7th Annual State of Automotive Recalls Summit

April 29, 2020
Welcome

Scott Tappan
SAA President
Upcoming Events

- May 6 webinar: Covid19's Impact on China and the Detroit Three: An Insider's View
- June 25: 11th Annual OEM Purchasing Executives Summit (held with Plante Moran and the OESA)
- Watch for more details (www.SAAauto.com)
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STOUT
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David Nemtuda
Senior Director, Business Development

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LexisNexis Recall Clarity Market Update

RECALL CLARITY SUCCESSFULLY LAUNCHED TO MARKET IN JULY 2019
Proprietary linking technology corrects disparities for hard-to-find secondary market vehicle owners

AUTOMAKER ENGAGEMENTS
• Four automakers in production
• Ten additional automakers engaged

PRODUCT PERFORMANCE
• On average we have been able to identify 95%+ of hard to find vehicles in our product set and are able to update owner information on over 50% of those vehicles
7th Annual State of Automotive Recalls Summit
Questions and Answers

- The speakers welcome and encourage questions from the audience.
- The Zoom webinar has a **Q&A** feature that will allow webinar participants to ask questions of the speakers.
  - Because all non-speaker registrants will be muted throughout the presentation, this will be the sole option to ask a question.
  - To ask a question of Stout or our co-presenters, click on the Q&A box on the top of your screen.
  - Type your question into the Q&A Box and click **Send**.
- The source of all questions will be anonymous to the speakers and the non-speaker audience will not be able to view questions asked by other participants.
Key Considerations in Analysis of Automotive Recalls
Recent Trends in Automotive Recalls
Regulatory Considerations
2019 Recall Remedy Times
Electronic Component Defects
Emissions Recalls
Automotive Recall in 2020
Key Considerations in Analysis of Automotive Recall
What is one facet of automotive component defects you would like to know more about?
Recent Trends in Automotive Recalls
2019 Recall Summary

• Number of light vehicles recalled in the U.S. increased in 2019 to over 28 million from approximately 22 million in 2017 and 2018 (excluding Takata recalls)
  • Individual campaigns increased to a record of 317 (excluding Takata)

• Seven non-Takata campaigns in 2019 affected more than 1 million vehicles (37% of non-Takata recalls):
  • GM brakes: The amount of vacuum created by the vacuum pump may decrease over time (3.5 million vehicles)
  • Subaru brake lights: Brake light switch malfunctioning due to exposure to certain contaminants (1.3 million vehicles)
  • Ford automatic transmission: The transmission may unexpectedly downshift into first gear, regardless of vehicle speed. (1.3 million vehicles)
  • Nissan backup camera: The back-up camera and display settings can be adjusted such that the rear view image is no longer visible and the system will retain that setting the next time the vehicle is placed in reverse. (1.2 million vehicles)
  • Ford suspension: The rear suspension toe links may fracture due to stress on the rear suspension. (1.2 million vehicles)
  • FCA tailgate latch: The tailgate actuator limiter tab may fracture and cause the tailgate to unlatch and open while driving. (1.1 million vehicles)
  • Honda airbags: Due to a manufacturing error, in the event of a crash necessitating deployment of the driver frontal air bag, these inflators may explode.
2019 Year in Review

2019 Recall Sizes

• Largest recall of 2019:
  • Issued by GM related to 2015-2017 Cadillac Escalade, 2014-2018 Chevrolet Silverado, GMC Sierra, 2015-2018 Chevrolet Suburban, Tahoe, GMC Yukon vehicles. The amount of vacuum created by the vacuum pump may decrease over time.
  • 3,456,719 vehicles affected

• Smallest recalls of 2019
  • Two single vehicle recalls by Mercedes-Benz and one by Porsche
Recent Trends in Automotive Recalls

2019 Peak in Number of Recalls and Near Record Levels of Vehicles Affected

* Excludes Takata recalls and GM Ignition Switch recalls.
Recent Trends in Automotive Recalls

Increase in Recall Size in 2019

* Excludes Takata recalls and GM Ignition Switch recalls.
Recent Trends In Automotive Recalls

The Number of Distinct Model and Model Years Under Recall has been Increasing

Number of Distinct Model and Model Years Recalled by Recall Year

* Excludes Takata recalls and GM Ignition Switch recalls.
Recent Trends In Automotive Recalls

The Highest Number of Recalls per Distinct Model and Model Year has been Increasing

* Excludes Takata recalls and GM Ignition Switch recalls.
Recent Trends in Automotive Recalls

Increases in Vehicles Affected can be Isolated to a Few Component Groups

* Excludes Takata recalls and GM Ignition Switch recalls. ** Due to size limitations, not all components are included in chart legend
§ 573 Notifications Review

- 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
Recent Trends in Automotive Recalls

Review of § 573 Notifications indicates continued trend of more frequent supplier identification.

