



# Ensuring Quality Across the Board

The Report of the Independent Takata Corporation  
Quality Assurance Panel

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February 2016

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Chairman, President, and CEO, USF Corporation, 2000-2003  
White House Chief of Staff, 1991-1992  
U.S. Secretary of Transportation, 1989-1991  
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President and CEO, Aerospace Industries Association,  
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Chairman of the National Transportation Safety  
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NHTSA Administrator, 1992-1993  
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President and CEO, Atkore International, 2008-2011  
Vice President, Eaton Corporation, 2002-2008  
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NHTSA Administrator, 1976-1977



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## Introduction

As of the date of this report, Takata is in the midst of one of the largest recalls of any consumer product in U.S. history.<sup>1</sup> To date, ten fatalities<sup>2</sup> and as many as 139 injuries<sup>3</sup> have been linked to Takata airbag inflator ruptures. Nine of the ten fatalities have occurred within the United States.<sup>4</sup> More than 20 million vehicles produced by 14 auto manufacturers have been recalled in the U.S. and another 20 million vehicles are subject to recalls in other countries.<sup>5</sup>

These events prompted Takata to commission the Independent Takata Corporation Quality Assurance Panel to conduct an unbiased review of Takata's quality-related practices. The Panel was not asked to evaluate the products that prompted the current recalls or the processes employed when the products of concern were manufactured. Others are looking into these critical questions, including Takata itself, the National Highway Traffic Safety Administration ("NHTSA"), Congress, and the automakers impacted by the recall.<sup>6</sup>

The Panel's task is different. The Panel's mission was to evaluate Takata's current practices to ensure that product quality, which is an indispensable component of product safety, is at the forefront of all facets of Takata's operations so that consumer safety is paramount. No link between the gaps in quality processes identified by the Panel and the failure of products covered by Takata's current recall campaign should be inferred. These issues are the subject of

ongoing legal proceedings that raise serious concerns about Takata's products and the risk they pose to public safety, as well as the company's conduct in dealing with these concerns. It is not appropriate for the Panel to comment on these issues.

The Panel has completed its review and concludes that Takata must make significant improvements across the quality spectrum and, in particular, in three broad areas: (1) addressing quality-related concerns; (2) ensuring quality in Takata's design and manufacturing processes; and (3) promoting quality through improved management practices. This report provides an explanation of the quality concerns the Panel has identified, and the Panel's recommendations on how to close the identified quality gaps. Recognizing that some issues related to design, testing, and integration of airbags into vehicles may not be confined to Takata, the Panel has additional observations that are discussed as well.

The Panel has a commitment from Takata that it will do everything within its power to implement the Panel's recommendations. Indeed, Takata has already taken certain steps to improve its quality-related operations that are consistent with the Panel's recommendations. It is the Panel's hope that, by implementing the recommendations outlined in this report, Takata will be able to ensure the highest quality in its operations across the board.

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<sup>1</sup> Committee on Commerce, Science, and Transportation, Office of Oversight and Investigations Minority Staff, *Danger Behind the Wheel: The Takata Airbag Crisis and How to Fix Our Broken Auto Recall Process* at 13 (June 22, 2015), <http://1.usa.gov/1BIA0zt>; Hiroko Tabuchi, *Takata Airbag Flaw Linked to 10th Death; 5 Million More Vehicles Recalled*, NY Times (Jan. 22, 2016), [http://www.nytimes.com/2016/01/23/business/takata-airbag-death-recall.html?\\_r=0](http://www.nytimes.com/2016/01/23/business/takata-airbag-death-recall.html?_r=0).

<sup>2</sup> Tabuchi (*Takata Airbag Flaw Linked to 10th Death*); Joan Lowy, *8th U.S. Death Due to Takata Airbag Explosion*, Assoc. Press (Dec. 23, 2015), <http://abcn.ws/1SbPZvb>; Honda Confirms 8th Fatality From Exploded Takata Airbag, Automotive News (June 19, 2015), <http://bit.ly/1EHDgqx>.

<sup>3</sup> Hiroko Tabuchi, *Takata Saw and Hid Risk in Airbags in 2004, Former Workers Say*, NY Times (Nov. 6, 2015), <http://nyti.ms/1MCHRko>.

