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VEHICLE SAFETY

Enhanced Project Management of New Information Technology Could Help Improve NHTSA's Oversight of Safety Defects

GAO-16-312

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GAO Highlights

Highlights of GAO-16-312, a report to congressional committees

Why GAO Did This Study

NHTSA's mission is to save lives, prevent injuries, and reduce the economic costs due to traffic crashes. As such, NHTSA is responsible for overseeing vehicle safety, a task made more challenging by the increasingly complex electronics and software used in today's vehicles. NHTSA's oversight faces greater scrutiny after a series of high-profile vehicle recalls that highlighted deficiencies with NHTSA's safety-defect investigation processes.

GAO was asked to examine NHTSA's oversight of safety defects and new automotive technologies. This report addresses: (1) challenges identified for NHTSA's oversight of safety defects, (2) NHTSA's implementation of a new IT system for safety-defect investigations, and (3) how NHTSA is addressing new technologies in its oversight of vehicle safety, among other things. GAO reviewed reports on NHTSA's safety-defect process since 2005, such as reports by the Department of Transportation (DOT) Inspector General and literature from scholarly journals, as well as NHTSA budget requests, reports, and priority plans; compared NHTSA's project-management documents for the CIF system to DOT guidance and other recognized practices for project management; and interviewed NHTSA officials and industry stakeholders.

What GAO Recommends

GAO recommends that NHTSA develop an integrated project-management approach for the CIF as well as an overall schedule to customize the CIF applications for ODI. DOT concurred with the recommendations.

View GAO-16-312. For more information, contact Susan Fleming at (202) 512-2834 or flemings@gao.gov.

What GAO Found

The National Highway Traffic Safety Administration (NHTSA) faces several challenges in its oversight of vehicle safety defects and has initiated or proposed some actions to address them. Challenges include improving data collection and analysis, providing adequate guidance and standard business processes to the staff who identify and investigate potential vehicle defects, and keeping pace with new technologies. A key step NHTSA is taking to address some of these challenges is implementing a new information technology (IT) system—the Corporate Information Factory (CIF)—to enhance data mining and case management for identifying and investigating potential safety defects. According to NHTSA, some of its proposed actions could require additional resources. Congress has indicated that additional resources would depend on NHTSA's improving how it manages investigating defects.

NHTSA's implementation of its new IT system reflects some recognized project-management practices, like developing plans for managing system requirements and risks, but the agency could better manage the CIF in two areas.

- *Integrated management*: The Office of the Chief Information Officer (OCIO) and Office of Defects Investigation (ODI) have distinct responsibilities for implementing the CIF—the base infrastructure and ODI customizations, respectively. However, the offices have not integrated their CIF project plans as recommended by recognized practices for project management. Integration could benefit both offices—ODI by helping ensure that CIF customizations meet staff needs and are incorporated into their daily work, and OCIO by being able to apply lessons from ODI's customizations to other offices that will be customizing and using the CIF.
- *Project schedule:* While ODI recently created a schedule for an initial set of CIF customizations, it lacks an overall schedule for customizing and releasing CIF software applications. ODI officials said they do not have an overall schedule because they view customization as an ongoing process; that is, as staff understand and learn to better use the CIF, ODI will identify additional customizations. Given the complexity of implementing the CIF, as well as other changes occurring in ODI to address the challenges discussed above, an overall schedule that sequences work and includes milestones would help ODI manage and prioritize already identified customizations, as well as those that may be identified in the future.

NHTSA has taken steps to address new technologies in its oversight of vehicle safety, and its strategic-planning efforts are ongoing. Among these steps, in 2012 NHTSA completed internal roadmaps for research on vehicle electronics, and in 2015 NHTSA created the Vehicle Innovation Team, which aims to identify regulatory and other challenges to increasing vehicle automation. In 2012, a Transportation Research Board study recommended that NHTSA issue a strategic plan to guide key policy decisions related to the scope and direction of the agency's vehicle safety programs, including oversight of new technologies. NHTSA officials told GAO they recently restarted their strategic-planning effort and plan to release a strategic plan for the agency in spring 2016. This plan will be critical for NHTSA in prioritizing and coordinating its initiatives.

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Abbreviations

CAFE	Corporate Average Fuel Economy
CIF	Corporate Information Factory
CMMI®	Capability Maturity Model® Integration
DOT	Department of Transportation
EWR	early warning reporting
FAA	Federal Aviation Administration
FDA	Food and Drug Administration
FAST Act	Fixing America's Surface Transportation Act
FMVSS	Federal Motor Vehicle Safety Standard
FTE	full-time equivalent
IPPM	Integrated Program Planning and Management
IT	information technology
MAP-21	Moving Ahead for Progress in the 21st Century Act
NCAP	New Car Assessment Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
OCIO	Office of the Chief Information Officer
ODI	Office of Defects Investigation
OIG	Office of Inspector General
SEI	Software Engineering Institute
SMS	safety management system
TRB	Transportation Research Board
TREAD Act	Transportation Recall Enhancement, Accountability and Documentation Act
UAS	unmanned aerial systems
Volpe	The National Transportation Systems Center
VRTC	Vehicle Research and Test Center

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In recent years, a series of high-profile vehicle safety defects—such as problems with GM ignition switches and Toyota unintended acceleration—has heightened scrutiny of the National Highway Traffic Safety Administration's (NHTSA) oversight of vehicle safety defects. The mission of NHTSA—part of the Department of Transportation (DOT)—is to save lives, prevent injuries, and reduce the economic costs due to traffic crashes. As part of this mission, NHTSA is tasked with identifying and monitoring the remedy of vehicle and vehicle equipment defects for the approximately 265 million passenger vehicles that the agency reports are on the road today. Prompted by these high-profile cases, NHTSA and others have studied the agency's safety defect-related processes and have highlighted several deficiencies in NHTSA's oversight. For example, a congressional investigation of the GM ignition-switch recall found that NHTSA did not make efficient and effective use of all available data, such as detailed crash-investigation reports, when analyzing whether a defect had prevented the air bags from deploying in a number of reported crashes.[1] NHTSA, in response to these reviews, has announced actions to improve its oversight of safety defects, including implementing a new information technology (IT) system, to enable the agency to more efficiently and effectively identify possible safety defects.

In addition to its responsibilities for identifying safety defects, NHTSA is more broadly responsible for improving vehicle safety, including conducting research on new safety technologies, promulgating safety standards related to new technologies, and enforcing these standards. That mission is made more challenging by increasingly complex electronic systems and software in today's passenger vehicles. Electronic control systems governed by computer software monitor and control most safety-critical components in vehicles like steering and braking. Moreover, these types of electronic control systems will be essential for new technologies such as connected vehicles and partially and fully

[1]U.S. House of Representatives, Committee on Energy and Commerce, *Staff Report on the GM Ignition Switch Recall: Review of NHTSA* (Washington, D.C.: Sept. 16, 2014).

automated vehicles—technologies that have the potential to reduce crashes and save lives.[2] While new safety features in vehicles have likely contributed to a decline in U.S. traffic fatalities from 43,510 in 2005 to 32,675 in 2014 (the most recent year for which NHTSA data on fatalities are available), a number of other factors may have also contributed to this decline including an increase in gas prices and decrease in vehicle miles traveled during the first half of this decade. In 2012, a Transportation Research Board (TRB) committee reported that NHTSA will need to keep pace with changing safety demands placed on the agency as vehicles become more dependent on electronics systems for their critical functions.[3] As such, realizing the life-saving potential of many new technologies will depend on the agency's ability to adapt its regulatory and oversight processes to these new technologies.

You asked us to review NHTSA's oversight of safety defects and ability to adapt to new developments in automotive technology. This report examines (1) the challenges that have been identified for NHTSA's oversight of safety defects since 2005 and the actions NHTSA has taken in response, (2) the status of NHTSA's implementation of a new IT system for safety-defect investigations and the extent to which its implementation is aligned with recognized project-management practices, and (3) how NHTSA is addressing new automotive technologies in its oversight of vehicle safety and how its efforts compare to those of other regulatory agencies that oversee safety in industries with new technologies.

To determine the challenges NHTSA faces in its oversight of safety defects in passenger vehicles, we reviewed reports and literature that examined NHTSA's safety-defects processes and that was published

[2]Connected vehicles rely on data sent between vehicles, road infrastructure, and personal communications devices to warn drivers and pedestrians of potential accidents. DOT issued an Advanced Notice of Proposed Rulemaking in August 2014 seeking comments on a proposed requirement that cars include technologies to enable vehicle-to-vehicle communications. Automated vehicles are those in which at least some aspects of a safety-critical control function (e.g., steering, braking) occur without direct driver input by using onboard sensors, cameras, GPS, and telecommunications to obtain information and act appropriately in safety-critical situations.

[3]National Research Council of the National Academies, Transportation Research Board Special Report 308, *The Safety Promise and Challenge of Automotive Electronics: Insights from Unintended Acceleration* (Washington, D.C.: Apr. 23, 2012).

since 2005[4] and interviewed stakeholders—industry groups, automotive manufacturers, safety advocates, and researchers. We selected these stakeholders to reflect variety in their roles and based on recommendations from interviewees. The information and perspectives that we obtained from the interviews may not be generalized to all industry stakeholders that have an interest in vehicle safety. To describe the actions NHTSA has taken or proposed in response, we reviewed DOT and NHTSA documents, which include *NHTSA's Path Forward* and *Workforce Assessment: The Future of NHTSA's Defects Investigations* that outline proposed changes to NHTSA's Office of Defects Investigation (ODI). We also interviewed officials from ODI. We did not evaluate the sufficiency of steps taken or planned by NHTSA to respond to each challenge, as some steps were not yet complete and other steps were being assessed by the DOT Office of Inspector General (OIG) at the time of our review.

To assess NHTSA's implementation of a new IT system, we analyzed NHTSA guidance and documents on (1) overall plans and procedures to implement the new system—the Corporate Information Factory (CIF)—and (2) plans and procedures to tailor CIF capabilities and make capabilities available to ODI.[5] We examined the extent to which the agency's project-management approach adheres to recognized project-management practices in the Software Engineering Institute's (SEI) *Capability Maturity Model® Integration (CMMI®) for Acquisition* and *CMMI® for Development* and DOT's *Integrated Program Planning and*

[4]We limited our review of reports and literature to the last 10 years as this time period included several high-profile safety-defect recalls and followed the implementation of changes to NHTSA's oversight of safety defects under the Transportation Recall Enhancement, Accountability and Documentation (TREAD) Act, which was enacted in 2000.

[5]NHTSA is implementing the CIF system to be an agency-wide system. Three program offices—ODI, Corporate Average Fuel Economy (CAFE), and Crash Data Acquisition Network—were involved in identifying the initial requirements for developing and deploying CIF capabilities throughout the agency. We focused primarily on NHTSA's implementation of the CIF for ODI since ODI's program needs helped drive the investment in the CIF and a pilot of the CIF.

Management (IPPM) Governance Guide.[6] We also used leading practices for effective strategic workforce planning to supplement information on workforce-planning and human-capital considerations included in SEI and DOT. From these sources, we identified six key project-management documents to analyze in detail: the charter; project management plan; requirements management plan; risk management plan; development guides for testing, training, and procedures; and workforce plan. For each of the key project-management documents, we evaluated NHTSA's documents for the CIF against specific recognized project-management practices identified by DOT and SEI. We also interviewed NHTSA officials from ODI and the Office of the Chief Information Officer (OCIO) about the roles and responsibilities of the NHTSA offices involved in implementing CIF capabilities.

To examine how NHTSA addresses new automotive technologies in its oversight of vehicle safety, we reviewed relevant legislation and NHTSA documents including budget requests, research and rulemaking priority plans for vehicle safety and fuel economy, and requests for comments on vehicle-safety programs. We also interviewed NHTSA officials to learn about other efforts that the agency has taken or plans to take to adapt to new technologies. Our review focused on electronic control systems because these systems, while already widely used in vehicles, are also the underpinning for several technologies in development, including those that would enable connected vehicles and automated vehicles.[7] Additionally, we interviewed stakeholders, as described above, that interact with NHTSA on vehicle safety to gather their views on and experiences with NHTSA's oversight of new automotive technologies. To compare NHTSA's efforts to those of other regulatory agencies, we reviewed planning and other documents and interviewed officials from the Food and Drug Administration (FDA) and Federal Aviation Administration

[6]DOT, Office of the Chief Information Officer, *Integrated Program Planning and Management (IPPM) Governance Guide* (May 2010), and Software Enterprise Institute, *CMMI® for Acquisition, Version 1.3*, and *CMMI® for Development, Version 1.3* (November 2010). The DOT *IPPM Governance Guide* highlights the processes and activities necessary to ensure that IT solutions are properly planned and managed, and the CMMI® models collect best practices from government and industry to help organizations improve their processes and effectively manage projects. The high-level practices in the DOT *IPPM Governance Guide* are consistent with practices described by *CMMI® for Acquisition* and *CMMI® for Development*.

[7]We did not examine NHTSA's efforts related to vehicle cybersecurity because we are conducting separate work on this topic that is expected to be published in March 2016.

(FAA). We selected these two agencies because they have missions similar to NHTSA (i.e., overseeing the safety of products affected by new technologies), take different approaches to overseeing their respective industries, and have been the subject of recent GAO work.

We conducted this performance audit from January 2015 to February 2016 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives. See appendix I for more information on the scope and methodology.

Background

About 20 automotive manufacturers and their major divisions sell the vast majority of motor vehicles in the United States. Each manufacturer designs its vehicles and their features to meet consumer demands for various attributes like comfort, fuel economy, safety, and reliability and to comply with the Federal Motor Vehicle Safety Standards (FMVSS). NHTSA is responsible for developing these safety standards for certain safety features and characteristics, like brakes and air bags.[8] FMVSSs establish minimum performance requirements. Therefore, according to a 2012 TRB report, FMVSSs are intended to be technology neutral and provide manufacturers with the flexibility to innovate in the design of vehicle systems covered by standards.[9] Therefore, vehicle systems vary not only over time but also across manufacturers and vehicle models. For example, FMVSS 124 for accelerator control systems establishes requirements that a vehicle's throttle return to the idle position when the driver removes his or her foot from the accelerator control or in the event of a severance or disconnection in the system. However, because the standard does not define how the connection should be made, manufacturers have been able to innovate from mechanical to electronic systems and use different software and mechanisms to meet these

[8]NHTSA issues FMVSSs to which manufacturers of motor vehicles and items of motor vehicle equipment must conform and certify compliance. FMVSSs provide objective criteria by which an automobile can be tested to see if it meets the minimum standard for motor vehicle performance. FMVSSs are grouped into three main categories—crash avoidance, crashworthiness, and post-crash integrity.

[9]Transportation Research Board, *Special Report 308*.