Percentage of Unique Campaigns by Supplier Identification and Year


Supplier Identified: Yes, No
Suppliers are More Likely to be Identified for Certain Components

* Includes components for 10 or more unique campaigns in 2019.
Recent Trends in Automotive Recalls

Proportion of Suppliers Identified in recalls involving Design Related Defects has been Modestly Increasing since 2009

Percentage of Unique Campaigns by Supplier Identification and Year

[Diagram showing the percentage of unique campaigns by supplier identification for each year from 2000 to 2019. The chart indicates a modest increase in the proportion of suppliers identified over the years.]
Recent Trends in Automotive Recalls

Suppliers Named in Manufacturing Related Defects in the Past Two Years is the Highest its been since 2008
Recent Trends in Automotive Recalls

Recall Completion Percentages on the Rise

Overall Median and Average Completion Percentage by Year

* Excludes Takata recalls and GM Ignition Switch recalls. Includes completion percentages after six quarters from launch accounting for vehicles identified as unreachable.
Recent Trends in Automotive Recalls

*Most Completion Percentage Gains Happen in First Three Quarters from Launch*

Summary of Average Completion Percentage by Quarter and Vehicle Age

*Excludes Takata recalls and GM Ignition Switch recalls. Quarters are measured from launch of each recall campaign for years 2000-2018. Age of vehicles represents the oldest model year in each recall. Completion percentages account for vehicles identified as unreachable.*
Recent Trends in Automotive Recalls

Recall Completion Percentages in 2019 Look to Continue Upward Trajectory

Vehicles Three Years Old or Younger

Third and Sixth Quarter Median Completion Percentage

Vehicles Three to Five Years Old

Third and Sixth Quarter Median Completion Percentage

Vehicles Five to Eight Years Old

Third and Sixth Quarter Median Completion Percentage

Vehicles Eight Years Old and Older

Third and Sixth Quarter Median Completion Percentage

* Excludes Takata recalls and GM Ignition Switch recalls. Includes completion percentages after three quarters from launch accounting for vehicles identified as unreachable.
Recent Trends in Automotive Recalls

Recall Completion Percentages in 2019 Look to Continue Upward Trajectory

* Excludes Takata recalls and GM Ignition Switch recalls. Includes completion percentages after three quarters from launch accounting for vehicles identified as unreachable.
Recent Trends in Automotive Recalls

Age of Recalled Vehicles One of Most Critical Factors in Completion Percentage

Quarter Six Median Completion Percentage by Vehicle Age Group

* Excludes Takata recalls and GM Ignition Switch recalls. Includes completion percentages after six quarters from launch accounting for vehicles identified as unreachable.
Recent Trends in Automotive Recalls

The Risk on Non-Operability Influences Recall Completion Percentages

* Excludes Takata recalls and GM Ignition Switch recalls. Includes completion percentages after six quarters from launch accounting for vehicles identified as unreachable for years 2000-2018.
Recent Trends in Automotive Recalls

The Number of Vehicles in a Recall Influences Completion Percentages

* Excludes Takata recalls and GM Ignition Switch recalls. Includes completion percentages after six quarters from launch accounting for vehicles identified as unreachable for years 2000-2018.
Recent Trends in Automotive Recalls

Focus on Increasing Recall Completion Percentages

- The Takata recalls have provided new insights into effective recall administration
  - New research, findings and insights regarding vehicle owner barriers to completion
  - New insights on the integrity of vehicle owner contact information
  - New forms of outreach to vehicle owners
  - Has created new programs with franchised dealers
  - Identified new opportunities for engagement with non-traditional parties
  - NHTSA Takata recalls coverage - https://www.nhtsa.gov/equipment/takata-recall-spotlight
Polling Question 2

What do you think is the primary reason completion percentages are increasing?
Regulatory Considerations
Regulatory Considerations

Updates to Federal Motor Vehicle Safety Standards (FMVSS)

- In the Fall of 2019, the U.S. Department of Transportation explained, “NHTSA plans to issue regulatory actions that:
  - Allow for permanent updates to current FMVSS reflecting new technology; and
  - Allow for updates to NHTSA’s regulations outlining the administrative processes for petitioning the Agency for exemptions, rulemakings and reconsiderations.”

- In 2019, NHTSA issued three advanced notices of proposed rulemaking (“ANPRM”)
  - The near and long-term challenges of testing and verifying compliance with existing crash avoidance safety standards (FMVSS 100 series) for vehicles that lack traditional controls
  - Permitting camera based rear visibility systems as an alternative to inside and outside rearview mirrors (as required by FMVSS 111)
  - Updating tire performance requirements related to the strength test, bead unsealing resistance test and endurance test, as well as issues related to new tire technologies
Regulatory Considerations

Investigations

- At the close of 2019, NHTSA’s Office of Defects Investigation (“ODI”) had 40 open defect investigations
  - 18 Engineering Analyses and 22 Preliminary Evaluations
    - 13 Engineering Analyses had been open for over 1 year, the longest has been open for 13 years
    - Eight Preliminary Evaluations were open, the oldest had been open for a little over three years
- Airbags were the most heavily investigated components that remain open with 4 Engineering Analyses and 4 Preliminary Evaluations each
  - Three of the four Preliminary Evaluations were related to occupant classifications system
  - 12 Preliminary Evaluations and 1 Engineering Analysis were closed in 2019 – 10 of which resulted in recalls
    - One closed investigation was opened in 2017, nine in 2018 and three in 2019
In 2019, NHTSA entered into three settlement actions (one with a manufacturer of light duty vehicles, one manufacturer of heavy duty vehicles and one with a dealership).