<sup>4</sup> Tabuchi (*Takata Airbag Flaw Linked to 10th Death*); Lowy (*8th U.S. Death Due to Takata Airbag Explosion*); Automotive News (*Honda Confirms 8th Fatality from exploded Takata airbag*); Tabuchi (*Takata Saw and Hid Risk*).

<sup>5</sup> Tabuchi (*Takata Airbag Flaw Linked to 10th Death*); see Ryan Beene, *U.S. says 19.2 million U.S. vehicles have defective Takata airbags*, Automotive News (Sept. 1, 2015).

<sup>6</sup> Amanda Bronstad, *Takata Executive: We May Never Know Why Airbags Exploded*, National Law Journal (June 2, 2015), <http://bit.ly/1Ja1H49>; Wall St. J. (*Takata Air-Bag Probe Points to Leaky Seals*); Ryan Beene, *Automakers Choose Aerospace Firm to Run Takata Airbag Tests*, Automotive News (Feb. 26, 2015), <http://bit.ly/1zLg4F7>; *Automakers Select Orbital ATK to Lead Independent Review of Takata Airbag Inflators*, Reuters (Feb. 26, 2015), <http://reut.rs/1NqyNRa>.

## The Events that Prompted the Creation of the Panel

Takata is a Japanese company with its global corporate headquarters in Tokyo and operations in North America, South America, Europe, Africa, and Asia.<sup>7</sup> Today, Takata is one of the world's largest manufacturers of automobile safety devices, including seatbelts, airbags, and child safety restraint systems. It also manufactures other vehicle components such as steering wheels and interior trims.<sup>8</sup> Takata provides these products to a wide variety of vehicle manufacturers, including Audi, BMW, Daimler, Fiat-Chrysler, Ford, GM, Honda, Hyundai, Isuzu, Mazda, Mitsubishi, Nissan, Subaru, Suzuki, Toyota, and Volkswagen.<sup>9</sup>

While Takata began in 1933 as a manufacturer of lifelines for parachutes and other textiles, it has long been in the vanguard of automobile safety technology. In 1962, Takata performed the first public seat belt crash tests in Japan and, in 1963, Takata supplied seatbelts to the first Japanese car to include passenger restraints as standard safety equipment.<sup>10</sup> In the late 1970s, Takata turned its attention to other safety technologies. In 1976, Takata started researching the use of airbags in automobiles as well as various child safety restraint systems.<sup>11</sup> In 1987, Takata began producing airbags in earnest, and, that same year Takata provided the airbag to the first Japanese car fitted with a driver's side airbag.<sup>12</sup> Takata is now one of the three major manufacturers of airbags for the automotive industry, with its products in nearly every major manufacturer of automobiles.

Over the last several years, Takata and its customers have identified instances in which certain products have failed to operate as intended. In particular, the rupture of airbag inflators has resulted in ten deaths and significant injury to drivers and passengers involved in motor vehicle crashes in which the airbag deployed. The first incident of which the Panel is aware involving a faulty Takata airbag inflator occurred in 2003 in Switzerland.<sup>13</sup> The airbag's inflator ruptured during deployment and Takata reported that this was an isolated event that was due to an "overloading of propellant in the assembly of the inflator."<sup>14</sup> Additional inflator ruptures occurred over the next several years. In 2004, a Takata airbag inflator ruptured in a car in Alabama<sup>15</sup> and in 2007 and 2008, four additional Takata airbag inflator ruptures were reported.<sup>16</sup> These inflator ruptures led to the first Takata airbag-related recall in November 2008.<sup>17</sup>

In the years that followed, additional issues with Takata's inflators arose. There were nine reported incidents in 2009, with two of these incidents resulting in the death of the driver.<sup>18</sup> These incidents prompted additional recalls.<sup>19</sup>

Reports of inflator ruptures continued and the recalls expanded. Between 2011 and 2012, 16 additional inflator ruptures occurred<sup>20</sup> and in 2013 there were 18 additional incidents.<sup>21</sup> That year, five vehicle manufacturers expanded existing recalls and another automaker issued its first recall.