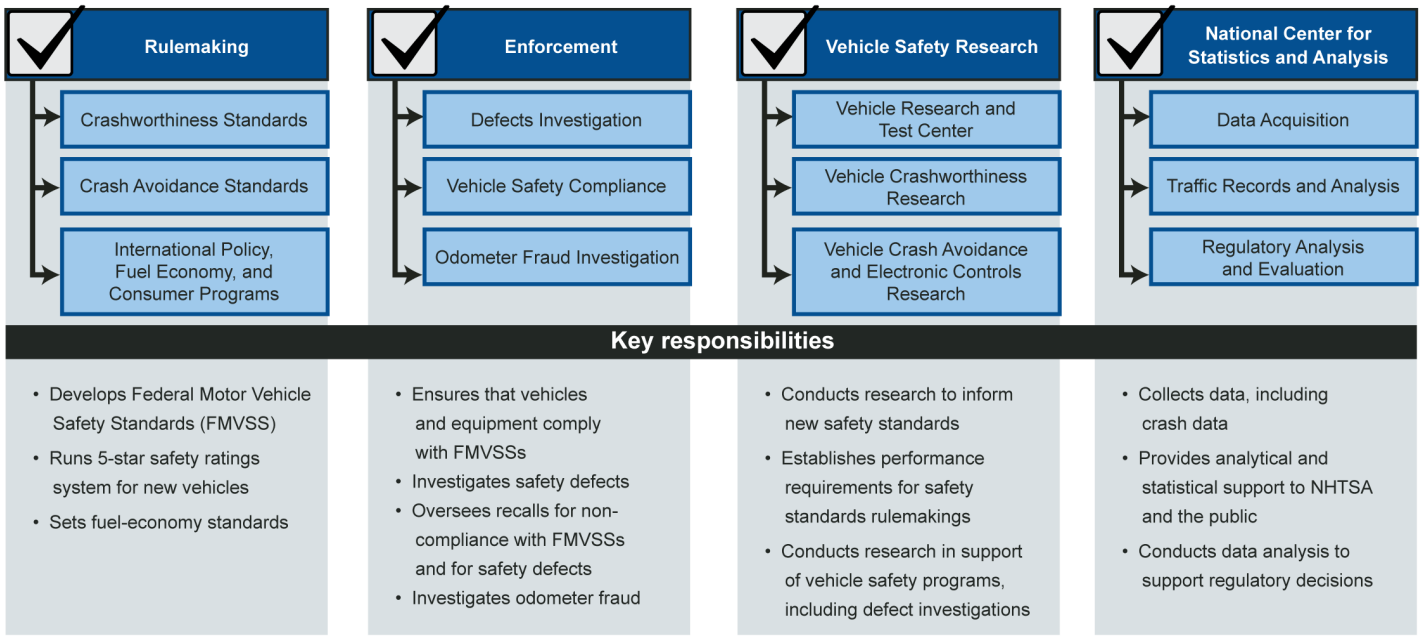
requirements. To meet consumer demands for safer vehicles, manufacturers may also develop new safety features for vehicles that exceed the safety standards required by NHTSA. For example, manufacturers developed electronic stability control, a system that helps drivers maintain control of their vehicle and keep the vehicle headed in the intended direction by using automatic braking on individual wheels to prevent spinning or plowing out.[10] Manufacturers continue to introduce new features to improve the safety of vehicles, including those that aim to help drivers avoid crashes like lane departure warning and forward collision avoidance. These systems use different methods to monitor the environment, such as radar, camera, light-wave sensing (lidar), or some combination thereof, to warn a driver of a potential crash or automatically take steps to avoid a potential crash.

According to NHTSA, safety is the agency's top priority. NHTSA was established by the Highway Safety Act of 1970 to carry out safety activities.[11] These activities range from establishing FMVSSs to working with states and local communities to reduce impaired driving to conducting research on driver behavior and traffic safety. Four NHTSA offices—Rulemaking, Enforcement, Vehicle Safety Research, and the National Center for Statistics and Analysis—are responsible for NHTSA's motor-vehicle safety program. Examples of the four offices' responsibilities are outlined in figure 1. Staff in these offices are located in Washington, D.C., and at the agency's Vehicle Research and Test Center (VRTC) in East Liberty, Ohio.

[10]Due to the effectiveness of electronic stability control systems to reduce crashes and fatalities, NHTSA issued an FMVSS in 2007 to require vehicles to have electronic stability control systems.

[11]Pub. L. No. 91-605 (1970).

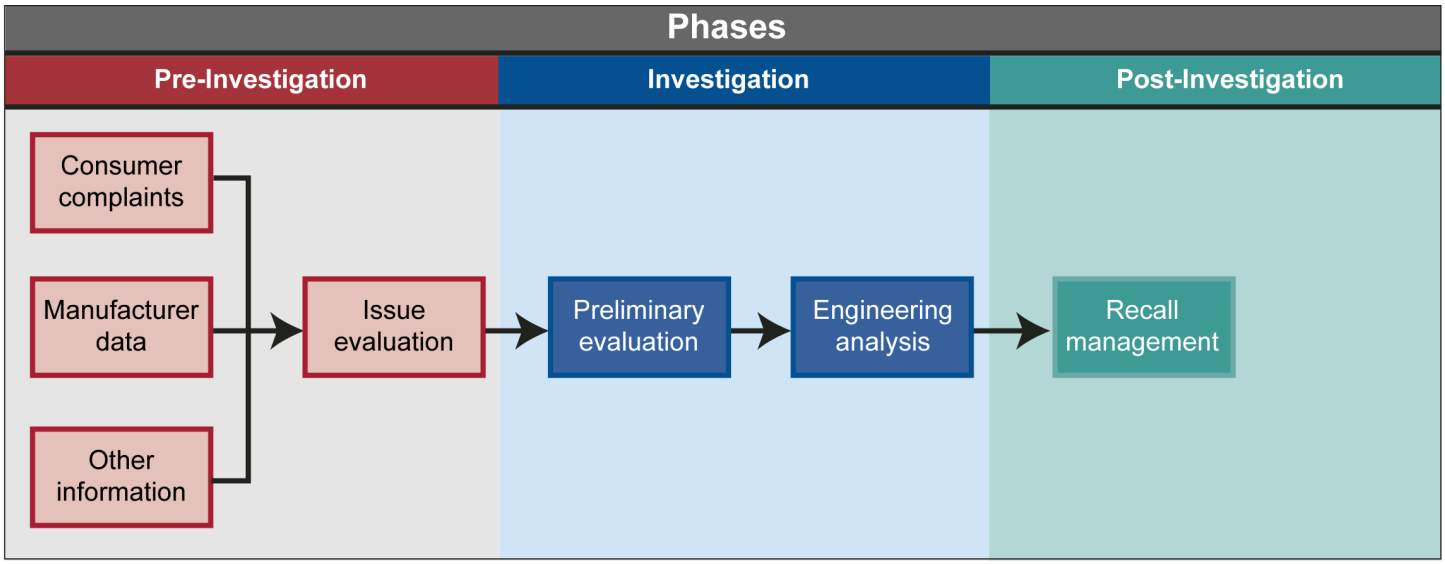
Figure 1: National Highway Traffic Safety Administration (NHTSA) Offices Responsible for Vehicle Safety



Source: GAO analysis of NHTSA's data. | GAO-16-312

Within the Enforcement Office, ODI conducts defect investigations and oversees recalls. ODI's process for investigating safety defects generally has three phases, based on agency documents and DOT OIG reports (see fig. 2):

Figure 2: Overview of the National Highway Traffic Safety Administration's (NHTSA) Process for Investigating Safety Defects



Source: GAO presentation of DOT and NHTSA information. | GAO-16-312

Note: Investigations are generally conducted in two phases. A preliminary evaluation (first phase) is upgraded to an engineering analysis (second phase) if the Office of Defects Investigation (ODI) determines that further analysis is warranted. Further, a manufacturer may make a recall decision during the pre-investigation or investigation phase that may result in ODI ending an issue evaluation or closing an investigation and beginning its recall-management activities.

- Pre-investigation involves collecting and analyzing vehicle-safety data to identify and select potential safety issues for further investigation, and this work is conducted by screeners. ODI primarily uses two sources of data to identify potential safety issues: consumer complaints submitted in vehicle owner questionnaires, which are voluntarily submitted to NHTSA by vehicle owners, and required manufacturer-reported early warning reporting (EWR) data that include aggregate counts of warranty and property damage claims and information on incidents involving death or injury about which the manufacturer learns through claims or notices.[12]
- Investigation is the investigation of potential safety issues that are often but not always identified and selected during the pre-

[12]The TREAD Act authorized NHTSA to require manufacturers to provide EWR data. Pub. L. No. 106-414, 114 Stat. 1800 (2000). NHTSA can impose a civil penalty on a manufacturer that fails to comply with EWR requirements.

investigation phase.[13] Investigations are conducted by ODI specialists (investigators) in vehicle control (e.g., suspension, wheels, tires); vehicle integrity (e.g., air bags, light vehicles); medium- and heavy-duty vehicles; and other vehicle types and applications (e.g., motorcycles). At any time, a manufacturer may decide to conduct a recall that, depending on the breadth and adequacy of the remedy to address the defect, may result in an investigation's closure.[14]

- Post-investigation, or recall management, involves ensuring that manufacturers comply with requirements for recalls when a manufacturer or NHTSA determines that a defect exists in a vehicle or vehicle equipment that creates an unreasonable safety risk.[15] In this phase, ODI staff review draft recall notices to owners and track manufacturers' progress in implementing remedies, among other activities.[16]

NHTSA's database for storing data used to identify and address potential safety defects is called Artemis. Artemis was developed in 2002 in part to collect and manage the EWR data required under the TREAD Act. Over time, NHTSA has added other data and capabilities to Artemis for supporting ODI's pre-investigation, investigation, and post-investigation work. In addition, Artemis information is used to populate www.safercar.gov, NHTSA's primary means of communicating defect

[13]Investigations are generally conducted in two phases—preliminary evaluation and engineering analysis. A preliminary evaluation is upgraded to an engineering analysis, which is a more detailed and complete analysis of the alleged defect, if ODI determines that further analysis is warranted.

[14]ODI carries out other types of investigations, such as recall queries and defect-petition analyses. Recall queries typically investigate the scope or adequacy of a recall after a campaign has been launched and there are continued problems in the field. Defect petitions are technical reviews of external requests for an investigation of a potential safety defect.

[15]While some recalls are initiated because of NHTSA's investigations of safety defects—known as influenced recalls—a majority of recalls are initiated by manufacturers without influence from agency investigations—known as voluntary or uninfluenced recalls. Manufacturers are required to provide notice to NHTSA of a safety-related defect within 5 working days, and NHTSA can impose a civil penalty on a manufacturer that fails to make a timely notification.

[16]ODI staff in the recalls group also conduct recall-related investigations, including recall queries, equipment queries, and timeliness queries. Equipment queries investigate the distribution of potentially defective or noncompliant equipment to ensure complete recall coverage among a host of manufacturers where necessary. Timeliness queries investigate potential untimely decision making on a recall by a manufacturer.

information to the public. For example, the public can find information on recalls and investigations and can search consumer complaints and manufacturers' service bulletins, which contain information on safety recalls, defective product components, service campaigns, and customer satisfaction campaigns. The National Transportation Systems Center (Volpe) developed Artemis for NHTSA and continues to provide support for the operation and maintenance of the system.[17]

In fiscal year 2015, NHTSA's total budget was $830 million with 612 full-time equivalent (FTE) staff. Vehicle Safety's share of this total was $130 million and 341 FTEs, of which $9.7 million and 54 FTEs was for ODI. In the past few years, ODI has been responsible for reviewing substantially more consumer complaints and overseeing an increasing number of recalls. According to NHTSA, ODI reviewed almost 80,000 consumer complaints in 2014 compared to an average of about 50,000 per year from 2010 through 2013. In 2014, there was also a record number of recalls—NHTSA reported 902 recalls affecting over 74-million vehicles. In comparison, in the 5 previous years, automobile manufacturers initiated an annual average of 665 recalls affecting nearly 21-million vehicles, based on agency data. In 2015, NHTSA also began its oversight of a national recall of Takata air bags, one of the largest recalls ever, which NHTSA says involves more than 23-million air-bag inflators, 19-million vehicles, and 12 automakers.

As noted above, high-profile cases in the last decade have highlighted deficiencies in NHTSA's oversight of safety defects. For example, in 2014, GM initiated a recall of over 8-million vehicles with faulty ignition switches associated with a number of fatalities and injuries.[18] NHTSA's ODI had examined this problem in its pre-investigation phase as early as 2005 but did not open a formal investigation because, according to NHTSA, it attributed the air bag non-deployments in GM vehicles to the circumstances of the crashes and not to the position of the ignition switch.[19] In its subsequent review of the GM recall, NHTSA reported that

[17]Volpe is a fee-for-service organization that performs work for DOT as well as other federal, state, local, and international agencies and entities.

[18]The recalled ignition switch could unexpectedly move from the "run" or "on" position to the "accessory" or "off" position, shutting down the engine and disabling power steering, power brakes, and air bags.

[19]According to NHTSA, ODI believed that the position of the ignition switch would not prevent the air bag from deploying based on its understanding of earlier air-bag systems.

it did not fully understand the application of GM's advanced air-bag system—specifically the importance of the ignition switch in GM's advanced air-bag system—and that NHTSA's internal offices did not share relevant data with one another. While GM eventually determined that a safety defect existed, GM admitted that it failed to notify NHTSA of the safety-related defect in a timely manner, as required by statute, and agreed to pay a $35-million civil fine, the maximum allowed by statute at that time.[20] This and other cases prompted several reviews of NHTSA's defect investigation and recall processes, resulting in reports with numerous recommendations to the agency, including the following:[21]

- DOT OIG audit: In response to the GM ignition-switch recall, the Secretary of Transportation asked the DOT OIG to examine ODI's pre-investigation processes. Among other things, the DOT OIG assessed ODI's procedures for collecting and analyzing consumer complaint and EWR data and made 17 recommendations to NHTSA in its June 2015 report.[22] NHTSA concurred with the recommendations and committed to implementing changes to address all the recommendations by June 2016. According to NHTSA, the agency is on schedule for meeting this goal as of December 2015.
- NHTSA internal review: NHTSA conducted an internal review of its processes in the wake of the GM ignition-switch recall. In June 2015, NHTSA released its findings as well as planned improvements to address these findings in *NHTSA's Path Forward*.[23] In conjunction

[20]Manufacturers are required to provide notification of a defect within a reasonable time after the manufacturer first decides that a safety-related defect exists. 49 U.S.C. § 30119(c). In a separate probe by the Department of Justice, in September 2015 GM admitted its failure to disclose a safety defect, and through a deferred prosecution agreement, agreed to pay $900 million. Additionally, an independent monitor was imposed and charged with reviewing and assessing policies, practices, and procedures relating to GM's safety-related public statements, sharing of engineering data, and recall processes. In June 2014, GM established a compensation program for victims of ignition-switch defects in certain GM vehicles.

[21]Other reviews include the following: U.S. House of Representatives, Committee on Energy and Commerce, *Staff Report on the GM Ignition Switch Recall: Review of NHTSA*; DOT, OIG, *Process Improvements are Needed for Identifying and Addressing Vehicle Safety Defects*, MH-2012-001 (Washington, D.C.: Oct. 6, 2011); and GAO, *Auto Safety: NHTSA Has Options to Improve the Safety Defect Recall Process*, GAO-11-603 (Washington, D.C.: June 15, 2011).

[22]DOT, OIG, *Inadequate Data and Analysis Undermine NHTSA's Efforts to Identify and Investigate Vehicle Safety Concerns*, ST-2015-063 (Washington, D.C.: June 18, 2015).

[23]DOT, *NHTSA's Path Forward*, June 2015.

with the release of that report, NHTSA announced the formation of a Safety Systems Team of outside experts to advise the agency on implementation of improvements to ODI.

- TRB review: NHTSA requested that the National Research Council convene an independent committee to examine the safety assurance challenges arising from the proliferation and growing complexity of automotive electronics and their implications for NHTSA's vehicle-safety programs. This work, completed by a TRB committee and conducted during NHTSA's investigation into unintended acceleration in Toyota vehicles, resulted in April 2012 recommendations to strengthen NHTSA's safety oversight of automotive electronic systems.[24]

NHTSA Faces Numerous Challenges in Its Oversight of Safety Defects and Has Announced Plans and Taken Some Steps in Response

We identified seven types of challenges that NHTSA faces in its oversight of safety defects. Specifically, based on the findings and recommendations taken from reports over the past 10 years as well as challenges cited by a variety of stakeholders during interviews, the seven types of challenges below were the most commonly identified.[25] NHTSA has announced some steps it is taking or would like to take to attempt to address these challenges. Many of these response steps are outlined in two documents that NHTSA released in June 2015, *NHTSA's Path Forward* and its *Workforce Assessment*, based on its internal review of the agency's processes to identify and address safety defects. While NHTSA has completed or is in the process of taking some steps, other steps require additional resources or changes to the agency's authorities. While the challenges span a number of areas, some types of challenges, such as keeping pace with new technologies and human capital management, are interrelated and could be addressed by similar steps.

Data Collection and Analysis

One type of challenge facing NHTSA is improving how it collects and analyzes data. NHTSA collects a lot of data that it can use to help identify potential safety issues, including consumer complaints, EWR data, and crash data, among other data from NHTSA and external sources.

