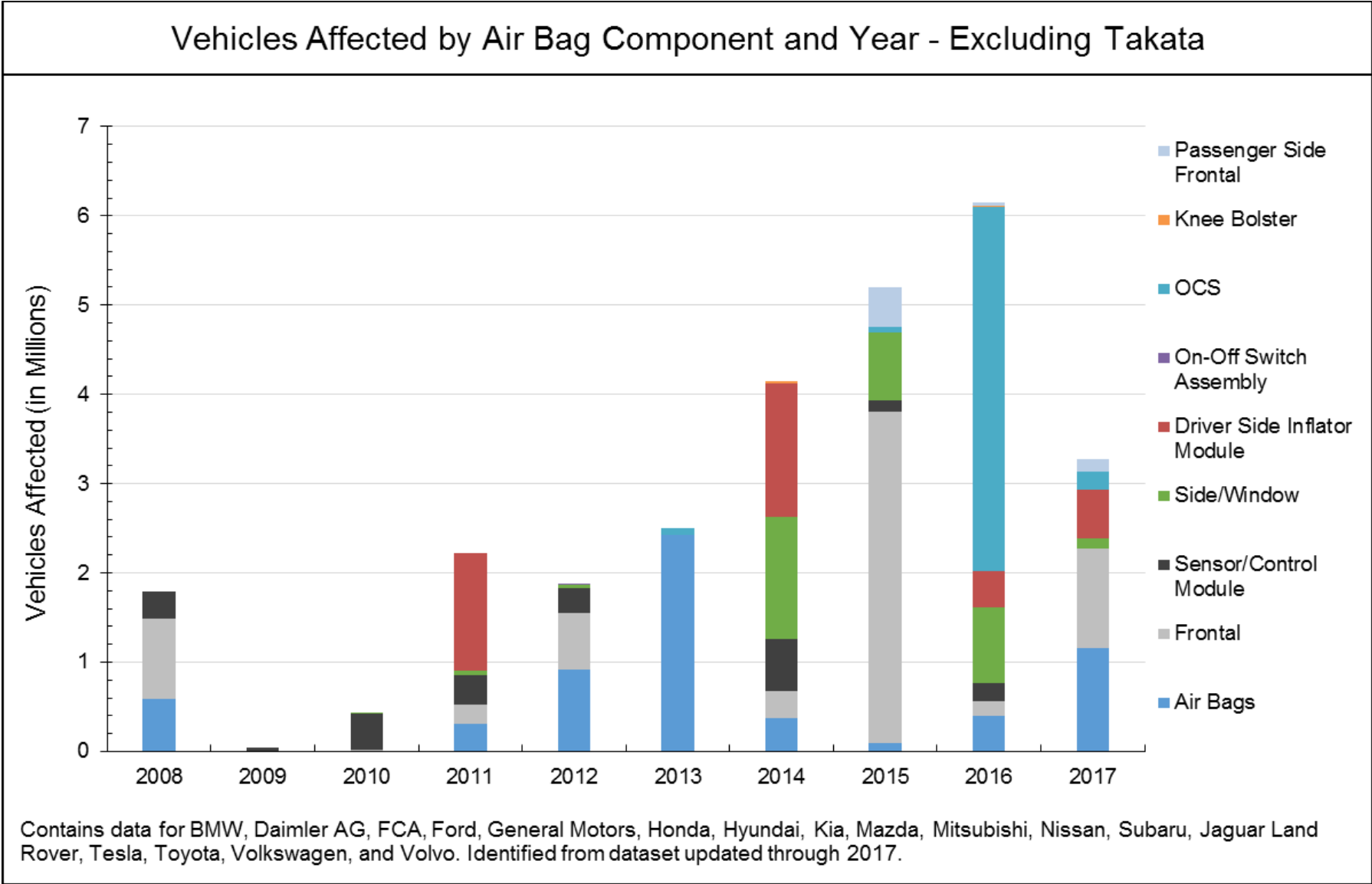


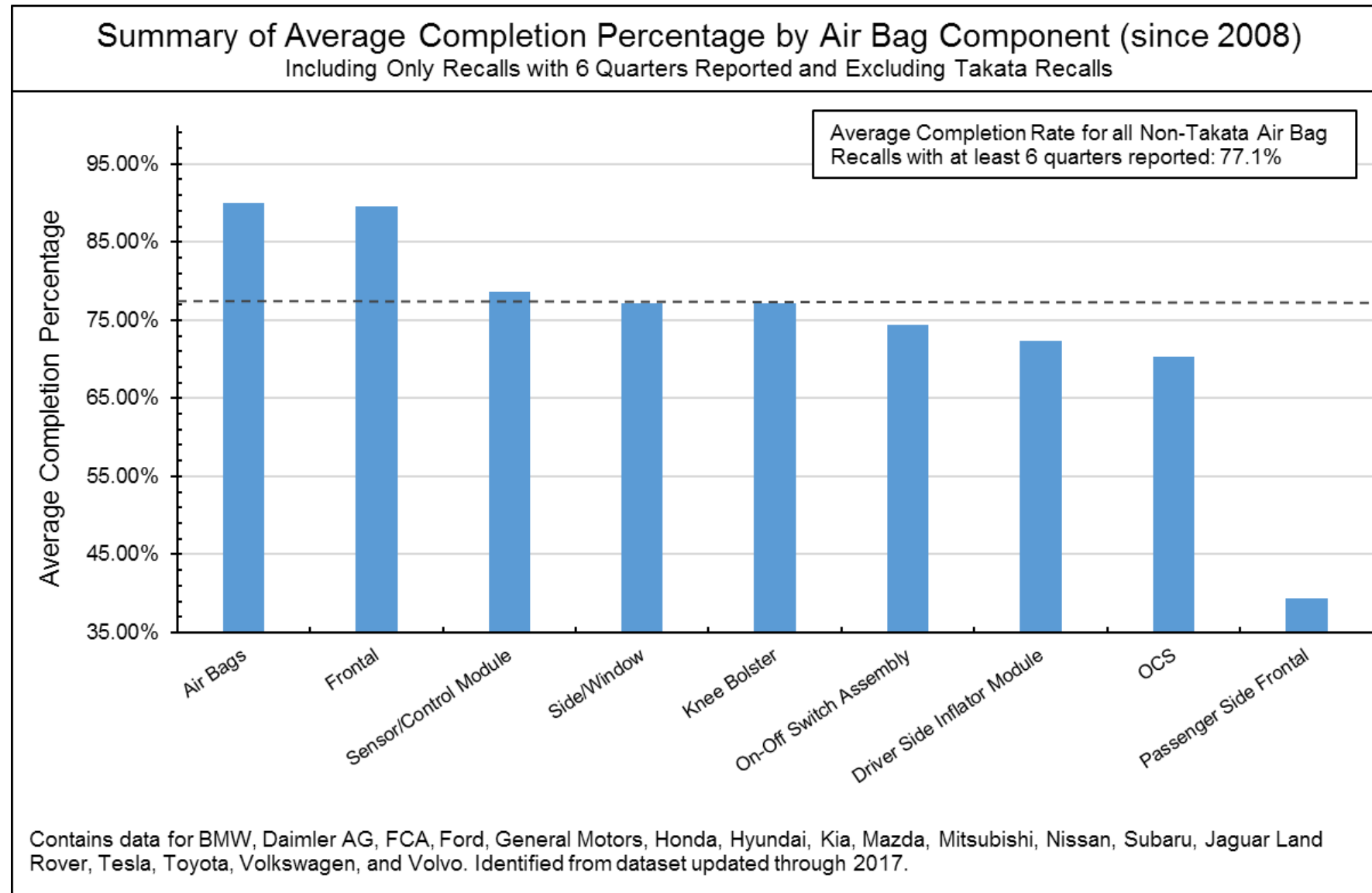


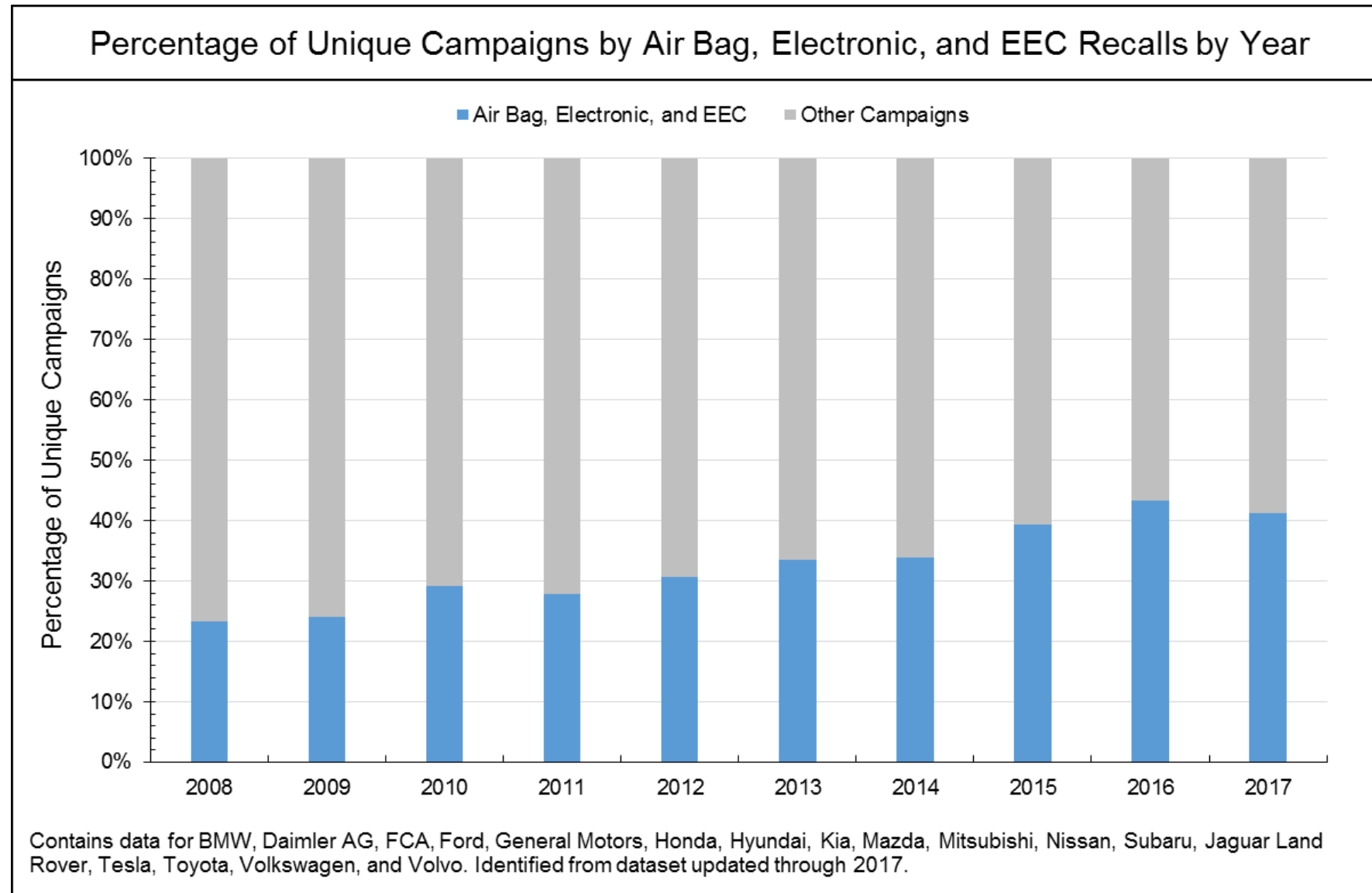


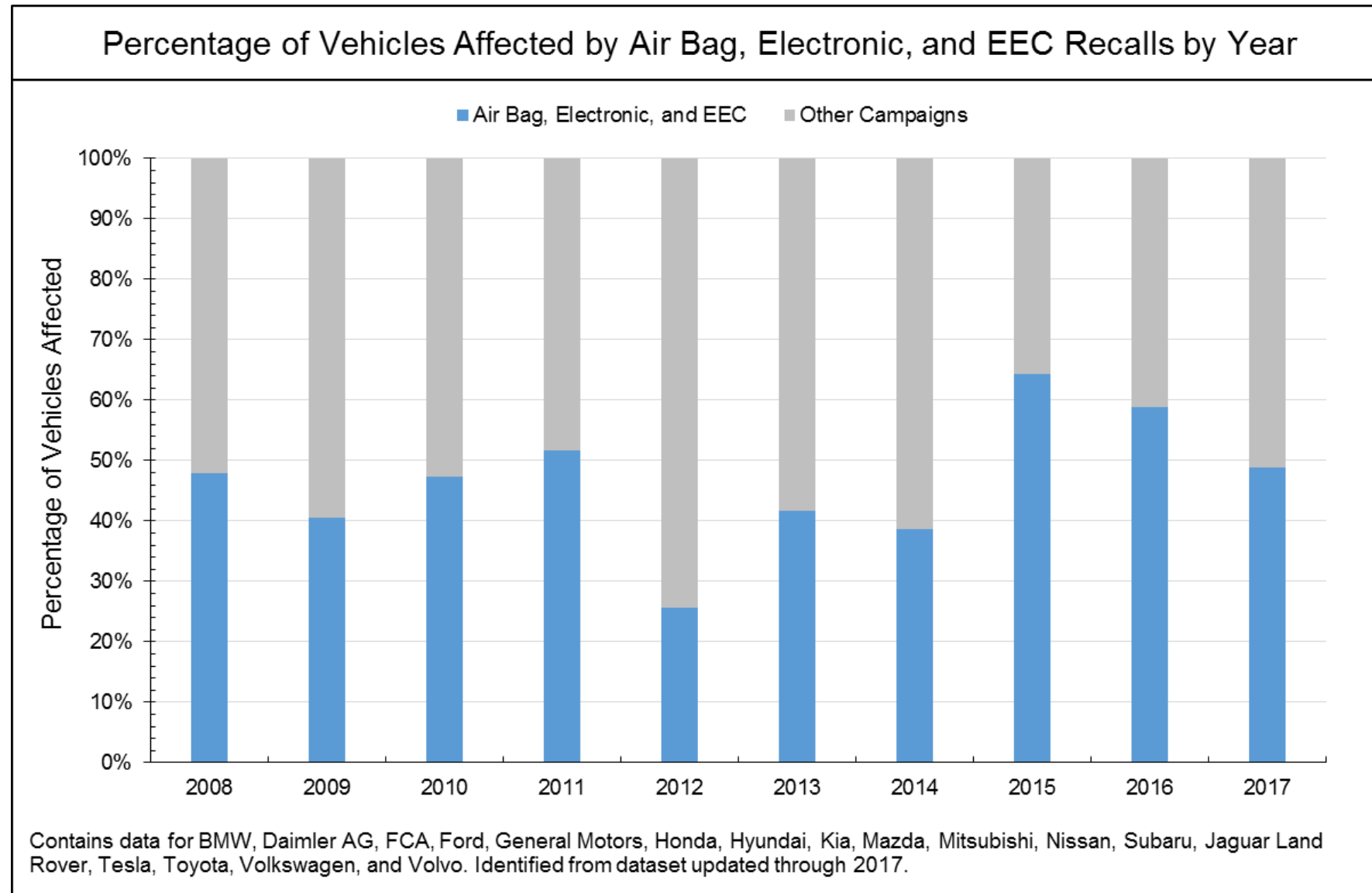












Air Bag Components: Observations and Conclusions

- Takata inflator ruptures have represented the majority of air bag recalls since 2014
 - Excluding the Takata recalls, a elevated level of recall activity is observed beginning in 2014
- Cushions continue to represent a significant proportion of unique campaigns and number of vehicles affected, however we have observed notable activity occupant classification systems in the past three years
- Overall air bag completion percentages lag the industry average



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