- Of significance was a $20 million dollar settlement with a light vehicle manufacturer.
- The fine was the result of failing to notify vehicle owners of recalls and make other recall filings within mandated timelines.
In 2019, NHTSA **Denied 1** Motor Vehicle Defect Petition

- The petition explained that the rollover side curtain airbag system, side window glass, rear seat belt and roof structure are defectively designed in the 2010 Chevrolet Tahoe.
  - This can allow vehicle passengers located in the second and third row of the vehicle to be ejected in the event of a rollover crash.\(^6\)

- No additional filings were reported for Motor Vehicle Defect Petitions by NHTSA.
Regulatory Considerations

2019 Petitions for Inconsequential Noncompliance

- In 2019, **15 New** Petitions for Inconsequential Noncompliance were reported on the Federal Register, **7** were granted and **1** was **Denied** by NHTSA.

  - Denial OEMs: Jaguar Land Rover and BMW

  - NHTSA found that the magnitude of non-compliance was not small as the defect resulted in acceleration 3.6 times the standard.
Polling Question 3

What do you think poses the greatest risk of component defect resulting in safety recalls in the next two years?
Recall Remedy Times
2016-2019 Recall Remedy Times

Recall Labor Times by Affected Vehicles

* Excludes campaigns remedied with a software remedy.
* Includes labor times as reported in dealer repair bulletins.
2016-2019 Recall Remedy Times

Recall Repair Labor Times - Probability Distribution

Mean = 1.9 Hours

+1 Standard Deviation = 4.5 Hours

* Excludes campaigns remedied with a software remedy.
* Includes labor times as reported in dealer repair bulletins.
Recall Remedy Times

2016-2019 Recall Remedy Times

* Excludes campaigns remedied with a software remedy.
* Includes labor times as reported in dealer repair bulletins.

Mean = 1.6 Hours
+1 Standard Deviation = 2.8 Hours
-1 Standard Deviation = 0.4 Hours
**2016-2019 Recall Remedy Times**

* Excludes campaigns remedied with a software remedy.
* Excludes Takata Recall campaigns.
* Excludes sub-components reported as “airbags”
* Includes labor times as reported in dealer repair bulletins.
Recall Remedy Times

2016-2019 Recall Remedy Times

Power Train Recall Repair Labor Times - Probability Distribution

- Mean = 2.1 Hours
- +1 Standard Deviation = 4.3 Hours

* Excludes campaigns remedied with a software remedy.
* Includes labor times as reported in dealer repair bulletins.
Recall Remedy Times

2016-2019 Recall Remedy Times

* Excludes campaigns remedied with a software remedy.
* Includes labor times as reported in dealer repair bulletins.
* Includes labor times within +/- 1 standard deviation (z-score) from the average labor time per component.
Does design and engineering collaboration create increased risks for suppliers when it comes to potential future defects or recalls?
Electronic Component Defects
Electronic Components: Regulatory and Industry Updates

- NHTSA issued a proposed rulemaking in March 2020, intended to modernize various safety standards and facilitate development of automated vehicle technologies. The proposed rule addresses the following modifications:
  - Modification of key definitions to clarify application of safety standards to ADS equipped vehicles
  - Clarifies standards for vehicles designed to carry objects and not people
  - Protections required when there is no steering wheel
  - Address situations when there may be no driver’s seat and multiple outboard passenger seats
  - Treatment of airbag systems for seat that may contain child occupants
- Public comments on the NPRM are due by May 29, 2020
- Insurance Institute for Highway Safety issued a set of guidelines related to monitoring of driver attention when using driver assistance systems and regain driver attention.
Electronic Components: Regulatory and Industry Updates

- Request for Comments: Advanced Driver Assistance Systems Draft Research Test Procedures:
  - On November 21, 2019, NHTSA published a request for comment on draft research test procedures that assess nine different ADAS technologies: Active Parking Assist (APA); Blind Spot Detection (BSD); Blind Spot Intervention (BSI); Intersection Safety Assist (ISA); Opposing Traffic Safety Assist (OTSA); Pedestrian Automatic Emergency Braking (PAEB); Rear Automatic Braking; Traffic Jam Assist (TJA); Forward Collision Warning (FCW) and Automatic Emergency Braking (AEB).
  - NHTSA has extended the comment period on the RFC to run until March 6, 2020.¹⁰
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 Recalls and Software Recalls

Recall Campaigns by Electronic Components and Year

Percentage of Recall Campaigns by Electronic Components and Year
Electronic Recalls and Software Recalls

Vehicles Affected by Electronic Components and Year

Percentage of Vehicles Affected by Electronic Components and Year

Stout Integration Classification
- IEC
- Software Defect
- Software Integration
- Software Remedy
Electronic Recalls and Software Recalls