[24]Transportation Research Board, *Special Report 308*.

[25]The seven types of challenges presented in this section were the most frequently cited across our sources, but each literature review article, study, and stakeholder did not identify all seven challenges. In addition, we did not prioritize these challenges. See appendix I for more information on the methodology used to identify these challenges.

However, the DOT OIG and our prior work have found weaknesses in how NHTSA uses the data available to it to identify and remedy safety defects. For instance, the 2015 audit report by the DOT OIG made six recommendations to improve ODI's collection of data and made three recommendations to improve ODI's analysis of data. The DOT OIG recommended that NHTSA expand verification processes to assess manufacturers' compliance with EWR requirements and provide detailed and specific guidance to consumers on what to include in their complaints. The importance of such verification processes was demonstrated by two automobile manufacturers acknowledging in the last 18 months that they had failed to comprehensively report EWR data to NHTSA. Four of 17 stakeholders we spoke with said that NHTSA could make better use of the data available to it. For example, one of these stakeholders said that NHTSA could develop leading indicators using crash data, which may enable NHTSA to more quickly identify possible defects.[26]

A key step NHTSA is taking to improve its data collection and analysis is implementing a new IT system called the CIF. According to NHTSA, the CIF will provide advanced data-mining and analytical tools, case management tools to track ODI's work, and access to multiple NHTSA data sets via a data warehouse. ODI, working with NHTSA's OCIO, piloted some of the tools in fiscal years 2012 and 2013, and OCIO began a fuller deployment of the tools for ODI and other NHTSA offices in fiscal year 2014.[27] We evaluate NHTSA's implementation of the CIF in the next section of the report. In addition to implementing the CIF, NHTSA has announced plans to improve the quality of the data it uses. NHTSA plans to, for example, provide more clarity to manufacturers about EWR requirements and create mechanisms through which consumers can provide more complete information in complaints filed with NHTSA. Many of these changes were in response to the recommendations made by the DOT OIG in June 2015 and were largely in progress during the time of

[26]For example, some have advocated that NHTSA adopt a forward-looking statistical approach to help identify and prioritize potential safety risks, such as testing the likelihood of an expected number of events (e.g., tire-related crash, fire-related crash), given the number of events that actually occurred. See R.A. Whitfield and A.K. Whitfield, "Improving surveillance for injuries associated with potential motor vehicle safety defects," *Injury Prevention*, vol.10 (2004).

[27]The DOT OIG did not examine NHTSA's planning for and implementation of the CIF in its 2015 audit report.

our review. Also, in January 2016, NHTSA and 18 auto manufacturers committed to working together to enhance EWR data by analyzing the current quality and use of EWR data, exploring changes that could enhance the usefulness of the data, and examining whether advanced analytical tools can be used with EWR data to proactively identify potential safety issues.[28]

Internal Guidance and Business Processes

Another type of challenge facing NHTSA is inadequate internal guidance and business processes for ODI staff. This includes a lack of criteria or thresholds to guide pre-investigation and investigation activities, and not documenting some key decisions, actions, and outcomes, such as a decision not to launch a formal investigation of a potential safety issue. In 2015, the DOT OIG reported that ODI had identified factors for deciding when an investigation of an issue is warranted, including the rate of consumer complaints and the severity of the potential issue, but had not developed specific guidance on how screeners should apply the factors, leaving pre-investigation screeners unsure about how much support is necessary to propose an investigation. The DOT OIG made seven recommendations to improve ODI's pre-investigation processes. In 2011 and 2015, the DOT OIG also noted ODI failures to adequately document steps and decisions, like documenting steps ODI took during an investigation such as meetings with manufacturers and external parties. This type of missing information hinders ODI's ability to assess or support the adequacy of previous investigations it conducted.

In response to the 2015 DOT OIG recommendations and based on the agency's internal review of the GM ignition-switch recall case, NHTSA announced, in *NHTSA's Path Forward*, changes to ODI's business processes, including steps to improve controls for assessing potential defects by carefully documenting decisions and monitoring issues. An internal document listing 45 specific improvements to ODI's processes provides additional detail on planned changes, including 9 initiatives to improve tracking and documentation. For example, NHTSA plans to develop internal rules by June 2016 that would require ODI to revisit an issue examined during pre-investigation that did not lead to an investigation if certain criteria are met. Also, as noted above, NHTSA's new IT system will include a case management tool to allow ODI staff to

[28]DOT, *Proactive Safety Principles* (Washington, D.C.: Jan. 15, 2016).

more easily annotate and add documents to pre-investigation issues, automate processes, and provide alerts related to pre-investigation work deadlines. In addition, the DOT OIG is currently auditing NHTSA's actions to implement its 2011 recommendations, many of which focused on internal guidance and business processes.

New Technologies

New vehicle technologies have transformed the automotive industry, in many cases making cars safer but also creating another type of challenge for NHTSA in detecting defects. NHTSA recognizes that new automotive technologies pose a challenge for its oversight of safety defects. The NHTSA *Workforce Assessment* for ODI stated that complex, new automotive technologies make it more challenging to identify the root causes of known defects and whether those causes are electronic in nature or the result of a mechanical issue. Six of 12 stakeholders we initially interviewed to identify key challenges also identified overseeing the safety of new automotive technologies as a type of challenge.[29] One stakeholder stated that new agency staff and expertise is needed to help NHTSA keep up with rapidly evolving automotive technology. According to another stakeholder, ODI staff are competent, dedicated, and talented but are mostly skilled in mechanical engineering—they are good at identifying mechanical problems such as broken axles but not as strong at identifying problems associated with electronic systems. Five stakeholders we interviewed said NHTSA needed to better communicate and engage with industry to learn about new automotive technologies.

NHTSA's Path Forward identified the need for ODI to expand its interaction with industry to understand new automotive technologies and interrelationships among vehicle systems. NHTSA officials and some manufacturers said that NHTSA's Vehicle Safety Research hosts manufacturers to demonstrate and discuss new automotive technologies and safety features. According to NHTSA, more frequent meetings with broader office attendance will help the agency increase its knowledge base and break down information stovepipes within the agency on new technologies. In addition, ODI's division chiefs are responsible for ensuring that appropriate ODI staff attend all meetings on new automotive technologies. NHTSA officials shared other examples of recently

[29]At the time we conducted our analysis to identify the most frequently cited challenges, we had completed 12 initial stakeholder interviews.

developed internal communications and trainings to help ensure ODI staff learn about new technologies. NHTSA's steps to create a training plan and assess the skills and expertise needed in its workforce are described in the next section.

Human Capital Management

Adequately managing human capital—which includes acquiring and developing staff whose numbers, skills, and deployment meet agency needs—is another type of challenge for NHTSA, particularly in light of rapidly evolving automotive technologies. Reports and stakeholders largely framed this challenge in terms of NHTSA needing to ensure that it had the right mix of skills and expertise to oversee evolving vehicles. For example, 7 of 17 stakeholders we interviewed said NHTSA needs new expertise, including electronics expertise, and new skills among its defects investigation staff. In 2011, the DOT OIG made two recommendations related to this issue: that ODI develop a formal training plan for its staff, and that ODI conduct a workforce assessment to determine the number and mix of staff needed to meet its objectives. In 2013, a NHTSA contractor recommended that the agency conduct a thorough analysis of the number of staff needed to fulfill its mission, considering the characteristics of the current ODI staff as well as the characteristics that will be needed of ODI staff in the future.[30]

NHTSA created a training plan and conducted a workforce assessment for ODI in response to the DOT OIG recommendations. NHTSA released a training plan in January 2014 that outlined ODI's training curriculum and requirements for staff. The training plan is to be reviewed and modified, if needed, every year. In June 2015, NHTSA released its workforce assessment for ODI, which contained two ODI staffing models. One staffing model outlined needs for fiscal year 2016, which NHTSA framed as the minimum increase in staff and funding needed to conduct the current defects-investigation program more efficiently. The other staffing model—termed the "new paradigm"—outlined a new model for defects investigations that would grant ODI a larger and more proactive enforcement presence. This model outlined the number of staff needed in each of ODI's divisions, and for some divisions, described the skill sets

[30]As part of its work, the contractor used an activity-based workforce model to estimate the staffing levels required to perform ODI's primary business activities. The contractor's assessment found an appropriate and effective mix of experience and expertise within the ODI staff and determined that there was a gap of approximately five FTEs.

required of additional staff, such as mechanical or electrical engineering. Overall, the new paradigm staffing model called for 380 additional FTEs. The DOT OIG, as noted above, is currently auditing NHTSA's actions to address these and other recommendations from 2011. In December 2015, the Comprehensive Transportation and Consumer Protection Act of 2015 was enacted as part of the Fixing America's Surface Transportation (FAST) Act, which authorized increased funding for NHTSA's motor-vehicle safety program for fiscal years 2016 through 2020.[31] NHTSA's actions to address new technologies in its broader oversight of vehicle safety, including human capital management actions, are discussed further below.

Agency Culture

Another type of challenge facing NHTSA's safety-defect oversight is whether a fundamental change in agency culture is needed; in particular, whether the agency has been too reactive in responding to potential defects. One stakeholder, for example, described ODI's culture by saying that the office was very tentative about opening investigations, and though staff identified a trend and recommended opening an investigation in the GM ignition-switch case, ODI did not open a formal investigation. NHTSA, in its review of the GM ignition-switch case, found that the agency did not push back and request more information from GM or hold GM accountable for providing inadequate information in response to inquiries on deaths and injuries during the pre-investigation phase. To overcome this challenge, one literature review article said that NHTSA needs to consistently and aggressively exercise information-gathering powers, while another article said NHTSA must publicize evidence of defects that are discovered in the monitoring process and move quickly in mandating appropriate recalls.[32]

NHTSA has already taken some steps to bolster its oversight approach. First, the Secretary of Transportation and the NHTSA Administrator have stressed that NHTSA will hold manufacturers accountable when they do

[31]The Comprehensive Transportation and Consumer Protection Act of 2015 authorized about $133 million for fiscal year 2016 with annual increases to $144 million for fiscal year 2020. Pub. L. No. 114-94, div. B, title XXIV, § 24101 (2015).

[32]B. Kelley, "Why the United States Lags in Auto Safety and Lessons It Can Import," *Journal of Public Health Policy*, vol.31, no.3 (2010), and J. Finch, "Toyota Sudden Acceleration: A Case Study of the National Highway Traffic Safety Administration," *Loyola Consumer Law Review*, vol.22, no.4 (2009-2010).

not comply with safety-defect reporting and repair requirements. For example, the Secretary, commenting on the record $126 million in civil penalties that NHTSA issued in 2014, said that all automakers have a safety responsibility they must live up to, no excuses. Further, in its oversight of the national recall of Takata air bags, NHTSA used its authority to accelerate recall repairs for the first time by directing Takata and manufacturers to prioritize their remedy programs based on risk and establishing a schedule by which manufacturers must have sufficient parts available to remedy the defect for all affected vehicles.[33] Second, in January 2016 DOT announced that NHTSA and 18 auto manufactures agreed to a statement of safety principles that lays out a voluntary approach to improve vehicle safety. DOT, NHTSA, and 18 automakers committed to working together to complete a number of actions, including determining how to promote more effective dialogue between NHTSA and the automotive industry on potential and emerging safety issues and exploring whether the aviation industry's anonymous safety-information-reporting system could be utilized in the auto industry.[34] As voluntary guidelines, this agreement does not grant NHTSA additional enforcement authority. Third, NHTSA officials said the agency now considers enhanced oversight when it finds that a manufacturer has failed to meet its obligation for a timely recall. In particular, in recent consent orders imposing fines for noncompliance with reporting requirements for GM, Hyundai, Fiat-Chrysler, and others, NHTSA required manufacturers to report to the agency on pending safety issues, internal training, consumer-outreach efforts, and reviews of their internal processes. As described in *NHTSA's Path Forward* and in the *Workforce Assessment*, NHTSA has additional plans to increase the accountability of the automotive industry by strengthening information collection requirements and auditing manufacturers' internal processes for identifying potential safety defects. However, according to NHTSA, some of these steps would require additional funding for staffing and administrative expenses. For example, given additional resources, NHTSA states it will investigate manufacturing processes at plants, test recall remedies before

[33]49 U.S.C. § 30120 (c)(3). NHTSA also issued a record civil penalty of $200 million on Takata for failing to issue a timely recall and to provide NHTSA with complete information. Of the $200 million fine, $70 million is payable in cash for safety violations and $130 million would become due if Takata fails to meet commitments agreed to with NHTSA or if additional violations are discovered.

[34]The four principles are (1) enhance and facilitate proactive safety, (2) enhance analysis and examination of EWR data, (3) maximize safety recall participation rates, and (4) enhance automotive cybersecurity. See DOT, *Proactive Safety Principles* (January 2016).

manufacturers implement them, and investigate alleged vehicle defects in the field, among other things.

Overall, such change-management initiatives are not simple endeavors and require the concentrated efforts of leadership and employees to realize the intended outcome. People are at the center of any serious change-management initiative because people define the organization's culture and drive its performance. Leading practices state that the mission and strategic goals of an organizational transformation define the culture and serve as a vehicle for employees to unite and rally around.[35] Thus, addressing challenges related to an agency's culture is not a short-term undertaking and requires process as well as cultural change.

Enforcement Authorities

NHTSA and some outside stakeholders have indicated that NHTSA's statutory enforcement authorities are too limited to ensure industry compliance with safety standards. The primary authority mentioned by stakeholders and literature review articles is NHTSA's authority to impose civil penalties for violations of requirements in statute or regulation, such as a manufacturer's failing to report safety-related defects to NHTSA within 5 business days. For example, three literature review articles argued that NHTSA needs authority to impose higher civil penalties. Though higher penalties were favored by some stakeholders, two stakeholders said that NHTSA's current civil penalty caps were appropriate or that higher fines would not necessarily serve as a deterrent.

DOT sought authority for a higher maximum civil penalty for NHTSA to provide a more meaningful deterrence against violations of the Motor Vehicle Safety Act.[36] Recently enacted legislation increases the civil penalty cap from $35 million to $105 million and prohibits rental-car companies from knowingly renting vehicles that are subject to safety recalls, both of which DOT sought.[37] Additional changes to the agency's authorities sought by DOT that it believes would improve NHTSA's ability

[35]GAO, *Results-Oriented Cultures: Implementation Steps to Assist Mergers and Organizational Transformations*, GAO-03-669 (Washington, D.C.: July 2, 2003).

[36]The administration's proposal for surface-transportation reauthorization sought to increase NHTSA's civil penalty cap from $35 million to $300 million.

[37]Pub. L. No. 114-94, div. B, title XXIV, §§ 24109, 24110.

to oversee motor-vehicle safety include adding imminent hazard authority and requiring that used-car dealers fix defects before making cars available to the public.[38]

Budgetary Resources

Another type of challenge to NHTSA's oversight of safety defects is whether it has sufficient budgetary resources, including resources for staff and IT. According to one literature review article that examined NHTSA and industry actions in the case of Toyota unintended acceleration, NHTSA needs increased funding to fulfill its mission, noting that the agency's funding has decreased at the same time that automotive technology and the demands of investigating defects have increased.[39] With increased funding, the article asserts that NHTSA would be able to add new staff and technological resources to ODI. Stakeholders we spoke with varied in whether they thought ODI needed more staff or IT resources. For example, 4 of 17 stakeholders said ODI needs more staff. One stakeholder we spoke with said that since ODI has such limited resources, the office cannot be more aggressive and has to rely on manufacturers to flag problems. However, 2 stakeholders said ODI needed resources for IT improvements more so than for additional staff.

NHTSA requested a three-fold increase in the budget for ODI for fiscal year 2016—from $9.7 to $31 million—to add staff and improve its IT systems. The proposal sought to add 57 positions that the agency says are needed to process and analyze the growing number of consumer complaints it receives and to attend to increasingly complex safety issues arising from the proliferation of in-vehicle electronics. Among the 57 proposed positions are 2 data analysts to perform EWR compliance audits and data analysis in support of open investigations and an additional 12 engineers to conduct investigations of passenger vehicles, a figure that would nearly double the number of investigators in ODI.[40] NHTSA also proposed two new divisions for ODI—a Trend Analysis

[38]While NHTSA has the authority to order a recall, the agency does not have "imminent hazard" authority, which would permit NHTSA to order manufacturers to stop further production, sale, or distribution of vehicles containing a defect found to present an imminent hazard to public safety that may result in death or serious bodily harm.