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<sup>7</sup> Takata Corporate Profile at 13-14. Takata's operations outside North America are located in Brazil, South Africa, France, Germany, Poland, Romania, Czech Republic, Japan, Singapore, China, Korea, Philippines, Thailand, Malaysia, and India.

<sup>8</sup> *Id.* at 11.

<sup>9</sup> *Id.* at 11.

<sup>10</sup> *Id.*

<sup>11</sup> *Id.*

<sup>12</sup> *Id.* at 8-9.

<sup>13</sup> TK Holdings Inc., Defect Information Report, PSDI, PSDI-4, and PSDI-4K Driver Air Bag Inflators (May 18, 2015), at 3.

<sup>14</sup> *Id.*

<sup>15</sup> Takata Saw and Hid Risk in Airbags in 2004, Former Workers Say; TK Holdings Inc., Defect Information Report, PSDI, PSDI-4, and PSDI-4K Driver Air Bag Inflators.

<sup>16</sup> Letter from Kazuo Higuchi, Senior Vice President, Takata, to George Person, Chief, Recall Management Division, Office of Defect Investigation, National Highway Traffic Safety Administration, at 5 (Feb. 19, 2010) (online at [www.odi.nhtsa.dot.gov/acms/cs/jaxrs/download/doc/ACM13395661/INRL-RQ09004-39140Pdf](http://www.odi.nhtsa.dot.gov/acms/cs/jaxrs/download/doc/ACM13395661/INRL-RQ09004-39140Pdf)).

<sup>17</sup> Letter from William R. Willen, Managing Counsel, Product Regulatory Office, American Honda Motor Co., to Daniel C. Smith, Associate Administrator for Enforcement, National Highway Traffic Safety Administration (Nov. 11, 2008) (online at [www.odi.nhtsa.dot.gov/acms/cs/jaxrs/download/doc/ACM10641506/RCD-NN-08V593-1511.pdf](http://www.odi.nhtsa.dot.gov/acms/cs/jaxrs/download/doc/ACM10641506/RCD-NN-08V593-1511.pdf)).

<sup>18</sup> Takata Response to Senate Commerce Committee, Exhibit A (Dec. 12, 2014); Takata Response to Senate Commerce Committee, Exhibit B (Mar. 27, 2015).

<sup>19</sup> NHTSA, Close Resume, RQ09-004.

<sup>20</sup> Letter from Jay Joseph, Senior Manager, Product Regulatory Office, American Honda Motor Co., Inc., to Nancy Lewis, Acting Administrator for Enforcement, National Highway Traffic Safety Administration (Dec. 1, 2011) (online at [www.odi.nhtsa.dot.gov/acms/cs/jaxrs/download/doc/ACM19786131/RCDNN-11V260-5849.pdf](http://www.odi.nhtsa.dot.gov/acms/cs/jaxrs/download/doc/ACM19786131/RCDNN-11V260-5849.pdf)).

<sup>21</sup> Takata Response to Senate Commerce Committee, Exhibit A (Dec. 12, 2014); Takata Response to Senate Commerce Committee, Exhibit B (Mar. 27, 2015).

## The Events that Prompted the Creation of the Panel

(cont.)

In June 2014, after receiving multiple complaints regarding Takata airbag inflator ruptures, NHTSA opened an investigation to look into the problem. In October 2014, NHTSA issued a consumer advisory encouraging owners of vehicles affected by the Takata airbag-related recalls—which had by then grown to cover ten automakers and 7.8 million vehicles—to promptly respond to the outstanding notices.<sup>22</sup> The advisory stated that responding to the recalls was “essential to personal safety” and to identifying the root cause of Takata’s inflator ruptures.<sup>23</sup>

On October 30, 2014, NHTSA issued a Special Order to Takata seeking information on the inflator ruptures.<sup>24</sup> And on November 18, 2014, NHTSA called for a national recall of certain Takata driver-side airbags.<sup>25</sup> NHTSA also issued a second Special Order to Takata, seeking additional information related to the propellant used in Takata airbag inflators.<sup>26</sup>