Unique Campaigns By Year

Percentage of Unique Campaigns By Year

Stout Integration Classification
- IEC
- Software Defect
- Software Integration
- Software Remedy
- Other Recalled Vehicles
Electronic Recalls and Software Recalls

Vehicles Affected By Year

Percentage of Vehicles Affected By Year
Electronic Components: Observations

• Recalls of electronic components increased in 2019, consistent with overall industry trends
  • The proportion of software based defects continued to increase for the fourth consecutive year
• Record-setting number of vehicles affected by electronic defects in 2019:
  • Emerging driver assistance technology trends
• Significant increase in number of campaigns and vehicles affected by recalls involving software remedies
• For the second consecutive year the largest recall involved a software based defect:
  • GM braking system (3.5 million vehicles): The engine mounted vacuum pump output may decrease over time, decreasing the amount of power brake assist
  • GM reprogrammed the Electronic Brake Control Module with a new calibration improving how the system utilizes the hydraulic brake boost assist function when the vacuum assist is depleted, improving how the system utilizes the hydraulic brake boost assist.
Electronic Recalls and Software Recalls

Unique Campaigns by Component and Year

Percentage of Unique Campaigns by Component and Year
Electronic Recalls and Software Recalls

Vehicles Affected by Component and Year

Percentage of Vehicles Affected by Component and Year
Driver Assistance Technologies:

- Material defect trends related to or involving components in advanced driver assistance technologies **beginning to emerge**, including recalls related to back-up cameras and forward collision avoidance.
- Significant increase in number of vehicles affected by recalls involving driver assistance technologies – approximately 1.6M vehicles in 2019
  - Primarily related to one recall of 1.2M vehicles involving back-up camera display settings that may reduce rear-visibility.
  - First major recall of back-up cameras since included on vehicles manufactured after May 1, 2018.
- Three recalls of forward collision avoidance systems in 2019:
  - Includes largest single recall of forward collision avoidance components to date.
  - Nearly 50,000 vehicles affected in 2019, represented one-third of all forward collision avoidance recalls.
  - All three 2019 recalls involve **software based defects** instead of component failures.
Exterior Lighting:

• Lighting systems are critical to vehicle safety and OEMs continue to deploy advanced technologies and capabilities

• Stout observed the greatest number of exterior lighting recalls involving electronic component defects in 2019
  • Nine recalls, involving more than 1.4 million total vehicles
  • Six of these recalls affecting more than 120k vehicles total involved software based defects

• One recall of 1.3 million vehicles due to failure of a brake lamp switch after exposure to oxidized silicone believed to originate from consumer products in the field
  • Involved model year 2008 – 2016 vehicles
  • OEM had previously implemented an alternative switch with higher resistance to silicone
  • After receiving additional reports, OEM conducted voluntary recall in Japan
  • Concluded that substantially similar vehicles sold in the U.S. and conducted recall in this market
Electronic Recalls: Component Trends

Electrification:

• Moderate battery related recall activity in 2019, however majority related to traditional battery systems:
  • Nine campaigns affecting nearly 1 million vehicles
  • Most appear related to issues arising during vehicle assembly
• Two recalls occurred involving batteries related to hybrid or battery propulsion
  • Small recalls affecting 1,646 and 464 vehicles
  • One recall involved moisture intrusion in sensitive components, the other was the failure of the DC-DC converter
• Two other recalls occurred involving non-internal combustion engine propulsion where batteries were not the subject of the recall:
  • Inadequate protection against high voltage – 2,108 vehicles affected
  • Circuit board problem on module may result in loss of propulsion – 159 vehicles affected
Electronic Recalls and Software Recalls

Electronic Components: Notable Software Remedy Trends

- Recalls involving software remedies near record-setting levels in 2019. More vehicles were involved in recalls with software remedies in 2019 than any year.

- Notable software remedies in 2019:
  - GM braking system (3.5 million vehicles) – updated calibration of hydraulic brake assist to compensate for decreased vacuum pump output
  - Ford transmission (1.3 million vehicles) – powertrain control module reprogrammed to prevent an unintended downshift resulting from a failure of the Transmission Output Speed Sensor
  - Honda fuel pump (437k vehicles) – software programming eliminates certain functioning of fuel pump to eliminate accumulation of sodium deposits in fuel pump components

- Second safety recall utilizing over-the-air update as a remedy:
  - Mercedes-Benz updated communications module software to ensure determination of correct vehicle position and ensure functionality of emergency call service
  - Owner notification began December 23, 2019 – 58% completion as of April 17, 2020
Sibros is a Silicon Valley based company enabling the connected vehicle ecosystem across cars, bikes, off-road equipment and commercial vehicles. *Sibros has deep roots in building the world’s largest and most heavily used automotive software update and data collection platform.*

**Hemant Sikaria | CEO, Co-Founder**

- 6 years at Tesla, helped bring three models to production
- Tech Lead for OTA Updates, Body and Chassis Firmware
- Holds patents for Tesla’s Falcon Wing Doors

**Enabling Next Generation Applications**
- Enabling Parking Payments
- Usage-Based-Insurance
- EV Charging Stations
- Third-Party Apps

**Sibros Applications**
- Deep OTA updates
- Deep Data Logging
- Data Analytics
- Remote Diagnostics
The Automotive Industry is shifting from a vehicle-first to a **software-first mentality**. The necessity for recording advanced in-vehicle metrics and doing deep software updates is clear.