[39]Finch, "A Case Study of the National Highway Traffic Safety Administration."

[40]NHTSA's budget request for ODI requested 28.5 FTE, which the agency translates to 57 positions for the office.

Division to conduct broad trend analysis of all ODI data and a Field Investigation and Testing Division to conduct investigations of specific vehicles with alleged defects. The fiscal year 2016 request also sought funds to continue implementation of the CIF, but during hearings and through legislation some members of Congress have indicated that they are hesitant to provide additional resources until management issues are resolved. Some stakeholders also shared this view; for instance, 4 stakeholders said that adding staff would not be helpful until NHTSA takes other steps, such as remedying their processes or determining the right mix of new skills needed. As noted above, the Comprehensive Transportation and Consumer Protection Act of 2015 authorized increased funding for fiscal years 2016 through 2020 for NHTSA's motor-vehicle safety program as well as authorizing additional funding after the Secretary of Transportation certifies that NHTSA has implemented the 17 recommendations made by the DOT OIG.[41]

Implementation of New IT System Is Under Way, but NHTSA Could Improve Some Project-Management Practices

NHTSA could improve its project management for implementing the CIF system to ensure that the full capabilities of the system and its tools are made available to ODI in a timely fashion. For example, NHTSA lacks an overall schedule for customizing the CIF tools for ODI—initial customizations needed to deploy the tools for staff use and future customizations that will add further capabilities. While NHTSA developed management plans for implementing the base CIF system infrastructure and created a team to help carry out this work, NHTSA's efforts do not fully align with other recognized project-management practices. In particular, NHTSA's management plans do not include or integrate all aspects of CIF implementation, including ODI's work to customize and release the CIF tools. An integrated approach to managing CIF implementation can help ensure that all relevant staff across offices are aware of the status of various CIF-related activities and thus effectively coordinate on these activities.

[41]Pub. L. No. 114-94, div. B, title XXIV, § 24101. The Comprehensive Transportation and Consumer Protection Act of 2015 authorized about $133 million for fiscal year 2016 with annual increases to $144 million for fiscal year 2020 and authorized as additional amounts, if NHTSA implements all the 2015 DOT OIG recommendations, $46 million for fiscal year 2016 with annual increases to $70 million for fiscal year 2020.

Implementation of NHTSA's IT System Continues

NHTSA's implementation of the CIF has been delayed and as a result, NHTSA continues its work to implement the CIF for all staff to use in ODI. Within NHTSA, ODI intends to use the CIF to enhance its ability to identify vehicle safety risks faster, reduce the time spent investigating potential safety problems, and better document ODI's actions, according to ODI officials and agency documents. Making these improvements is necessary, according to ODI officials, because of the growing volume of consumer complaints. NHTSA has also noted that the CIF will provide capabilities that can help address problems identified by the 2015 DOT OIG audit. NHTSA is taking a two-step approach to implementing the CIF system.

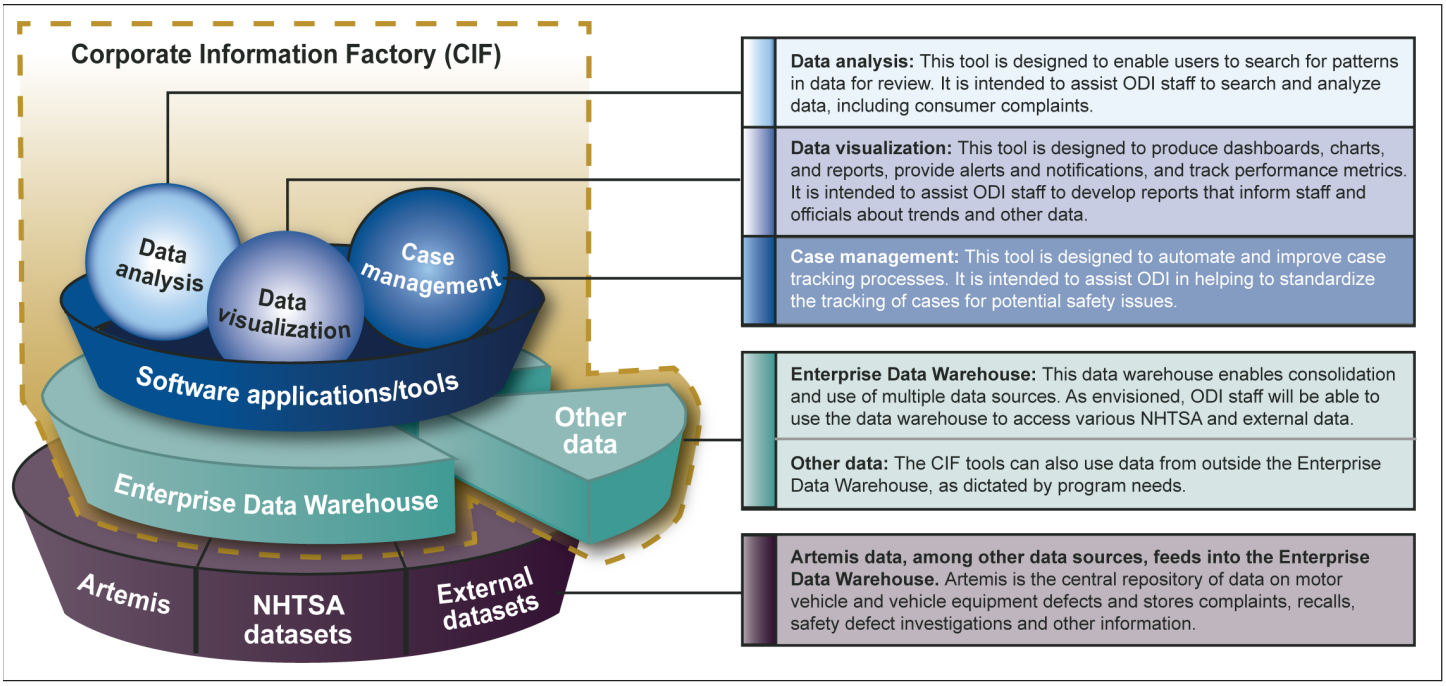
- *Base CIF system*: First, OCIO is deploying the base CIF system, which primarily focuses on providing the infrastructure (i.e., hardware and software) to support the three software applications or tools as well as designing and developing a data warehouse.[42] The base CIF system was originally planned to be deployed by April 2015 with a total estimated cost to OCIO of about $24.1 million.[43]
- *CIF tool customizations*: Second, program offices, including ODI, are responsible for customizing the three CIF tools to best meet program offices' needs—that is, to enhance or modify the CIF tools to develop specific capabilities such as creating tailored reports or adding search parameters needed by a program office as described subsequently in this report. ODI estimates that it will cost about $1.4 million to complete its CIF customizations through fiscal year 2016.

The CIF has four main components: three tools and an enterprise data warehouse (see fig. 3).

[42]The contractor also implemented a limited number of program-driven customizations as part of the base CIF system. According to OCIO officials, these customizations represented functions that were high-value and resource-intensive, with other functions to be developed outside the contract by individual program offices.

[43]This total includes costs to implement the base CIF system for fiscal years 2011 through 2016. Estimated costs for fiscal year 2016 include labor costs for contractors with expertise on the CIF tools and operation and maintenance costs for servers and software.

Figure 3: Components of the National Highway Traffic Safety Administration's (NHTSA) Corporate Information Factory for the Office of Defects Investigation (ODI)



Source: GAO analysis of NHTSA information. | GAO-16-312

- **Data analysis.** The Watson Content Analytics tool is designed to enable users to search data for patterns and to provide the capacity to support the review of unstructured or narrative data, like consumer complaints. According to ODI, this tool is expected to assist ODI screeners in searching and analyzing consumer complaints and other data, thereby reducing the amount of time it takes to identify vehicle safety risks. For instance, an ODI official explained that defects investigation staff currently have to use simple key word searches, like Boolean search terms, to search consumer complaints and then download the information to another program like Microsoft Excel or Access to conduct analyses. The official said that this approach is time consuming as there is currently no standardized analysis program in use within ODI. In 2015, the DOT OIG reported that while ODI pre-investigation screeners are encouraged to query all consumer complaints for vehicle safety risks in their areas of concentration, half of the screeners reported not doing this because, in some cases, it takes too much time.

- **Data visualization.** The Cognos tool is designed to produce dashboards and other reports to provide on-demand access to information, provide alerts and notifications, and track workload and performance metrics. According to an ODI official, this tool aims to assist ODI officials in developing reports that inform officials about trends in consumer complaints and other data more efficiently than in the past, as developing some reports required that staff manually compile data.

- **Case management.** The Advanced Case Manager tool is designed to automate and improve case-tracking processes. According to ODI, this tool is expected to help standardize case tracking (i.e., potential safety issues) that is part of ODI's pre-investigation processes. Case tracking is intended to enhance ODI's accountability for its decision-making, such as whether an investigation should be opened on a potential safety issue, and improve records retention. Historically, ODI has had no single program that allowed its staff to track cases as part of the pre-investigation process, according to an ODI official. According to the 2015 DOT OIG report, ODI does not always adequately document its decisions not to investigate potential safety issues during its pre-investigation process, so decisions lack transparency and accountability. This has made it difficult for ODI officials to justify why investigations were not opened for certain safety issues, including the GM ignition-switch safety defect.

- **Enterprise data warehouse.** The enterprise data warehouse is designed to enable consolidation and use of multiple data sources by NHTSA program offices. The three CIF tools are designed to pull data from the enterprise data warehouse for program offices to conduct data analyses and develop reports. At first, it is envisioned that the enterprise data warehouse will contain data for the program offices initially using the CIF, according to an OCIO official. For instance, for ODI, the enterprise data warehouse will contain data from Artemis and select external sources, like consumer complaints from the Center for Auto Safety.[44] Ultimately, according to OCIO and ODI officials, the plan is for the enterprise data warehouse to contain additional NHTSA data, including special crash-investigation reports, so that all NHTSA program offices, including ODI, can access these

[44]The Center for Auto Safety, a consumer-advocacy organization, allows consumers to submit complaints on its website. The Center for Auto Safety makes all the submitted complaints available to the public.

data. According to NHTSA, this will allow ODI and other program offices to analyze data across program offices automatically, rather than having to manually compile data as is currently required. This ability to share data across organizational boundaries is intended to enhance NHTSA's ability to address deficiencies it and others have identified.

NHTSA began implementing the base CIF system for agency-wide use following an early pilot in ODI. In 2010, OCIO and ODI officials first explored purchasing a new IT system to enhance ODI's IT capabilities. In fiscal year 2012, OCIO initiated a pilot to support ODI with its pre-investigation process. During the pilot, some ODI staff had access to certain features of the CIF data analysis and data visualization tools. For example, using the data analysis tool during the pilot, an ODI official said that ODI's pre-investigation staff could search the consumer complaint data in more ways than in Artemis, such as by component, symptom, and vehicle type or make. ODI's pre-investigation staff also had access to a chart in the data visualization tool that showed the vehicles with the highest number of consumer complaints, which they could filter by vehicle component, date, and other attributes and use to directly access the underlying consumer complaints. The pilot continued through fiscal year 2013, during which time OCIO and ODI staff gained familiarity with CIF tools, according to OCIO and ODI officials. Using those experiences, OCIO and ODI developed initial requirements[45] to expand the base CIF system beyond the functionality provided in the pilot, both to enhance the capabilities available to ODI and to support use of the CIF by other program offices in NHTSA, including Corporate Average Fuel Economy (CAFE). In September 2014, OCIO signed a contract with CDW Government, a private contractor, to build the base CIF system infrastructure and implement the initial requirements.

Originally scheduled for full implementation by April 2015, OCIO completed its work to deploy the infrastructure and tools for the base CIF system in August 2015. In May 2015, NHTSA and its contractor modified its contract to address network, database, and configuration issues encountered while implementing the base CIF system. Due to these issues, OCIO officials determined that the contractor needed additional time to correct configuration issues with the installed software, conduct

[45]A requirement is a condition or capability needed by a user to solve a problem or achieve an objective.

tests of the CIF system infrastructure to validate that the tools in the base system worked and that information was saved when offline, and to train and provide initial support to OCIO personnel who will be responsible for administering the CIF system, among other tasks.[46] After resolving the issues that delayed implementation of the base CIF system, OCIO deployed the three tools in the base system in scalable environments in August 2015. This deployment enabled users in NHTSA's program offices, including ODI, to test the base tools, a necessary step before program offices could then further customize and use the tools.

After the base CIF system is implemented for all three tools, customization for the tools must be completed and additional data must be added to the enterprise data warehouse before ODI staff will be able to use the CIF system as ultimately envisioned. The base tools provide some initial capabilities, but each of the three CIF tools will require numerous customizations to support ODI's mission.[47] Additional information on these customizations and the time frames for their completion is provided below. Furthermore, OCIO officials said that as of December 2015 the infrastructure for the enterprise data warehouse is deployed but that they plan for additional data sets to be incorporated through at least 2016. Therefore, the CIF will not provide the full set of capabilities NHTSA and ODI envision for the CIF—like quickly filtering and searching data from across the agency—until the enterprise data warehouse matures and contains additional data sets.[48]

[46]The contract to implement the base CIF system was for one year, with options for four one-year support and maintenance periods, for a total period of up to 5 years. Since the contract to implement the base CIF system ended on September 30, 2015, the tasks in the contract modification did not extend the contract but are being performed as part of the support and maintenance contract. The total cost of this and two other modifications is about $1.5 million.

[47]For example, when NHTSA's OCIO deployed the data-analysis and data-visualization tools, each included some initial customizations that were completed by the contractors. For example, the data analysis tool includes the capability to review content on the Center for Auto Safety website to enable ODI to search this content to help detect or examine trends. When OCIO deploys the case management tool, it will include some initial customizations, like being able to automatically create a new case for every consumer complaint.

[48]NHTSA was in the initial planning stages for the enterprise data warehouse during our review, so we were unable to comprehensively review and comment on the implementation of the enterprise data warehouse.

NHTSA Could Improve Some Aspects of Its CIF Project Management

NHTSA Lacks an Overall Project Schedule for Customizing and Releasing CIF Tools for ODI

While the deployment of the base CIF system is a key step in implementing the CIF, ODI must also complete dozens of customizations for the CIF tools before the tools meet ODI's requirements. As discussed above, the base CIF system includes some initial capabilities, but additional customizations are necessary to meet ODI's needs, particularly for the data-visualization and case-management tools. For example, one ODI customization for the data visualization tool creates a report that shows the most active automobile models based on the severity of consumer complaints received by NHTSA (e.g., crashes with injuries or fatalities, crashes with fires), a report that is intended to help staff as they determine whether to propose investigations on particular vehicle risks. ODI has enlisted Volpe to complete all of ODI's tool customizations to date.[49] As of December 2015, Volpe staff completed 8 customizations for the data analysis tool and 29 customizations for the data visualization tool. For the case management tool, ODI has mapped its pre-investigation process to develop the requirements for customizing the tool but has not determined how many customizations will be needed to satisfy these requirements. ODI officials said that there is no total number of customizations for each tool because more customizations will likely be needed as the CIF tools are integrated into ODI's processes.

ODI and Volpe have developed a schedule for completing customizations for one CIF tool but have not created an overall project schedule for sequencing and carrying out customization work for all three tools. *CMMI® for Development* states that the project planning process should cover all phases of the project and that an overall schedule, to include major milestones for the project and an ordered sequence of tasks, should be established and maintained. DOT's *IPPM Governance Guide* states that planning documents, including a schedule, can be used to

[49]ODI and Volpe have an interagency agreement that states that Volpe's work may include customizing the three CIF tools and supporting database and data management. For example, Volpe's work includes programming to develop unique reports in the data visualization tool and supporting the data synchronization and integration processes and procedures between the CIF and the Artemis systems.

manage a project's daily progress and ensure the project is implemented on time. ODI and Volpe recently created a schedule for completing initial customizations for the data analysis tool by May 2016. The schedule includes timelines for completing several tasks to provide additional capabilities to pre-investigation staff, such as incorporating expanded data from EWR field reports and enabling further analysis of EWR data.[50] ODI has also identified near- and long-term capabilities for all three CIF tools that require customization, but ODI has not established a comprehensive project schedule to sequence or set timelines for this work.