Congress got involved as well. In November 2014, the Senate Commerce, Science & Transportation Committee held a hearing to examine potential Takata airbag defects and the recall process.<sup>27</sup> Following the hearing, then Chairman Rockefeller and Senator Nelson sent an inquiry to Takata requesting additional information on Takata airbags.<sup>28</sup> The minority staff of the Committee recently issued a report criticizing Takata’s handling of its investigation into Takata airbag inflator ruptures and its recall-related efforts more broadly.<sup>29</sup>

By the end of December 2014, more than 11 million vehicles in the United States had been recalled and five deaths had been linked to Takata airbags.<sup>30</sup> The scope of the potential problem prompted the recall to be expanded and resulted in a consortium of automakers joining together to investigate the root cause of the airbag inflator ruptures.<sup>31</sup>

On November 3, 2015, NHTSA issued two orders pertaining to Takata’s airbag inflator ruptures.<sup>32</sup> Through a consent order, NHTSA imposed a \$200 million civil penalty—the largest penalty in NHTSA’s history—for specified violations of the Motor Vehicle Safety Act.<sup>33</sup> The consent order requires Takata to phase out the manufacture and sale of inflators that use phase-stabilized ammonium nitrate propellant and imposes a schedule for recalling ammonium nitrate inflators in the automobile fleet unless Takata “can prove they are safe or can show it has determined why its inflators are prone to rupture.”<sup>34</sup> The order also requires Takata to create a new chief safety officer position to manage oversight of safety-related programs and who will report directly to Takata’s board of directors. A companion coordinated remedy order directs Takata and 12 vehicle manufacturers to prioritize their remedy programs based on risk, and establishes a schedule by which they must have sufficient parts on hand to replace airbag inflators in all affected vehicles. NHTSA appointed an independent third-party monitor to oversee Takata’s compliance with the orders and the Safety Act, and that monitor will remain in place for at least the next five years.

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<sup>22</sup> Consumer Advisory: Vehicle Owners with Defective Airbags Urged to Take Immediate Action.

<sup>23</sup> *Id.*

<sup>24</sup> National Highway Traffic Safety Administration, Special Order Directed to TK Holdings, Inc. (Oct. 30, 2014) (online at [www-odi.nhtsa.dot.gov/acms/cs/jaxrs/download/doc/UCM465855/INLM-PE14016-60576.pdf](http://www-odi.nhtsa.dot.gov/acms/cs/jaxrs/download/doc/UCM465855/INLM-PE14016-60576.pdf)).

<sup>25</sup> National Highway Traffic Safety Administration, USDOT Calls for National Recall of Defective Takata Driver Side Air Bags (Nov. 18, 2014) (online at [www.nhtsa.gov/About+NHTSA/Press+Releases/DOT-calls-for-national-recall-of-takata-driver-air-bags](http://www.nhtsa.gov/About+NHTSA/Press+Releases/DOT-calls-for-national-recall-of-takata-driver-air-bags)).

<sup>26</sup> National Highway Traffic Safety Administration, Second Special Order Directed to TK Holdings, Inc., PE14-016 (Nov. 18, 2014).

<sup>27</sup> Senate Committee on Commerce, Science, and Transportation, Examining Takata Airbag Defects and the Vehicle Recall Process, 113th Cong. (2014).

<sup>28</sup> Letter from Chairman John D. Rockefeller, IV and Senator Bill Nelson to Shigehisa Takada, Chairman and Chief Executive Officer, Takata Corporation (Nov. 24, 2014).

<sup>29</sup> Committee on Commerce, Science, and Transportation, Office of Oversight and Investigations Minority Staff, *Danger Behind the Wheel: The Takata Airbag Crisis and How to Fix Our Broken Auto Recall Process* at 13 (June 22, 2015), <http://1.usa.gov/1BIA0zt>.

<sup>30</sup> Honda to Expand Airbag Recall Nationwide as Takata Resists, *New York Times* (Dec. 3, 2014).