**100-250 Million Lines of Code**

The complexity of software is increasing exponentially because of electric cars, autonomous driving and connectivity features.

**200 Million OTA-Enabled Cars by 2022**

Vehicles are becoming more intelligent and it is predicted that hundreds of millions of cars will get over-the-air updates in the near future.
"As the car continues its transition from a hardware-driven machine to a software-driven electronics device, the auto industry’s competitive rules are being rewritten."

“Rethink car software and electronics architecture”
McKinsey, February 2018

~90M vehicles sold worldwide in 2018
~30M vehicles recalled worldwide in 2018
~15M software recalls in 2018 (up from ~2.5M in 2017)
~75M connected cars will be sold in 2023
Software Can **Prevent** Hardware Recalls

* Not all, but quite a few
Software Updates: But Seriously, What's The Big Deal?

10+ years

Number of updateable components: 1

Safety Critical? **Unlikely**

10+ years

Number of updateable components: 1

Safety Critical? **Unlikely**
Software Updates: What’s the Challenge for Automotive?

Number of updateable components: ~100

Safety critical? YES!

Number of possible hardware & software combinations: **Millions or Billions**
Deep Software Updates and Data Logging form the **building blocks** for any advanced connected car solution today and enables applications to be built on top of it.
What differentiates writers is *not* whether they used Microsoft Office or Google Docs, but rather what they wrote.

This is analogous to what is happening in the auto industry where automakers are creating a software update and data collection platform (i.e. *undifferentiated heavy lifting*) as opposed to building unique services on top of the platform.
Parting Thoughts: What’s Needed

- Systematic & standardized software update protocol for all ECUs
- Established safety protocols, and security handshakes
- End-to-end development and validation process with state of the art Continuous Integration and Continuous Deployment (CI/CD)
- Better software package and version management - menu-and-order concept
- Functional Safety Standards applied across entire development lifecycle & software itself
- An end-to-end solution encompassing low level vehicle hardware, central gateways and telematics, cloud and infrastructure
Emissions Recalls
U.S. Environmental Protection Agency Compliance Activities

- The EPA derives its authority to regulate vehicles, fuels, and engines from statues enacted by Congress:
  - Clean Air Act
  - Energy Policy and Conservation Act
  - Energy Policy Act
  - Energy Independence and Security Act
- Through these acts, the EPA is responsible for emissions compliance oversight from initial product design to performance in the field.
- The Clear Air Act requires each vehicle and engine to have a Certificate of Conformity in order to produce and sell products.
- U.S. air quality has improved due to enhanced regulations and advances in technologies.
- According to the EPA’s report *Our Nation’s Air: Status and Trends Through 2017*, concentrations of many air pollutants have dropped since 1990, while the number of vehicle miles, GDP, population, and energy use continued to grow.
Vehicle Emissions Defects

Figure ES-1: Comparison of Growth Areas and Declining Emissions, 1970 - 2017
Defect and Recall Reporting

- The EPA’s Office of Transportation Air Quality (OTAQ) considers defect and recall reporting to be critical components of compliance for the light-duty vehicle sector:
  - Light-duty emissions standards are the most stringent
  - Light-duty vehicles have sophisticated and complex emissions control systems, increasing opportunities for defects to occur
  - Dealership infrastructure conveys information to consumers and repairs vehicles
  - Manufacturers are required to report emissions related defects to the EPA
- Emissions related defects in emissions-related components can result in a recall but **may not if defects do not increase emissions.**
- Under the Clean Air Act, the EPA can also require manufacturers to recall and repair affected vehicles if it determines a substantial number in a category or class do not meet emissions standards while in use.
Stout’s Analysis

• Consistent with our study of vehicle safety defects, we have focused our analysis on emissions defects and recalls related to light vehicles.

• Stout submitted FOIA requests to the EPA for all defect and recall reporting related to light vehicles to collect and analyze data through December 31, 2019.

• Information provided by EPA contains record level data related to:
  • Defect reports
  • Emissions recalls
  • Recall completion percentages

• Data from 2014 – 2017 was reconciled to most recent EPA report on compliance activities.

• Data also analyzed for 2018 and 2019 which has not yet been incorporated into materials published by the EPA.
Vehicle Emissions Defects

Defect Reports

- Manufacturers are required to notify the EPA of emissions-related defects in 25 or more vehicles in the same class and category.
- Emissions related defect is a defect in design, materials or workmanship in a device, system or assembly as described in the approved application for certification.
- Emissions related defect can result in a recall but may not if defect in emissions related component does not increase emissions.
- The majority of defect are reported by light-vehicle manufacturers.