ODI officials said they did not have an overall schedule for the CIF tool customization work because they view CIF tool customization as an ongoing process. That is, additional customizations will be needed as ODI staff understand and learn to better use each tool. For the case management tool, for example, ODI finished mapping its pre-investigation process to develop the initial requirements for customizing the tool in fall 2015.[51] According to ODI, the office plans to deploy the case management tool with this initial set of customizations by early February 2016. This deployment is intended to enable testing, pilot use, and staff training for ODI's initial screening of consumer complaints. Now that ODI has mapped its current business rules and processes, ODI can determine how those rules and processes should further evolve, since, according to officials, the CIF system provides radical, new tools that offer the office capabilities it did not have before. Thus, ODI officials explained that additional customizations will be sought in the future. In addition, after ODI completes and releases customizations for the case management tool for the pre-investigation process, ODI plans to look to expand use of the case management tool to other ODI processes, according to an ODI official. Last, ODI's rollout of the CIF is complicated by the changes that ODI is making to its processes based on the 2015 DOT OIG

[50]A field report is a report prepared by an employee or representative of a manufacturer concerning the failure, malfunction, lack of durability, or other performance problem of a motor vehicle or item of motor vehicle equipment. ODI staff initially have access to basic information from each field report in the data analysis tool like the make, model, and model year, but ODI seeks to make the text that is read from the field report available in order to use the tool's natural-language-processing capabilities to analyze the full text.

[51]In 2012, ODI deployed interim software solutions to meet its case management needs. According to ODI, lessons learned from using the interim software solutions helped inform the requirements for customizing the case management tool.

recommendations and NHTSA's internal process improvements, according to one ODI official. Therefore, this official said that strict adherence to the schedule ODI and Volpe are developing for customizing the data analysis tool should not come at the expense of ODI making other improvements to its safety-defect investigation process.

While ODI must balance its work to customize the CIF tools with other activities and its current resources, an overall schedule could help ODI plan and manage this work. A schedule with high-level milestones for completing tasks would enable ODI and Volpe to better manage and prioritize all CIF tool customization activities. *CMMI® for Development* states that larger projects can contain multiple phases, which in the case of the CIF could include finishing initial customizations for each tool and sequencing future customizations. Further, *CMMI® for Development* also states that identifying milestones that must be demonstrated before the following step is initiated provides some flexibility in a schedule and a better view of the state of the project. Therefore, an overall schedule that organizes work and includes milestones is compatible with ODI's view that implementing the CIF is an ongoing process and can incorporate the schedule ODI and Volpe created for the data analysis tool. Moreover, given the changes occurring in ODI and the complexity of implementing the CIF, an overall schedule could help ODI officials track progress of CIF tool customizations to ensure the work advances toward release dates for initial and future customizations for each of the tools.

A project schedule could also encapsulate key activities for training ODI staff to use the CIF tools. While ODI conducted some training with ODI staff during the CIF pilot, ODI has not developed a schedule for training ODI staff to use the three CIF tools. *CMMI® for Development* states an organization should establish and maintain a training plan and the *IPPM Governance Guide* states that standard operating procedures and training materials should be developed to transition to the new system. In September 2015, ODI held an initial briefing and demonstration for all ODI staff on the data analysis and data visualization tools, but an ODI official said that ODI is determining whether ODI staff or an external trainer should develop and lead future trainings. In September 2015, NHTSA executed a contract to map ODI's business processes to the capabilities of the CIF tools in order to develop a training program, according to NHTSA officials. Once the training program is developed, ODI officials said it will take time for all staff to fully leverage the tools in their work. Therefore, by including training in an overall project schedule, ODI could help ensure that all staff understand how to make full use the new CIF tools in their work. This aligns with DOT's *IPPM Governance*

Guide that says comprehensive training should be provided to staff with additional training needed when the new software tools are particularly complex.

NHTSA Follows Some Recognized Practices, but Lacks an Integrated Approach to Managing All Aspects of the CIF

NHTSA has implemented some recognized project-management practices for its implementation of the CIF. For example, OCIO has established project management, risk management, and requirements management plans for implementing the base CIF system infrastructure and initial capabilities. The development of these plans is consistent with recognized project-management practices set forth in *CMMI® for Development*, which states that the project plan and other plans should account for current and projected needs, objectives, and requirements of the organization. The plans developed by OCIO describe how OCIO officials will manage the base CIF system project work; identify, analyze, plan, and control for CIF system risks; and update and accept CIF system requirements, which align with recognized practices in DOT guidance and *CMMI® for Development*. OCIO also created an integrated program team consisting of key staff from OCIO, ODI, and another program office to focus on OCIO's implementation of the base CIF system and initial capabilities. OCIO's CIF project charter describes generic roles and responsibilities for all the integrated program team members and establishes processes for working with this team, such as monthly progress updates on implementing the CIF.

OCIO and ODI have distinct responsibilities for implementing the CIF system, but neither office has assumed responsibility for leading the overall implementation of the CIF system. OCIO is primarily responsible for implementing the base CIF system infrastructure, while ODI is primarily responsible for customizing the three CIF tools to meet ODI's needs. However, these activities have never been integrated into a single plan. *CMMI® for Development* states that the project plan and other plans that affect the project should be integrated and that the project plan should account for current and projected needs, objectives, and requirements of the organization and end users as appropriate.[52] The guidance also stresses the importance of stakeholder involvement to identify, negotiate, and track critical interrelated tasks, as well as

[52]Further, federal-internal control standards require that an agency's organizational structure clearly define key areas of authority and responsibility and establish appropriate lines of reporting. GAO, *Standards for Internal Control in the Federal Government*, GAO/AIMD-00-21.3.1 (Washington, DC: Nov. 1, 1999).

establishing coordination among stakeholders to ensure the quality and integrity of the overall project. However, our review of OCIO's plans for the CIF found that they do not include or describe ODI's responsibilities to further customize and deploy the CIF tools for staff use. For example:

- OCIO and ODI have separate processes for managing CIF risks. OCIO has a risk management plan that explains how OCIO officials identify, analyze, plan, and control for CIF system risks, including tracking risks in a register and reviewing these risks every week. This plan, which focuses on managing risks for the CIF agency-wide, also identifies the members and role of OCIO's risk review team, which includes OCIO and contractor staff but no ODI or Volpe staff. ODI has a separate process for identifying and managing risks for CIF tool customizations that similarly does not involve OCIO officials. An ODI official explained that ODI and Volpe staff meet quarterly to discuss and record any major customization risks, which ODI and Volpe track in a separate document from OCIO's risk register.

- OCIO and ODI also take different approaches to assessing whether the CIF meets the goals for the system. The CIF project charter includes goals and outcomes for the CIF system. To track progress toward fulfilling these goals and outcomes, OCIO officials said they demonstrate that the implementation of the base CIF system satisfies requirements. According to OCIO officials, the CIF system test plan—a plan that includes tests to verify that the system meets specified requirements—is another way that OCIO determines whether the CIF meets stated goals and outcomes. For example, the system test plan includes testing to verify that the case-linking capability functions and meets requirements. OCIO also conducted tests to ensure continuity of operations and stability of the system infrastructure, according to OCIO officials. Separately from OCIO, program offices including ODI have their own goals and outcomes for the CIF system. As noted earlier, ODI aims to use the CIF to enhance its ability to identify vehicle safety risks faster, reduce the time spent investigating safety problems, and better document ODI's actions. ODI has not established any performance measures, but an ODI official said ODI plans to develop performance measures to, for example, measure whether and to what extent efficiency gains occur through using the three CIF tools. According to DOT's *IPPM Governance Guide* project-management plan template, performance measures should be generated during a project's early stages and establish a time frame for developing specific targets, how measures are documented, and the frequency with which measures are reviewed and updated.

OCIO officials told us that OCIO and ODI have distinct responsibilities for implementing the CIF because ODI has previous experience managing the design and development of its historical IT system, Artemis. Therefore, Volpe's work to customize the CIF tools for ODI has not been incorporated into OCIO's overall project plan. ODI has worked with Volpe since 2002 to establish Artemis and, since then, add functionality and data to that IT system. According to ODI, the process ODI officials and Volpe staff use to approve and implement CIF tool customizations is based on the process used to make changes to Artemis, and these changes are outlined in the Artemis Configuration Management Plan. OCIO officials said that since Volpe is completing the work to implement ODI's CIF tool customizations, OCIO is not the lead office for defining or carrying out CIF tool customizations for ODI but provides support to ODI, as needed. Thus, OCIO has a limited leadership role overseeing ODI-specific CIF tool customizations.[53] By contrast, OCIO officials explained that for other program offices using the CIF system that do not have experience managing IT system design and development, OCIO takes a greater leadership role managing CIF customization work from beginning to end. For example, OCIO took the lead in assisting NHTSA's CAFE program office in determining its business needs and requirements for the CIF, according to an OCIO official. In the future, OCIO officials told us that they plan to take a greater leadership role as other program offices seek to use the CIF system.

OCIO, through its contractor, is developing a CIF shared-services guide to describe how OCIO will manage the CIF now that the base system is in place. NHTSA's OCIO also executed a contract to develop a standard, end-to-end process for working with program offices to tailor, test, and deliver CIF tool customizations. According to OCIO officials and agency documents, these efforts would help ensure that there is a standard, predictable process for OCIO to use to engage program offices throughout NHTSA to use the CIF to meet each office's needs. A January 2016 draft of the CIF shared-services guide outlines an approach where program offices will engage with OCIO to define, acquire, and get support on services to meet each program office's needs, and defines initial

[53]According to OCIO officials, once ODI completes a tool customization, OCIO's change control board reviews and approves the deployment of each customization to ensure it will not negatively affect the CIF infrastructure and performance. However, this change control board does not review the content of or need for a particular ODI customization, according to OCIO officials.

metrics that OCIO will use to measure CIF shared services performance, including usage, uptake, and satisfaction of program offices. According to OCIO officials, this approach will apply to all program offices, including ODI. While the draft of this guide provides a road map for an integrated-management approach to the CIF for new program offices seeking to use the CIF, it does not contain details on responsibilities for OCIO and program offices or specify how OCIO and program offices will coordinate on activities like managing risks.

An integrated approach to managing the implementation of a new system like the CIF can help ensure that all relevant staff are appropriately aware of the status, plans, and activities of remaining work and can appropriately coordinate their work, as stated in *CMMI® for Development*. Therefore, without an integrated management approach, NHTSA risks that staff from OCIO and the program offices seeking to use the CIF now and in the future may not effectively coordinate to implement the CIF tools to meet program-specific needs. OCIO and ODI officials indicated that they did not believe it was necessary to formally integrate their respective plans for implementing the CIF tools in ODI. According to OCIO and ODI officials, NHTSA is a small, collaborative agency, so they are able to communicate on the CIF as needed. Further, an OCIO official explained that though they have distinct responsibilities, the two offices are partners on the CIF and OCIO has taken a proactive role on the CIF system. However, a more integrated approach would benefit OCIO, ODI, and other program offices. For instance, by being more formally involved with ODI's customization work, OCIO could be able to apply experiences and lessons learned to help with other program offices' tool customization needs. Moreover, stronger coordination and project-management support from OCIO could benefit ODI, in particular as ODI makes initial customizations available to staff and seeks to evaluate whether the CIF tools meet ODI's goals for the CIF. Further, until the data warehouse is complete, ODI will not be able to integrate disparate data across NHTSA program areas and will not have near real-time access to additional NHTSA data, including crash data, in the form of dashboards, reports, graphs, and charts. As OCIO is leading the work to add more data to the enterprise data warehouse, coordination and integration can help ODI and other program offices better plan for when and how they can leverage access to this data to conduct their work.

NHTSA Has Taken Some Steps to Address the Oversight of New Technologies but, unlike Selected Agencies, Has Not Yet Developed a Strategic Plan to Guide the Agency's Efforts

NHTSA Has Undertaken Various Efforts to Address New Technologies in Its Oversight of Vehicle Safety

In light of the rapid pace of technological advancement in motor vehicles and to help address some of the challenges discussed above, NHTSA has started several new efforts in recent years intended to help the agency stay abreast of technological advancements and improve its ability to oversee the safety of new technologies. These efforts are broader than ODI and span the research, rulemaking, and enforcement offices within NHTSA responsible for vehicle safety. Some of the agency's earlier efforts were in response to statutory requirements, while other efforts have been undertaken under the agency's initiative. NHTSA efforts taken in response to statutory requirements in the *Moving Ahead for Progress in the 21st Century Act* (MAP-21) include:

- *Establishing an Electronics Council*: NHTSA established the Electronics Council in October 2012 as required in MAP-21.[54] The council's mission is to provide a forum for research, rulemaking, and enforcement officials to coordinate and share information internally on advanced vehicle electronics and new technologies. According to NHTSA officials, the council meets bi-monthly to discuss key technology issues. Additionally, the council sponsors trainings for

[54]Pub. L. No. 112-141 § 31401(a) (2012).

vehicle safety staff on relevant issues such as process standards for functional safety systems, shares information learned at external conferences, and discusses issues such as the industry's progress in forming an information-sharing analysis center on cybersecurity issues. Moreover, the Council has led other efforts required by MAP-21 of NHTSA as discussed below.

- *Examining need for safety standards for electronic control systems*: The Electronics Council is examining the need for safety standards for electronic control systems, in response to a MAP-21 requirement. MAP-21 required that NHTSA report to Congress on the effort.[55] In connection with this effort, NHTSA is conducting systematic hazard analyses on select safety-critical electronic control systems, like brakes and steering, to better understand the vehicle-level safety risks and is developing categories of failures related to electronic control systems to help the agency and others analyze potential safety problems, among other efforts. NHTSA issued a request for public comment in October 2014 and issued its report in January 2016. As part of its examination, NHTSA is considering whether to adopt process standards—standards that prescribe specific processes for developing vehicle electronic systems—which would be a departure from its current approach of developing performance standards. That is, standards that set a specific level of performance but not the method that manufacturers use to meet that standard. Although NHTSA officials believe the agency has the authority to issue process standards, industry groups have raised questions, and the agency requested explicit authority in the Administration's reauthorization proposal.[56] NHTSA plans to announce a decision regarding this and other issues related to electronic control systems in 2016. According to agency officials, the decision could be to conduct more research, initiate a rulemaking, issue guidance, or some combination thereof.

- *Establishing an Honors Recruitment Program*: In 2012 NHTSA created an honors recruitment program as required by MAP-21 to enable students in engineering, computer science, and others interested in vehicle safety to train with agency engineers and other

[55]Pub. L. No. 112-141 § 31402. NHTSA was required to complete this examination by July 2014 and report to Congress upon completion of the effort.

[56]This authority for NHTSA was not included in the Comprehensive Transportation and Consumer Protection Act of 2015.

safety officials for careers in vehicle safety.[57] As of November 2015, two undergraduate engineering students had completed this program.

Other NHTSA efforts to improve its oversight of new technology, undertaken under the agency's initiative, include:

- *Updating EWR requirements*: In 2013 NHTSA updated its regulations regarding manufacturers' EWR requirements to incorporate several new technologies, including stability control systems, forward collision avoidance, lane departure prevention, and backover prevention, to the list of component categories that manufacturers use to report EWR data to NHTSA.[58] This additional reporting is intended to assist NHTSA screeners and investigators in identifying safety defects related to these technologies. These changes were effective as of August 2014.

- *Updating the New Car Assessment Program (NCAP)*: In December 2015, NHTSA announced plans to incorporate crash avoidance technology features such as blind spot warning and lane departure prevention in its star-rating system, which had previously been limited to crashworthiness and pedestrian protection technologies.[59] NHTSA requested comments on these proposed changes, which would be implemented in 2018 starting with model year 2019 vehicles, and plans to publish a final decision in 2016. We and others have previously recommended that NHTSA examine NCAP, including developing approaches to incorporate ratings of crash-avoidance technologies.[60] For example, in 2015 the National Transportation Safety Board (NTSB) recommended that NHTSA expand NCAP to include a rating system to assess the performance of forward collision

[57]Pub. L. No. 112-141 § 31401(b).

[58]78 Fed. Reg. 51382 (Aug. 20, 2013).

[59]80 Fed. Reg.78522 (Dec. 16, 2015). Under NCAP, which began in 1978, NHTSA provides consumers with information about crash protection, rollover safety, and crash avoidance technologies beyond what is required by law. The program aims to encourage market forces that prompt vehicle manufacturers to make safety improvements to new vehicles and provide the public with objective information on the relative safety performance of vehicles. Star ratings were introduced in 1994 and are intended to be a more consumer-friendly approach to conveying the relative safety of vehicles subject to NCAP's crash tests.

[60]GAO, *Vehicle Safety: Opportunities Exist to Enhance NHTSA's New Car Assessment Program*, GAO-05-370 (Washington, D.C.: Apr. 25, 2005).

avoidance systems. Additionally, in November 2015 NHTSA announced that automatic emergency-braking systems would be added to NCAP's list of recommended features starting with model year 2018 vehicles.[61]

- *Creating the Electronic Systems Safety Research Division*: In January 2012, NHTSA created a new division focused on vehicle electronics within Vehicle Safety Research's Office of Vehicle Crash Avoidance.[62] This division conducts research on electronics reliability, automated vehicles, and cybersecurity. For example, one recent project was a summary of best practices in the field of cybersecurity involving electronic control systems across a variety of industries.

- *Upgrading the VRTC facility*: Vehicle Safety Research identified opportunities to upgrade equipment for its test center in 2012 that would improve its ability to test new technologies. The new equipment it has since acquired includes a dynamometer, GPS satellite simulators, and a spectrum analyzer.[63] The dynamometer, for example, can be used to test a variety of vehicle systems in a lab rather than on a test track or without having to fake signals to vehicle control systems. NHTSA can also use the dynamometer in conjunction with a GPS simulator to further immerse a vehicle in a simulated environment to conduct cybersecurity research. The GPS simulators can prompt test vehicles to detect and simulate situations in repeatable trajectories in the lab. The agency's fiscal year 2016 budget request called for additional funds for additional space and new equipment as well as funds for a new program on vehicle

[61]Automatic emergency-braking systems can use information from the vehicle's sensors to enhance the driver's ability to avoid or mitigate rear-end crashes. These systems can provide automatic braking when forward-looking sensors indicate that a crash is imminent and the driver is not braking or can provide supplemental braking when sensors determine that driver-applied braking is insufficient to avoid an imminent crash. In September 2015, NHTSA announced that 10 automakers have committed to including automatic emergency braking systems in all new vehicles.

[62]When the new division was created, the office became the Office of Vehicle Crash Avoidance and Electronic Controls Research.

[63]A dynamometer allows for testing in an indoor laboratory environment, where a vehicle's wheels can spin at speed, under load, with the engine running. A GPS satellite simulator generates the same signals that are broadcast by navigation satellites and enable users to test any device or system with a GPS receiver. A spectrum analyzer, in conjunction with other electronic test equipment, is used to understand wireless and wired communications internal and external to vehicles.

electronics and emerging technologies to build on its ongoing research to support planned agency decisions. For example, additional equipment that NHTSA seeks for the VRTC includes service and diagnostic code readers from additional manufacturers, as NHTSA currently has such code readers from just two manufacturers; additional software licenses; and radiofrequency test equipment such as a channel emulator that could imitate radio channel characteristics.

- *Creating the Vehicle Innovation Team*: This effort, initiated in April 2015, includes an examination of the agency's regulatory framework to identify obstacles to vehicle automation. The team has begun an internal review of its standards, regulations, and other guidance and is reaching out to manufacturers to identify potential challenges. For example, some current standards, such as those addressing turn indicators and electronic stability control, reference steering wheels, which may not be necessary in a fully automated vehicle. Without some type of modification to the current standards, it is not clear whether manufacturers would be permitted to market a vehicle that is steered without a steering wheel. Another example of a potential regulatory challenge to vehicle automation is NHTSA's authority to allow manufacturers to produce only a limited number of vehicles that do not meet FMVSSs, which is currently capped at 2,500.[64] As part of its internal review, NHTSA is exploring the possibility of seeking solutions, such as expanded exemption authority, which could allow NHTSA greater flexibility to respond to quickly evolving technology. However, the recently created team has not yet established specific goals, objectives, timelines, or milestones to guide its work and assess its progress, although NHTSA officials told us they were working to do so.[65]

In addition to recent initiatives, the agency's ongoing interactions with the automotive industry allow it stay abreast of new developments in

[64]NHTSA is authorized to exempt vehicle manufacturers from temporarily complying with FMVSSs. 49 U.S.C. § 30113(b). NHTSA permits such exemptions to facilitate the development or evaluation of certain new technologies as long as the safety or impact protection level is at least equal to that of the standard. 49 C.F.R. § 555.6. As set out in statute, manufacturers may not sell more than 2,500 vehicles in a 12-month period under such an exemption. 49 U.S.C. § 30113(d).

[65]In addition, DOT announced initiatives to accelerate vehicle-safety innovations in January 2016 including that NHTSA will propose best-practice guidance to industry on establishing principles of safe operations for fully autonomous vehicles by July 2016.

automotive technology, according to NHTSA officials. For example, NHTSA staff periodically attend industry conferences, and Vehicle Safety Research hosts a manufacturer for a meeting or a demonstration of a new technology or feature about once a month, according to NHTSA officials. NHTSA sets the agendas for these meetings to learn about new technologies and features as well as what happens when the technologies or features do not function as expected. Two manufacturers told us that these meetings are helpful in keeping NHTSA officials up-to-date on developments in vehicle technology while an industry group representative told us that NHTSA needs to communicate more with industry about new technologies and that these meetings used to be more frequent and more productive. NHTSA also contracts with external entities such as SAE International, a standards-setting organization, to provide on-site training to agency staff on an as-needed basis to leverage NHTSA's training budget. Furthermore, NHTSA is coordinating with NTSB to learn about its investigative process and to discuss how NHTSA may be able to utilize NTSB's training related to new technologies to further leverage its training budget. NHTSA officials also participate as non-voting members of standard-setting committees within SAE International, which, according to NHTSA officials, helps them stay informed of developments in new technologies.

NHTSA also supports ongoing department-level efforts related to new technologies. Specifically, the Intelligent Transportation System Joint Program Office directs and administers the department's overall program related to connected vehicles and automated vehicles, and NHTSA leads and directs specific tasks in support of the overall effort. For example, NHTSA is pursuing actions to require that manufacturers install the underlying vehicle-to-vehicle technologies that would enable vehicle-to-vehicle applications in new passenger cars and light trucks, requested comment on this issue in an August 2014 Advanced Notice of Proposed Rulemaking, and according to agency documents, anticipates issuing an Notice of Proposed Rulemaking in 2016.[66] Further, NHTSA is conducting research to develop human factors principles that may be used by

[66]79 Fed. Reg. 49270 (Aug. 20, 2014).

manufacturers as they design vehicle-to-infrastructure and other driver-vehicle interfaces.[67]

NHTSA's Strategic Planning Is Ongoing, with a Plan Promised in Spring 2016

NHTSA has completed some strategic-planning steps specific to vehicle electronics research, while work on a broader strategic plan for the agency continues. According to NHTSA officials, the agency initiated a planning effort in 2010 focused on research strategies to address vehicle electronic systems safety. At the same time, NHTSA requested the aforementioned TRB study on safety assurance challenges arising from the proliferation and growing complexity of automotive electronics. The TRB report was released in 2012 and recommended that NHTSA initiate a strategic-planning effort that gave explicit consideration to the safety challenges resulting from vehicle electronics and consider near- and longer-term changes that will be needed in NHTSA's scope, direction, and capabilities.[68] TRB also recommended that NHTSA make the strategic plan public in order to help guide key policy decisions—from budgetary to legislative—that will determine the scope and direction of the agency's vehicle safety programs. According to NHTSA officials, the agency incorporated some of these recommendations into its strategic planning for research on vehicle electronic systems safety, and in 2012 completed three internal research road maps to correspond to three facets of electronic systems safety—electronic reliability, cybersecurity, and vehicle automation. These road maps set forth high-level goals along with related objectives, initiatives, and outcomes. For example, the vehicle-automation research road map identifies two objectives—to support policy decisions on emerging automated systems and to facilitate the development and deployment of automated systems that enhance safety—along with six agency initiatives and associated outcomes. One such ongoing initiative is to support agency policy decisions through human factors research, which applies knowledge about human abilities, limitations, and other characteristics to the design of vehicle-related

[67]We previously issued a report on benefits expected from DOT's efforts related to vehicle-to-vehicle and vehicle-to-infrastructure technology as well as challenges that exist to realizing those benefits. GAO, *Intelligent Transportation Systems: Vehicle-to-Vehicle Technologies Expected to Offer Safety Benefits, but a Variety of Deployment Challenges Exist*, GAO-14-13 (Washington, D.C.: Nov. 1, 2013); and GAO, *Intelligent Transportation Systems: Vehicle-to-Infrastructure Technologies Expected to Offer Benefits, but Deployment Challenges Exist,* GAO-15-775 (Washington, D.C.: Sept. 15, 2015).

[68]Transportation Research Board, *Special Report 308*.

equipment and tasks. This research provides data on driver engagement, among other things.

NHTSA also periodically issues priority plans that communicate the focus of the agency's research and rulemaking activities. These priority plans generally cover 2 to 3 years and identify some agency priorities as well as the agency's planned actions and milestone dates for those priorities. Projects and activities are selected for inclusion in the priority plan based on crash data, testing, computer modeling, and simulation, which together help identify technologies that offer the greatest promise in reducing injuries and preventing crashes, along with the agency's road maps discussed above, congressional mandates, and recommendations from the NTSB. For example, the most recent plan (2015–2017) identifies as priorities the MAP-21-required examination of the need for safety standards for electronic control systems, research on crash avoidance technology for heavy vehicles such as truck tractors and buses, and development of procedures to test the effectiveness of technologies that automatically brake to mitigate or avoid an impending forward collision with a pedestrian.

While NHTSA has undertaken strategic planning specifically related to vehicle safety research, its effort to complete a strategic plan for the agency continues. In 2009, NHTSA announced that it was beginning work on a strategic plan that would cover 2012 through 2020. In February 2014, NHTSA held a public meeting to seek input on its draft strategic plan that covered 2014 through 2018, which it was finalizing at the time. When we discussed the status of this plan with NHTSA officials in the summer of 2015, they said that leadership changes and competing priorities had temporarily halted work on the strategic plan. Since then, NHTSA officials stated that they have resumed work on a strategic plan that builds on the effort leading up to the 2014 listening session and that they plan to release a strategic plan for the agency in spring 2016 that will cover 2017 through 2020.

Completion of this agency-wide plan is a critical step to better position the agency as it takes on the challenges posed by new automotive technologies. As we have previously reported, a strategic plan can help unify an agency's staff in the pursuit of shared goals and facilitate internal coordination, as well as prioritize initiatives in a constrained budget environment. Further, strategic planning can aid organizations to set

goals and performance measures by which progress can be judged and efforts prioritized.[69] For example, a strategic plan could help NHTSA coordinate activities identified in its 2015–2017 priority plan—such as activities conducted by the Electronics Council—with activities conducted by the Vehicle Innovation Team, which is also examining whether and how the agency could adapt its regulatory framework to accommodate new technologies. Furthermore, a strategic plan may facilitate coordination among the various offices responsible for vehicle safety and may be particularly important for NHTSA as the senior associate administrator position, which had been responsible for leading and coordinating efforts among these offices, was recently eliminated in an effort to make reporting to agency leadership more efficient and effective.

Selected Agencies' Approaches to Overseeing New Technologies Use Strategic Planning and Formalized Methods to Identify Developments in New Technologies

Selected Agencies Share Challenges in Overseeing the Safety of New Technologies, but Differ in Terms of Regulatory Framework, Workload, and Funding

To compare NHTSA's efforts to oversee new technology, we reviewed the efforts of two other agencies with similar safety oversight missions, FAA and FDA. All three agencies are charged with overseeing the safety of products—vehicles, aircraft, and medical products, respectively—that can be subject to rapidly changing technologies.[70] As discussed above, vehicles are becoming increasingly complex as they rely more on electronic systems for their critical functions and as the industry moves towards incorporating more connected- and automated-vehicle technologies. Aircraft technology is also advancing rapidly with the introduction of new uses for materials and components, such as

[69]GAO, *Agencies' Strategic Plans Under GPRA: Key Questions to Facilitate Congressional Review*, GAO/GGD-10.1.16 (Washington, D.C.: May 1997).

[70]Each of the three agencies has a broader safety oversight mission. For example, FDA also regulates tobacco, animal drugs, animal feed, and foods. However, for the purpose of our review, we only focused on certain products.

composite materials and lithium-ion batteries, as well as new types of user technologies like unmanned aerial systems (UAS) and commercial space vehicles that FAA must safely integrate into the national airspace. Likewise, medical products have seen rapid advances in technology such as sequencing the human genome, novel cell and gene therapies, nanotechnology, and improved materials science that have transformed medical devices. Despite these technological advances, each agency is charged with ensuring the safety of the products it regulates. While the safety missions of these three agencies are similar, the agencies differ in terms of their regulatory frameworks as well as their workload and funding, based on our review of statutes, regulations, and other agency documents as well as our prior work.

FAA's and FDA's statutory authorities and accompanying regulatory frameworks rely much more than NHTSA's on a review of the regulated products before they are sold to the public. For example, aircraft manufacturers and operators must ensure that aircraft have obtained all required FAA certifications before introducing new aircraft into service.[71] FAA issues design and production certificates based on its evaluation and inspection against standards set forth in federal aviation regulations and related FAA guidance.[72] Similarly, under FDA, some medical products—drugs, biologics, and medical devices—must obtain the agency's license

[71]FAA is overseeing the implementation of a new approach—called a safety management system (SMS) approach—both within FAA and throughout the U.S. aviation industry. Under SMS, FAA and manufacturers will use aviation safety data they collect to proactively identify conditions that could lead to safety problems. See GAO, *Aviation Safety: Additional Oversight Planning by FAA Could Enhance Safety Risk Management*, GAO-14-516 (Washington, D.C.: June 25, 2014), and GAO, *Aviation Safety: Additional FAA Efforts Could Enhance Safety Risk Management*, GAO-12-898 (Washington, D.C.: Sept.12, 2012).

[72]Under 14 C.F.R. Part 183, FAA has the authority to use private individuals and organizational entities, known as designees, to carry out many certification activities on behalf of the FAA administrator in order to enable FAA to better concentrate its staff resources on safety-critical functions.

or approval before they can be legally marketed in the United States.[73] With both FAA and FDA, these pre-market activities can take several years, and both agencies have acknowledged the need to improve the timeliness of these activities and have taken some steps to do so.[74] NHTSA's pre-market process, by contrast, requires that manufacturers self-certify their products' adherence to NHTSA's FMVSSs. Each year, NHTSA tests a random selection of vehicles to verify that manufacturers' certifications are valid.

Once regulated products are on the market, differences among these agencies' regulatory approaches continue (see table 1). FAA staff periodically inspect foreign and domestic repair stations and documentation to ensure continued compliance with safety standards. When violations are identified, FAA may take compliance or legal enforcement actions.[75] Similarly, FDA continues to assess medical products' risks and benefits after the products are on the market. For

[73]Medical devices include instruments, apparatuses, machines, and implants that are intended for use to diagnose, cure, treat, or prevent disease, or to affect the structure or any function of the body. 21 U.S.C. § 321(h). Examples include simple tools such as tongue depressors and thermometers as well as high-tech life-saving implants such as artificial heart valves and pacemakers. Some medical devices are subject to FDA review before they are marketed, although most low-risk devices and some medium-risk devices are exempt from pre-market review. 21 U.S.C. § 360(k)-(l). Biologics are derived from living sources (such as humans and animals), unlike drugs, which are chemically synthesized, and include blood, vaccines, allergenic products, certain tissues, and cellular and gene therapies. 42 U.S.C. § 262(i). FDA's approval is required before new drugs and biologics can be marketed for sale in the United States. 21 U.S.C. § 355, 42 U.S.C. § 262.