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Emissions Recalls - Overview

- Many emissions recalls of light-vehicles since the late 1990s have been voluntary\(^\text{12}\)
  - Includes those influenced but not required by the EPA
- EPA recall regulations contained in 40 CFR Part 85 Subpart S
- In both mandatory and voluntary recalls, vehicle manufacturers are required to submit a recall plan for remedying the nonconformity and submitting quarterly remedy progress reports
- Manufacturers are required to notify vehicle owners and provide instructions about obtaining a remedy
- Stout has analyzed the recall data provided by the EPA in response to our FOIA request:
  - Annual number of recalls and vehicles affected
  - Components affected
  - Average recall size
  - Nature of emissions defects
Vehicle Emissions Defects

- Component classifications incomplete for recall years 2018 - 2019
Vehicle Emissions Defects

Component classifications incomplete for recall years 2018 - 2019
Vehicle Emissions Defects

Unique Campaigns by Size of Recall

Size of Recall
Vehicle Emissions Defects

Percentage of Vehicles Affected by Year and Size of Recall

Size of Recall:
- 0-10,000 Vehicles
- 10,000-50,000 Vehicles
- 50,000-100,000 Vehicles
- 100,000-500,000 Vehicles
- 500,000-1,000,000 Vehicles
- >1M Vehicles


Percentage of Vehicles Affected:
- 0%
- 20%
- 40%
- 60%
- 80%
- 100%
**Vehicle Emissions Defects**

**Emissions Recalls – Observations**

- Emissions recall activity not as significant as safety recalls but still material number of campaigns and vehicles affected.
  - 44 – 95 campaigns, 4M – 9M vehicles affected per year from 2014 - 2019
  - Average emissions recall involves 81k vehicles

- Largest recall - 1.9 million vehicles: Toyota recall for excessive engine oil consumption

- Smallest recall – 3 vehicles: Acura recall for vehicles built with incorrect transmission software calibrations

- Only two recalls greater than 1 million vehicles from 2014 – 2019, but 16 recalls affecting more than 500,000 vehicles

- More than 80% of emissions recalls involve 100k or fewer vehicles between 2014 – 2019, however year-to-year variability exists

- Average age of vehicles at the time of emissions recall from 2014 – 2019 approximately 4 years
Emissions Recalls – Observations

• Components most frequently involved in recalls 2014 – 2019:
  • Computer related (non-OBD): 12.3%
  • Fuel delivery: 11.9%
  • Electrical, mechanical, and cooling: 10.9%
  • On-board diagnostic: 10.5%

• Components with the greatest number of vehicles affected:
  • Electrical, mechanical, and cooling: 26.7%
  • Computer related (non-OBD): 15.3%
  • Fuel delivery: 9.29%
  • Computer related total (OBD and non-OBD): 22.1%

• Where component classification data is available
Recall Completion Percentage - Overview

- Manufacturers involved in either voluntary or mandatory recalls are required to submit quarterly reports for six consecutive quarters, including number of vehicles:
  - Involved in the action
  - Inspected and repaired
  - Not available for repair

- In response to Stout’s FOIA request, the EPA has provided quarterly completion data containing data elements from required quarterly reports

- Stout has analyzed quarterly data to understand average and median sixth quarter completion percentages, quarterly completion progress, and completion percentages by age of vehicles involved in emissions recalls
Vehicle Emissions Defects

Completion Percentage by Year

- Average of Completion Percentage
- Median of Completion Percentage
Recall Completion Percentage - Observations

- Stout matched emissions recalls with quarterly reporting information containing six quarters of completion data from 2014 – 2018

- Average sixth quarter completion percentage for recalls studied between 2014 and 2018 is approximately 77%
  - Increasing trend in median completion percentage 2015 - 2017

- Average sixth quarter completion percentage varies by vehicle age:
  - Less than 3 years: 85%
  - 3 – 5 years: 55%
  - Greater than 5 years: 53%

- Emissions recalls exhibit an overall pace of completion similar to safety recalls
  - Emissions recalls perform 5% better on average in first quarter than safety recalls, but safety recalls surpass emissions recalls by second quarter
  - Vehicle age is an important consideration in analysis of pace of completion
Automotive Recall in 2020
Defect Emergence, Part Availability and Repair Trends Likely to be Impacted by Shutdowns and Reduced Automotive Use by Vehicle Owners

- With vehicle owners using their vehicles less – it may take longer for some defects to become observable.
- Remedy part availability could be affected for recent recalls if suppliers are shutdown and/or experience a significant labor disruption.
  - Force Majeure and financial distress clauses could be triggered.
- Repair trends will be altered by vehicle owners practicing physical distancing and dealer capacity will likely be strained as guidance changes.
- Responses from the industry such as mobile repair and new vehicle delivery are emerging to alleviate concerns of visiting a dealership.
- The concept of vehicle “safety” may be reframed in light of other health and safety risks.
COVID-19 + THE LOOMING QUALITY CRISIS

Social distancing will destabilize assembly lines, and the impact will likely be felt in quality.

Read more: Drishti.com/Quality
About Drishti and About Dave

Manufacturing’s challenge:
How do you improve human performance at scale?

Drishti’s solution:
Digitizing assembly activities to create vast new datasets on human performance

Our core technology
Computer vision that converts manual actions into data, with AI at its core

Dave Prager
Head of Marketing and Business Development

Drishti employee #3
SAP, WPP, Intermedia
Syracuse University
Avid trail runner

Warning: will make 90s pop culture references
How do you use Drishti?

1. Stream video from every station into the cloud for access by engineers, managers, trainers, and many others.

2. Use our apps for post-facto unit inspection, root cause investigation, process improvement, training content creation, operator correction and more.

**ROI:**
- Faster line stabilization & improvement
- Significant quality risk & cost reduction
- More effective training
- + Support social distancing efforts

CUSTOMER EXAMPLE:
Escape defect resolution in 22 minutes

Read more: [Drishti.com/Quality](https://www.drishti.com/quality)
Social distancing is the right move to protect operator health on the assembly line.

But it will disrupt operations in ways that are utterly without precedent.
Problem #1: social distancing will destabilize the lines.
## Destabilizing factors

<table>
<thead>
<tr>
<th>Factor</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced operator density</td>
<td>Changes standardized work and reduces throughput</td>
</tr>
<tr>
<td>Change line layout</td>
<td>Introduces motion waste + buffers</td>
</tr>
<tr>
<td>Sanitation steps added to work instructions</td>
<td>Changes standardized work and reduces throughput</td>
</tr>
<tr>
<td>Stringent disinfection before &amp; after shifts</td>
<td>Reduces available work time, increases pressure on output</td>
</tr>
<tr>
<td>Staggered shifts and breaks</td>
<td>Unintended scheduled effects may impact availability of materials, tools, machines</td>
</tr>
<tr>
<td>Strict quarantine in case of exposure</td>
<td>Unpredictable workforce availability, new training requirements for other operators</td>
</tr>
<tr>
<td>New PPE requirements</td>
<td>Reduces operator dexterity</td>
</tr>
</tbody>
</table>
Problem #2: Social distancing will constrain your ability to regain control.
The social distancing Catch-22

In a time of social distancing, Indirect Labor needs to stabilize the line.

To stabilize the line, they need to visit the line.

They can’t visit the line because of social distancing.
Pressure to improve efficiency
   +
   Workforce churn
   +
   Constantly changing processes
   +
   Constraints on corrective actions
   =
   Mistakes are more likely to be made

Inexperienced workforce
   +
   Pace of change outpacing existing controls
   +
   Constraints on controls
   =
   Mistakes are less likely to be caught
DID YOU KNOW THAT THE CHINESE USE THE SAME WORD FOR 'CRISIS' AS THEY DO FOR 'OPPORTUNITY'? YES! "CRISITUNITY!"
Recommendations

Use this “crisitunity” to change how you mitigate quality risks

Think like an epidemiologist: tracing is as important as prevention

OEMs: Make “Bill of Process” traceability a condition of doing business

Suppliers: Make “Bill of Process” traceability a differentiator for costs and trust
Questions?

Dave Prager — d.prager@Drishti.com
How social distancing constrains problem-solving

<table>
<thead>
<tr>
<th>Process engineers can’t easily see the process to measure it</th>
<th>Optimization is constrained</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality engineers can’t easily observe the line to perform root cause analysis</td>
<td>Defect sources don’t get identified</td>
</tr>
<tr>
<td>Trainers can’t easily see the process to build instructional content</td>
<td>Operators lack training</td>
</tr>
<tr>
<td>Management “<em>genba</em> walks” are restricted</td>
<td>Management lacks visibility</td>
</tr>
<tr>
<td>Teams from HQ can no longer visit the plant</td>
<td>Can’t easily share best practices</td>
</tr>
<tr>
<td>Travel restrictions ground central <em>kaizen</em> teams</td>
<td>Can’t tap into off-site expertise</td>
</tr>
<tr>
<td>Collaboration and decision-making is slowed</td>
<td>“Crisis mode” extends</td>
</tr>
</tbody>
</table>
THE WALL STREET JOURNAL
Coronavirus Pushes Factories to Stagger Shifts, Separate Workers

How Austin factories are practicing social distancing

Industry Week
Rethinking Lean in a Time of Social Distancing

The Guardian
Vauxhall plans physically distanced car production in UK
Where will you see costs?

**Investigation phase**
- Teardown costs
  - Understanding why a unit is defective
- Inspection costs
  -Confirming “condition not present” in inventory, WIP, shipped goods, etc.
- Root cause analysis costs
  - Labor and opportunity
- Stopped production costs
  - Labor waste, overtime, safety stock

**Remediation phase**
- Rework costs
  - Time, labor and parts to fix defects
- Scrap costs
  - Unsalvageable material
- Countermeasure costs
  - New processes, people or equipment
- Warranty/recall costs
  - Retrieving and replacing defective units

**Fallout phase**
- Relationship costs
  - Risks to the existing customer contract
- Reputation/brand costs
  - Risks to other customers and future business
Drishti’s solutions:

For social distancing: Remote line stabilization, without risking operator health

For risk reduction: Video traceability + analytics of past events

1. Stream video from every station
2. Provide cloud-based access to video and data
3. Use our apps for training, process optimization, defect reduction, etc. — without physical proximity to the line
4. Keep the video and analytics as a “Bill of Process” for future risk mitigation

More: Drishti.com/Quality
The value of “Bill of Process” traceability

**Investigation phase**

- **Teardown costs**
  - Understanding why a unit is defective

- **Inspection costs**
  - Confirming “condition not present” in inventory, WIP, shipped goods, etc.