[74]For example, as we noted in 2014, industry stakeholders and experts have long raised questions about the efficiency of FAA's certification and approval processes. GAO, *Aviation Manufacturing: Status of FAA's Efforts to Improve Certification and Regulatory Consistency*, GAO-14-829T (Washington, D.C.: July 31, 2014). As required by the FAA Modernization and Reform Act of 2012 and in response to other recommendations, FAA is taking action to improve its certification and approval processes. Initiatives range from developing a comprehensive road map for major change initiatives to improving the project sequencing process. Moreover, as we found in 2009, FDA did not meet all of its requirements and performance goals related to its medical oversight responsibilities in fiscal years 2004 through 2008. For example, we found that the percentage of applications for generic drugs reviewed within the required time frame declined from 87 percent in fiscal year 2004 to 32 percent in fiscal year 2008. Additionally, the agency did not meet its goals related to the speed at which it scheduled and held meetings and responded to sponsor requests for the same time period. In response to our recommendations, the agency launched a study to develop an evidence-based approach to resource estimation focused on medical products.

[75]See FAA Order 2150.3B, *FAA Compliance and Enforcement Program* (June 11, 2014).

example, FDA collects and analyzes adverse event reports related to the use of new drugs from manufacturers, physicians, and the public, among others, to identify potential safety issues associated with the use of the drugs. The agency's review of these reports may lead FDA to require the product's sponsor to conduct a post-market safety study, make changes to product labeling, or suspend a drug's approval upon a finding of imminent hazard to public health. Additionally, FDA may levy civil penalties in certain circumstances. To monitor the safety of motor vehicles on the road, as discussed above, NHTSA reviews consumer complaints, EWR data, and other information to identify safety issues. When NHTSA identifies a safety defect, NHTSA can order a recall and can impose civil penalties on manufacturers for violations of requirements relating to the recall process.

Table 1: Examples of Pre-market, Post-market, and Enforcement Mechanisms for NHTSA, FAA, and FDA

	Pre-market	Post-market	Enforcement
NHTSA	NHTSA sets safety standards Manufacturers self-certify compliance to safety standards	NHTSA tests and inspects new vehicles to ensure compliance with safety standards NHTSA monitors consumer complaints, required manufacturer data, and other information sources to identify safety defects	Recall (order)[a] Civil penalties[b]
FAA	FAA sets safety standards FAA certifies that aircraft meet safety standards	FAA periodically inspects repair stations and documentation to verify adherence to standards	Administrative actions such as warning notices and letters of correction[c] Legal enforcement actions such as suspension or revocation of certificate, civil penalties, or injunctions[c]
FDA	FDA develops guidance and issues regulations to guide certain medical product sponsors through the pre-market process FDA reviews data from certain medical product sponsors and, if it determines that the product is safe and effective for its intended use or, for medical devices, is substantially equivalent to a legally marketed device, approves the product FDA periodically inspects clinical-trial and certain medical-product-manufacturing sites	FDA periodically inspects certain medical-product-manufacturing sites FDA collects and reviews data on adverse events	FDA may require a product sponsor to conduct a post-market safety study or order changes to product labels[d] Recall (mandatory for medical devices)[e] FDA may impose civil penalties in certain circumstances[f]

Source: GAO presentation of agencies' data. | GAO-16-312

[a]NHTSA has the authority to order manufacturers to conduct a recall, but manufacturers can challenge the agency's order in court and during this challenge can refrain from conducting a recall campaign and continue to sell the potentially unsafe product pending the outcome of the challenge. 49 U.S.C. § 30118(b)(2).

[b]49 U.S.C. § 30165(a).

[c]FAA Order 2150.3B, *FAA Compliance and Enforcement Program* (June 11, 2014).

[d]21 U.S.C. §§ 3601, 355; 42 U.S.C. § 262.

[e]FDA has mandatory recall authority for medical devices, meaning manufacturers face a mandatory requirement to conduct a recall and refrain from distributing their product to retailers, regardless of any challenge the manufacturer may make to the order. 21 U.S.C. § 360h(e), 21 C.F.R. pt. 810 (2010).

[f]FDA may impose civil penalties for many violations related to medical devices, 21 U.S.C. § 333(f)1)(A), but has limited authority to impose such penalties for violations related to human drugs or biologics.

These three agencies also differ in workloads and funding as outlined in table 2 below. Additionally, while all three agencies receive annual appropriations, FAA's budget is largely supported by dedicated passenger and industry fees appropriated from the Airport and Airway Trust Fund, and FDA's budget includes amounts derived from user fees paid by the industry in connection with FDA activities.[76] NHTSA, on the other hand, has no additional funding sources and cannot retain fines that it levies. Overall, while these differences make drawing direct comparisons on the agencies' capacity to oversee new technologies difficult, such information provides helpful context when considering each agency's approach to oversight of new technology.

Table 2: Comparison of Agencies' Scope of Products Overseen and Funding

	Illustrative products on market (2014)	Illustrative new products (2014)	Funding (2014)
NHTSA	Over 265-million vehicles on the road	1,179 new make-model combinations	$819-million total for NHTSA, including $134 million for vehicle safety
FAA	Over 210,000 certified aircraft in service	Issued 1,027 type certificates and supplemental type certificates[a]	$15.9-billion total for FAA, including $1.2 billion for Aviation Safety and $87 million for related research, engineering, and development
FDA	4-billion prescriptions filled; 150-million flu vaccines distributed	130 new drugs approved 18 original biologics approved 3,183 medical devices approved or cleared	$4.3-billion[b] total for FDA, including $1.9 billion for medical product programs[c]

Source: GAO analysis of agency, Kaiser Family Foundation, and Centers for Disease Control and Prevention documents. | GAO-16-312

Note: Data are generally for calendar year 2014, although funding data for the three agencies and information on illustrative new products for FAA and FDA are for fiscal year 2014.

[76]We previously found that decisions regarding the setting of user fees can affect the level of regulatory activity. GAO, *Federal User Fees: Key Considerations for Designing and Implementing Regulatory Fees*, GAO-15-718 (Washington, D.C.: Sept. 16, 2015).

[a]A type certificate signifies that airplanes manufactured to conform to the basic airplane and systems design will meet FAA's standards for the safe conduct of flights. For products that have already been issued a type certificate, FAA may issue a supplemental type certificate for modifications to the original design.

[b]Of this total, $1.7 billion is from user fees and $2.6 billion is from general revenues.

[c]Funding data include funding for human drugs, biologics, and devices and radiological health, and of this total, $951 million is from user fees and $998 million is from general revenues. Funding for inspections and Centers of Excellence in Regulatory Science and Innovation are not included in these totals.

Like NHTSA, FAA and FDA Collaborate with Industry, but They Also Use Strategic Planning and Formalized Methods to Stay Abreast of New Technologies

In terms of commonalities, all three agencies have mechanisms for collaborating with the industries they regulate such as meetings and demonstrations with manufacturers, informal seminars on new technologies, and meetings with industry groups to discuss current issues. Officials from each agency highlighted the importance of these mechanisms for learning about new technologies. Additionally, all three agencies collaborate with universities and other entities to conduct research, although FAA and FDA have more established mechanisms for collaborating with universities. Specifically, FAA and FDA both sponsor centers of excellence at universities. FAA's program launched in 1990 and includes centers that focus on new technologies such as advanced materials for aircraft and UAS. In 2011, FDA began funding Centers of Excellence in Regulatory Science and Innovation, and these centers have provided education and training and have conducted research on a variety of subjects such as the suitability of using 3D printing for testing the performance of certain bio-imaging techniques. While NHTSA has not created centers of excellence, it does work with external parties, including pre-approved contractors that bring together universities, manufacturers, suppliers, and other stakeholders, as part of its electronics and cybersecurity research. For example, a university conducted crash data analysis for NHTSA's report to Congress on heavy trucks, and another external group conducted human factors research to determine the amount of time needed by a driver to retake control of a vehicle from an automated driving state.

One difference between NHTSA's approach to overseeing new technologies and the approaches of FDA and FAA is that the latter two agencies have agency-wide strategic plans. FDA has an agency-wide strategic plan that is linked to its effort to respond to the accelerating pace of new technologies—the Advancing Regulatory Science Initiative. Through this initiative, launched in 2010, FDA aims to accelerate the process from scientific breakthrough to the availability of new medical

products.[77] Since then, the agency has issued multiple documents on its strategic planning related to the Advancing Regulatory Science Initiative.[78] This initiative built on FDA's other work to narrow the gap between the number of discoveries occurring in biomedical science and technology and the declining number of new medical treatments submitted for FDA approval. One effort associated with the initiative is the Medical Device Innovation Consortium, a public-private partnership that aims to improve product quality before devices are sold, which could lower the incidence of problems with medical devices and free FDA resources to focus on high-impact recalls. Further, FDA issued a strategy and implementation report in 2013, which was required by statute, in which FDA provided examples of how the work from the Advancing Regulatory Science Initiative had been adopted in FDA's oversight of medical products. Among the examples were new or updated guidance and regulations, including guidance to help create a pathway for accelerated approval of new cancer therapies.

While FAA does not have a specific initiative to address new technologies like FDA, its overall strategic plan, together with business plans developed by individual FAA offices, provide strategic direction for the agency's efforts, including those related to new technologies. For example, while FAA generally addresses new technologies in aircraft that are not covered by established safety standards through its special conditions process, in certain cases FAA may take additional steps to address new technologies.[79] For example, UAS present a number of unique regulatory challenges, and FAA has taken a number of actions to address these challenges. For example, in 2013, FAA released a

[77]GAO is conducting separate work on this initiative that is expected to be published in April 2016.

[78]FDA first published a strategic framework in 2010, followed by a strategic plan in 2011. Moreover, FDA's Strategic Priorities for 2014 through 2018 include advancing regulatory science as one of five cross-cutting priorities that are relevant to each strategic goal in the plan.

[79]Through the special conditions process, FAA may create conditions that the manufacturer must meet in order to demonstrate that new technology in an airplane meets the required level of safety. For example, when certifying design features related to the Boeing 787's composite fuselage, existing standards assumed that fuselage skin would be made from conventional aluminum. Therefore, FAA required Boeing, via the special conditions process, to develop a test to show that the composite fuselage was resistant to flame propagation and that any by-products that resulted from the test were not hazardous.

comprehensive plan and integration roadmap to outline the actions and considerations needed to safely integrate UAS into the national airspace. FAA's road map includes an approach to creating standards and a certification process specific to UAS to create a repeatable and predictable process that is currently lacking. Further, the road map is linked to the Office of Aviation Safety's business plan as well as to FAA's overall strategic initiatives. While we and others have noted that FAA's road map and comprehensive plan for UAS lack important implementation details, these strategic documents lay the broad groundwork for FAA to oversee this new class of aircraft. As noted above, while NHTSA does not currently have a strategic plan in place, it is working on a plan which it plans to issue in the spring of 2016.

Additionally, FAA and FDA have each established formalized methods to monitor product advancements, in particular new technologies, in the industry it regulates. FAA established a panel of chief scientists, called the Chief Scientific and Technical Advisors, to provide expertise on different issues that affect aircraft, including composites, icing, electromagnetic interference, and weight turbulence. According to FAA, the rapid technological advances in aviation safety require a limited number of personnel that possess knowledge and skill in certain highly specialized disciplines. According to FAA officials, the panel's responsibilities include scanning the industry by, among other things, speaking with the military to identify new technologies under development. FDA officials said that the agency recently created an Emerging Sciences Council to consider what technologies will be emerging in medical products in the next 5 to 10 years. FDA is currently finalizing the details of this council, which is composed of senior scientists from across the agency, but FDA officials said council activities may include coordinating with other agencies that conduct research and thus are aware of innovations early in their development. While NHTSA's established the Electronics Council, as discussed above, in part to stay abreast of technological developments in vehicle electronics and other areas, the council has also been tasked with implementing near-term projects such as reporting to Congress regarding the need for safety standards for electronic control systems and facilitating the honors recruitment program.

Conclusions

NHTSA is making changes to improve its processes to address challenges identified by the agency and others, and the implementation of its new IT system, the CIF, is a key change ODI is making to improve its ability to identify safety defects. The tools available through the CIF

system are intended to provide ODI staff with enhanced capabilities to more efficiently access and analyze data, among other things. NHTSA and others believe these enhancements offer significant opportunities for ODI to better use the growing amount of data available to identify potential safety risks. To take full advantage of these tools, ODI must customize them—that is, create tailored reports, add data sources, and adapt the search parameters—to fit its needs and business processes. ODI recently created a schedule with Volpe for completing an initial set of customizations for one of the three CIF tools, but ODI has no overall project schedule for carrying out additional tool customizations and training staff to take advantage of the new capabilities provided by the tools. ODI officials view the work to customize the CIF tools as an ongoing process, coupled with the idea that officials will seek to continually evolve and improve ODI's business processes. However, a schedule is an essential tool for managing such an important implementation process, and recognized practices, including DOT's own program-management guidance, stress the importance of creating and maintaining a schedule for IT projects. A schedule would help ODI track its progress and establish next steps, as well as help ensure that ODI makes timely progress toward incorporating the CIF tools into staff's day-to-day activities.

In its implementation of the CIF system, NHTSA has taken some steps to coordinate with program offices including ODI. For instance, NHTSA used an integrated program team for implementing the base CIF system and initial requirements. However, this integrated approach does not extend to the work ODI does to customize the three CIF tools for its use. Specifically, the absence of an integrated approach for implementing the CIF, as evidenced by OCIO and ODI having separate plans and approaches for managing risk and assessing outcomes, limits NHTSA's capacity to efficiently and effectively implement the CIF tools in ODI and other program offices. NHTSA is currently defining how OCIO will work with program offices to help these offices take advantage of CIF capabilities, a step that provides an opportunity to establish an integrated approach for managing the CIF that can help ensure staff from different offices understand their roles and responsibilities and coordinate effectively to use the CIF. An integrated management approach can help ensure that recognized practices, such as a program office's establishing performance measures to assess whether it meets its goals using CIF tools, are followed as more program offices seek to use the CIF.

More broadly, the number and complexity of vehicle electronic systems continues to expand, creating safety challenges and opportunities for

NHTSA and the automotive industry. NHTSA has taken some steps to address these new technologies, including examining what agency oversight tools might impede safety advances in automated vehicles and completing some strategic planning to guide research on vehicle electronics. However, NHTSA has not completed a strategic plan for the agency, though NHTSA is currently drafting and expects to release a strategic plan in spring 2016. Completion of an agency-wide strategic plan is an important step to guide agency actions, including those related to new vehicle technologies, in a unified way. Because the TRB committee already recommended that NHTSA complete and make public a strategic plan and because NHTSA officials said they are currently drafting a strategic plan for the agency, we are not making a recommendation at this time. It remains important that NHTSA prioritize the completion of a strategic plan that will identify agency goals and priorities—in light of the current and expected industry trends—to inform its decision making and allocate its resources going forward. A strategic plan would also build on the agency's other outreach efforts to share its vision for overseeing the safety of vehicles with the automotive industry, safety groups, and other stakeholders, all of which are adapting to the profound changes occurring in vehicles today.

Recommendations for Executive Action

To facilitate NHTSA's implementation of a new IT system within ODI as well as other program offices and to help ensure that the system's capabilities are available for staff to use in a timely manner, we recommend that the Secretary of Transportation direct the Administrator of NHTSA to take the following two actions:

- Develop a schedule for customizing CIF tools for ODI, to include milestones for releasing the CIF tools for ODI staff to use and developing training for staff on the CIF tools, as well as prioritizing and sequencing the customization work to be done.
- Establish an integrated management approach for implementing the CIF capabilities that (1) establishes clear lines of authority and roles and responsibilities among the program offices and the OCIO and (2) outlines how offices will coordinate project-management practices, such as managing risks and measuring performance, for the CIF.