- **Root cause analysis costs**
  - Labor and opportunity

- **Stopped production costs**
  - Labor waste, overtime, safety stock

**Use video — instead of labor — to investigate and define the scope of the problem**

**Investigate faster to reduce production downtime**
The value of “Bill of Process” traceability

**Investigation phase**
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**Limit remediation and resolution by quantifying your actual exposure**
The value of “Bill of Process” traceability

**Investigation phase**
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**Differentiate yourself on response and resolution time**
Recalls and the Big Re-Start: Legal and Commercial Considerations

SAA’s Annual Recalls Summit
29 April 2020

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For More Information on Stout’s Automotive Defect and Recall Analyses Download our 2019 White Paper at:

Q&A
For further information regarding this presentation please contact a Stout representative:

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Neil Steinkamp is a Managing Director at Stout. He has extensive experience providing a broad range of strategic, business and financial advice to business leaders and their advisors.

Mr. Steinkamp has provided consulting services and has been engaged as an expert in numerous matters involving automotive warranty and recall costs. His experience and expertise includes automotive warranty and recall data analytics, benchmarking, risk assessments, recall cost analysis and expert testimony. He frequently consults with both OEMs and suppliers to assist in measuring the costs of a recall to the OEM, the internal systems for recall and warranty data collection and reporting, measurement and assessment of recall and product defect risks, analysis of recall completion rates, and the alternative scenarios that may exist for an OEM (such as limited focused recalls, ongoing warranty monitoring, etc.). He has worked in a variety of nonlitigation settings, as well as having been engaged as an expert on a wide variety of automotive recall disputes. He has analyzed warranty and recall circumstances of many sizes, from large recalls affecting millions of vehicles to small recalls or extended warranty actions affecting several thousand vehicles. In addition, he has analyzed a broad spectrum of product failure response, from elevated product failure and warranty to full scale recall of all impacted vehicles.

Mr. Steinkamp has been a leader in the development of data and analysis regarding automotive recall completion rates. He has prepared analyses and presented his findings both domestically and internationally for organizations and other groups in the automotive industry. He has developed unique analyses demonstrating factors impacting recall completion including vehicle age, recall size, component and other factors.
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Raymond A. Roth, III is a Director in the Dispute Consulting group. Mr. Roth has significant experience providing a broad range of business and financial advice to litigating counsel, corporate counsel, audit committees, boards of directors, and other decision makers.

Mr. Roth has developed specialized skills in the management and analysis of large complex data sets (i.e. big data). He has experience in performing detailed analyses at the transactional level to provide business intelligence, risk assessment, and other attribute analysis. A non-exhaustive list where large data sets have been interpreted to offer opinions include FLSA hours worked studies, ERISA stock drop studies, Medicare investigations, asset tracing investigations, Breach of Contract and automotive and recall litigation.

Mr. Roth has testified in both bench and jury trials. He has been asked to present various topics to law firms, bar associations, state CPA societies and universities. In addition, he has assisted parties in settlement negotiations, mediation and facilitation.

Professional Memberships
• American Institute of Certified Public Accountants
• The Michigan Association of Certified Public Accountants (Including Chairman of its Fraud Task Force)
• The Association of Certified Fraud Examiners
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Robert Levine is a Director in the Disputes, Compliance, & Investigations group. The practice encompasses all areas of litigation support, forensic accounting and computer forensics. Mr. Levine has significant experience in providing a broad range of business and financial advice to trial lawyers and in-house counsel throughout the dispute process, including matters involving breach of contract, tortious interference, shareholder disputes, warranty and recall disputes, fraud and forensic investigations, post M&A disputes, securities litigation, business interruption claims, disputes in the context of bankruptcy, labor and economics disputes, as well as matters involving theft of trade secrets and intellectual property infringement.

Mr. Levine has provided consulting services in numerous matters involving automotive warranty and recall costs. His experience and expertise includes automotive warranty and recall data analytics, benchmarking, risk assessments, and recall cost analysis. He frequently consults with both OEMs and suppliers to assist in measuring the costs of a recall to the OEM, the internal systems for recall and warranty data collection and reporting, measurement and assessment of recall and product defect risks, and analysis of recall completion rates. He has analyzed warranty and recall circumstances of many sizes, from large recalls affecting millions of vehicles to small recalls or extended warranty actions affecting several thousand vehicles. In addition, he has analyzed a broad spectrum of product failure response, from elevated product failure and warranty to full scale recall of all impacted vehicles.

Professional Memberships

• American Institute of Certified Public Accountants
• The Michigan Association of Certified Public Accountants
Footnotes