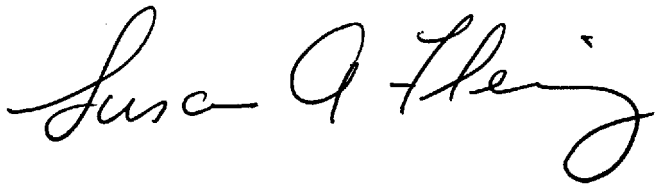
Agency Comments

We provided a draft of this report to DOT and the Department of Health and Human Services for review and comment. In written comments, reproduced in appendix II, DOT concurred with our recommendations and highlighted steps NHTSA is taking to improve its management practices

for IT investments including the CIF. DOT and the Department of Health and Human Services also provided technical comments that were incorporated, as appropriate.

As agreed with your offices, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies to the Secretary of Transportation and the Secretary of Health and Human Services. In addition, the report will be available at no charge on the GAO website at http://www.gao.gov.

If you or your staff have any questions about this report, please contact me at (202) 512-2834 or flemings@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix III.



Susan Fleming
Director, Physical Infrastructure Issues

List of Committees

The Honorable Fred Upton
Chairman
The Honorable Frank Pallone, Jr.
Ranking Member
Committee on Energy and Commerce
House of Representatives

The Honorable Michael C. Burgess, M.D.
Chairman
The Honorable Jan Schakowsky
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Subcommittee on Commerce, Manufacturing, and Trade
Committee on Energy and Commerce
House of Representatives

The Honorable Tim Murphy
Chairman
The Honorable Diana DeGette
Ranking Member
Subcommittee on Oversight and Investigations
Committee on Energy and Commerce
House of Representatives

Appendix I: Objectives, Scope, and Methodology

This report examines the National Highway Traffic Safety Administration's (NHTSA) oversight of safety defects and ability to adapt to new developments in automotive technology. Specifically, this report examines (1) the challenges that have been identified for NHTSA's oversight of safety defects since 2005 and the actions NHTSA has taken in response, (2) the status of NHTSA's implementation of a new information technology (IT) system for safety-defect investigations and the extent to which its implementation is aligned with recognized project-management practices, and (3) how NHTSA is addressing new automotive technologies in its oversight of vehicle safety and how its efforts compare to those of other regulatory agencies that oversee industries with new technologies.

To determine the challenges NHTSA faces in its oversight of safety defects in passenger vehicles, we examined a variety of sources to identify recurring themes and persistent challenges.[1] Specifically, we identified reports on NHTSA's safety defects investigation and recall processes published from 2005 through 2015 by GAO, the Department of Transportation's (DOT) Office of Inspector General (OIG), the National Research Council, and NHTSA. We limited our review to this time period as it included several high-profile safety-defect recalls and followed the implementation of changes to NHTSA's oversight of safety defects following enactment of the Transportation Recall Enhancement, Accountability and Documentation (TREAD) Act in 2000. For each of the identified reports, we examined the findings and recommendations related to NHTSA's processes to identify and investigate safety defects. We also conducted a literature search to identify scholarly journal articles, conference papers, think tank publications, and other documents from appropriate sources covering the same time period.[2] We conducted these searches working with our research librarian and methodologist to help ensure a comprehensive coverage of relevant information.[3] We then examined the literature found through our searches to identify the papers

[1]The focus of this report is on NHTSA's oversight of commercially sold passenger vehicles. Therefore, we did not focus on vehicle equipment like car seats or on heavy trucks or motor coaches.

[2]See appendix IV for a list of the literature articles and reports we reviewed.

[3]For example, databases we searched included Academic OneFile, Ei Compendex, National Technical Information Service (NTIS), Transportation Research International Documentation (TRID), and WorldCat.

and articles that were germane to our report (i.e., that analyzed NHTSA's processes to identify and investigate safety defects). Additionally, we interviewed stakeholders—industry groups, automotive manufacturers, safety advocates, and researchers (see table 3). We selected stakeholders to ensure variety in their roles and based on recommendations from interviewees; moreover, we selected automotive manufacturers to ensure variety in market share and number of makes or brands. Overall, we interviewed 17 stakeholder individuals and groups. At the time we conducted our analysis to identify the most frequently cited challenges, described below, we had completed 12 initial stakeholder interviews.[4] The information and perspectives that we obtained from the interviews may not be generalized to all industry stakeholders that have an interest in vehicle safety.

We then reviewed the information from each of these sources to summarize the cited challenges and identify the most frequently cited challenges. To describe the actions NHTSA has taken or proposed in response to these challenges, we reviewed DOT and NHTSA documents, including budget requests and two reports released in June 2015 outlining proposed changes to defects investigations—*NHTSA's Path Forward* and *Workforce Assessment: The Future of NHTSA's Defects Investigations*. We also interviewed officials from NHTSA's Office of Defects Investigation (ODI) and other Vehicle Safety offices to learn about changes that were under way or planned. We did not evaluate the sufficiency of steps taken or planned by NHTSA to respond to each challenge, as some steps require additional NHTSA budget resources and other steps were being assessed by the DOT OIG at the time of our review.

Table 3: List of interviewees

Advocates for Highway and Auto Safety
AAA Foundation for Traffic Safety
Alliance of Automobile Manufacturers
Consumer Reports
Erika Jones, Mayer Brown

[4]We completed five additional interviews—four with automotive manufacturers and one with a standards-setting organization—after the analysis. We asked these additional interviewees about challenges facing NHTSA's oversight of safety defects.

Ford Motor Company
Global Automakers
Insurance Institute for Highway Safety
Joan Claybrook and Clarence Ditlow III, Public Citizen and Center for Auto Safety
Leonard Evans, Science Serving Society
Randy Whitfield, Quality Control Systems Corporation
Richard Wallace, Center for Automotive Research
SAE International
Sean Kane and Ellen Lieberman, Safety Research & Strategies, Inc.
Subaru
Toyota
Volkswagen

Source: GAO. | GAO-16-312.

To assess NHTSA's implementation of a new IT system, we analyzed NHTSA guidance and documents on (1) overall plans and procedures to implement the new system—the Corporate Information Factory (CIF)—for the agency and (2) plans and procedures to tailor and make CIF capabilities available to ODI.[5] These documents included contracts, inter-agency agreements, project schedules and management plans, and tracking documents. To identify criteria by which to assess NHTSA's implementation of the CIF, we reviewed a variety of guidance and standards for project management and IT acquisition and development, including those issued by GAO, the Software Engineering Institute (SEI), and the Office of Management and Budget. In consultation with internal experts and given our focus on implementation of an IT system, we determined that the following two sources were most applicable to our review: SEI's *Capability Maturity Model® Integration (CMMI®) for Acquisition* and *CMMI® for Development*, which set out recognized, key IT management practices; and DOT's *Integrated Program Planning and Management (IPPM) Governance Guide*, which outline DOT's processes

[5]NHTSA is implementing the CIF system to be an agency-wide system. Three program offices—ODI, Corporate Average Fuel Economy, and Crash Data Acquisition Network—were involved in identifying the initial requirements for developing and deploying CIF capabilities throughout the agency. We focused primarily on NHTSA's implementation of the CIF for ODI since ODI's program needs helped drive the investment in the CIF and a pilot of the CIF.

and expectations for IT system planning.[6] We also used leading practices for effective strategic workforce planning to supplement information on workforce-planning and human-capital considerations included in SEI and DOT.[7] From these sources, we identified six key project-management documents to analyze in detail: the charter; project management plan; requirements management plan; risk management plan; development guides for testing, training, and procedures; and workforce plan. We evaluated NHTSA's project-management documents for the CIF against specific recognized project-management practices identified by DOT and SEI. We also interviewed NHTSA officials from ODI and the Office of the Chief Information Officer (OCIO) about the roles and responsibilities of the NHTSA offices involved in implementing CIF capabilities for defects investigations. We also interviewed these officials about the overall goals for the CIF, how NHTSA was measuring progress toward meeting these goals, and the schedule for completing various CIF tasks, as well as on areas where NHTSA's CIF project-management documents did not align with the recognized practices.

To examine how NHTSA addresses new automotive technologies in its oversight of vehicle safety, we reviewed relevant legislation, such as the *Moving Ahead for Progress in the 21st Century Act* (MAP-21), and NHTSA documents such as budget requests, research and rulemaking priority plans for vehicle safety and fuel economy, and requests for comments on vehicle safety programs. In particular, we reviewed NHTSA's October 2014 *Federal Register* notice seeking comments on the agency's examination of the need for safety standards for automotive electronic control systems and NHTSA's summation of received

[6]DOT, Office of the Chief Information Officer, *Integrated Program Planning and Management (IPPM) Governance Guide*, May 2010, and Software Engineering Institute, *CMMI® for Acquisition, Version 1.3*, and *CMMI® for Development, Version 1.3*, November 2010. The DOT IPPM guide highlights the processes and activities necessary to ensure that IT solutions are properly planned and managed and includes templates for several project-management documents—including the project charter, project management plan, and risk management plan—that we used in conjunction with the IPPM. The CMMI® models collect best practices from government and industry to help organizations improve their processes and effectively manage projects. The high-level practices in the DOT *IPPM Governance Guide* are consistent with practices described by *CMMI® for Acquisition* and *CMMI® for Development*.

[7]GAO, *Human Capital: Key Principles for Effective Strategic Workforce Planning*, GAO-04-39 (Washington, D.C.: Dec. 11, 2003), and *DOD Business Systems Modernization: Further Actions Needed to Address Challenges and Improve Accountability*, GAO-13-557 (Washington, D.C.: May 17, 2013).

comments in a draft of its report to Congress on electronic control systems. In addition, we interviewed NHTSA officials to learn about specific efforts—such as changes to its organizational structure and training or other workforce efforts—that the agency has taken or plans to take to adapt to new technologies. In addition, we interviewed agency officials about the steps, if any, the agency had taken in response to recommendations made by the a Transportation Research Board committee to identify near- and longer-term changes that may be needed in NHTSA's regulatory programs in light of advances in vehicle electronics. For new technologies, we focused on electronic control systems because these systems, while already widely used in vehicles, are also the underpinning for several technologies in development such as those that would enable connected vehicles and automated vehicles. We did not examine NHTSA's efforts related to vehicle cybersecurity because we are conducting separate work on this topic. Also, our examination did not include one office within Vehicle Safety—the National Center for Statistics Analysis—as we recently completed work on the modernization of its crashworthiness data system.[8] We also interviewed 17 stakeholders that interact with NHTSA on vehicle safety, as described above, to gather their views on and experiences with NHTSA's oversight of new automotive technologies.

To compare NHTSA's efforts to those of other regulatory agencies that oversee industries with new technologies, we reviewed similar planning and other documents and interviewed officials from the Food and Drug Administration (FDA) and Federal Aviation Administration (FAA). We also reviewed agency documents and GAO reports describing each agency's regulatory approach, statutory authorities, strategic-planning efforts, and efforts related to new technologies. We selected these two agencies because they have missions similar to NHTSA (i.e., overseeing the safety of products affected by new technologies), take different approaches to overseeing their respective industries, and have been the subject of recent GAO work.

[8]GAO, *Auto Safety: Status of NHTSA's Redesign of Its Crashworthiness Data System*, GAO-15-334 (Washington, D.C.: Mar. 6, 2015).

Appendix II: Comments from the Department of Transportation

U.S. Department
of Transportation

**Office of the Secretary
of Transportation**

Assistant Secretary
for Administration

1200 New Jersey Avenue, SE
Washington, DC 20590

FEB 16 2016

Susan Fleming
Director, Physical Infrastructure Issues
U.S. Government Accountability Office
441 G. Street N.W.
Washington, DC 20548

Ms. Fleming:

The Office of Defects Investigation (ODI) within the National Highway Traffic Safety Administration (NHTSA) is the leading authority for identifying and addressing vehicle safety defects. As vehicles have become more integrated with new technologies, including the advancement of in-vehicle electronics and automation, the complexity of safety issues warranting attention and possible investigation has increased. Accordingly, ODI has taken steps to further enhance its working knowledge about new and emerging technologies and the interrelationship between vehicle systems. NHTSA has implemented new business intelligence software to enhance ODI's data analysis efforts and introduce predictive analysis capabilities. Specifically, it developed a corporate information factory (CIF) consisting of multiple software programs and a data warehouse to meet the data analytics needs for not only ODI, but for all NHTSA program areas. In ODI, CIF helps staff manage data related to automotive complaints, determine trends, and identify defects. The CIF also allows ODI to increase data transparency and reduce the time taken to identify new defect trends that may occur with the development and implementation of new technology.

To enhance the usability of the CIF, NHTSA continues to customize its capabilities and provide specialized training to screeners and investigators. During this process, ODI collaborated with NHTSA's Office of the Chief Information Officer (OCIO) to efficiently deploy CIF into ODI's business processes. Given that NHTSA is planning to implement the CIF within other program offices, the OCIO has made several improvements to its management practices for information technology (IT) investments to include the following:

- Established a project management office (PMO) staffed with experienced and credentialed project managers to develop policies and governance for managing IT investments.
- Created a new division—the Office of Information Management—whose mission includes disseminating PMO guidance and managing the CIF investment to support program office requirements. The new office will adopt an integrated project management approach for CIF implementation and utilization across the agency.
- Hired a contractor specializing in IT consulting to analyze ODI's current business processes, identify quantitative and qualitative benefits of integrating CIF into ODI's

processes, and recommend additional process improvements and training needs to ensure CIF's capabilities are maximized. NHTSA plans to use the contractor's findings to document lessons learned which it will apply to other program offices' needs.

Upon review of the draft report, NHTSA concurs with the two recommendations to develop an overall project schedule for customizing CIF applications for ODI and adopt an integrated project management approach for the CIF. We will provide a detailed response to each recommendation within 60 days of the final report's issuance.

We appreciate this opportunity to respond to the GAO draft report. Please contact Madeline Chulumovich, Director Audit Relations and Program Improvement, at (202) 366-6512 if you have any questions or would like additional details.

Sincerely,

Jeff Marootian
Assistant Secretary for Administration

Appendix III: GAO Contact and Staff Acknowledgments

GAO Contact

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Staff Acknowledgments

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Appendix IV: Articles and Reports Used to Identify Challenges Facing NHTSA's Oversight of Safety Defects

Literature Review Articles

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Kaufmann, Daniel. *Capture by "Main Street": Was the Car Safety Regulatory Agency Asleep at the Wheel?* Washington, D.C.: Brookings, February 11, 2010. Accessed December 16, 2014. http://www.brookings.edu/research/opinions/2010/02/11-toyota-safety-kaufmann.

Kelley, Benjamin. "Why the United States Lags in Auto Safety and Lessons It Can Import." *Journal of Public Health Policy*, vol.31, no.3, September 2010: 369-377.

Pecht, Michael, Arun Ramakrishnan, Jeffrey Fazio, and Carl E. Nash. "The Role of the U.S. National Highway Traffic Safety Administration in Automotive Electronics Reliability and Safety Assessment." *IEEE Transactions on Components and Packaging Technologies*, vol.28, no.3, September 2005: 571-580.

Relevant Reports

GAO. *Auto Safety: NHTSA Has Options to Improve the Safety Defect Recall Process*. GAO-11-603. Washington, D.C.: June 15, 2011.

U.S. Department of Transportation Office of Inspector General. *Process Improvements are Needed for Identifying and Addressing Vehicle Safety Defects*. Washington, D.C.: October 6, 2011.

Transportation Research Board, National Research Council of the National Academies. *The Safety Promise and Challenge of Automotive Electronics: Insights from Unintended Acceleration*. Washington, D.C.: 2012.

U.S. Department of Transportation Office of Inspector General. *Inadequate Data and Analysis Undermine NHTSA's Efforts to Identify and Investigate Vehicle Safety Concerns*. Washington, D.C.: June 18, 2015.

NHTSA. *Workforce Assessment: The Future of NHTSA's Defects Investigations*. Washington, D.C.: June 5, 2015.