<sup>31</sup> Automakers Choose Aerospace Firm to Run Takata Airbag Tests, *Automotive News* (Feb. 26, 2015). The consortium consists of Honda, Toyota, Fiat-Chrysler, BMW, Mazda, Ford, Subaru, Mitsubishi, General Motors, and Nissan. Those companies have selected the aerospace and defense technology company Orbital to lead their review.

<sup>32</sup> NHTSA, U.S. DOT Imposes Largest Civil Penalty In NHTSA History To Takata For Violating Motor Vehicle Safety Act, And Accelerates Recalls To Get Safe Air Bags Into U.S. Vehicles (Nov. 3, 2015).

<sup>33</sup> *Id.*

<sup>34</sup> *Id.*

## Mandate

Takata's recent troubles prompted Takata to commission the Panel. The Panel was created to review how Takata<sup>35</sup> responds to concerns about quality, review Takata's "current manufacturing procedures for best practices in the production of safe inflators," and make recommendations about how Takata can improve its processes and procedures moving forward.<sup>36</sup> More specifically, the Panel was tasked with reviewing how Takata deals with internal and external concerns raised about quality so that consumer safety is paramount, identifying the extent to which there are quality gaps in Takata's design and manufacturing processes and management, and recommending a path to closing any quality gaps identified. The Panel was not created to duplicate or interfere with other ongoing public safety efforts to pinpoint why some Takata airbag inflators have ruptured during deployment. When Takata commissioned the Panel, it stated both that the Panel "will have all the resources and access they need to fulfill their mandate in a thorough and independent manner" and that, upon completion, the Panel's report "will be made public."<sup>37</sup> The Panel's charter and associated Takata press releases are included in full in Appendix C.

Since its inception, the Panel has had Takata's full cooperation and support. Takata has answered every Panel request, and has—in the Panel's view—strived for transparency. Several of the quality gaps discovered were identified by Takata and are currently being addressed.

## Independence

The Panel has operated independently as a group of outside advisors focused on fulfilling its mandate. Takata has not attempted to influence the Panel's efforts or the contents of this report in any way. Nothing was included in or excluded from this report at Takata's behest. No Panel member had a commercial or financial relationship with Takata prior to being appointed to the Panel or has a current relationship with Takata beyond their involvement with this report.

## Approach

The Panel was assisted in conducting its review by a leading management and business consulting firm with extensive automotive industry experience.<sup>38</sup> Working together with that firm and other Panel staff, the Panel met with a large number of Takata executives and visited the majority of Takata's North American airbag inflator and module manufacturing facilities. The Panel met with Takata management on multiple occasions, including in Washington, D.C., Chicago, IL, and at Takata's facilities in Armada, MI, Auburn Hills, MI, Moses Lake, WA, and Monclova, Mexico. Panel members toured Takata's facilities in Armada, MI, Moses Lake, WA, and Monclova, Mexico, and reviewed the processes employed and protocols followed at each of those facilities. The Panel's staff visited these facilities as well and also visited Takata's Auburn Hills, MI, and Torreon, Mexico, facilities. During the course of those visits, the Panel's staff

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<sup>35</sup> Specifically, the Panel was tasked with examining the airbag-inflator related operations of TK Holdings, Inc., the North American subsidiary of Takata Corporation of Japan. Takata as used in this report should generally be understood to refer to TK Holdings, Inc.

<sup>36</sup> Press Release, Takata, *An Open Letter From Takata Corporation*, (Dec. 3, 2014) <http://bit.ly/1V56XLS>.

<sup>37</sup> Press Release, Takata, *Takata Chairman's Statement*, (Dec. 18, 2014) <http://bit.ly/1V56XLS>.

<sup>38</sup> The Panel selected this firm after it received proposals from and interviewed multiple consulting firms.



## The Panel's Mandate and Process

(cont.)

conducted over 160 interviews with Takata employees ranging from Vice Presidents and plant managers to those who do the day-to-day, on-the-floor work of assembling airbag inflators and modules. To ensure that the information gleaned from these efforts could be understood in context, the Panel's staff also conducted 28 external interviews with personnel from Takata's competitors, automobile manufacturers, and others with relevant technical expertise and firsthand knowledge of automobile safety issues. While the Panel's efforts were focused on Takata's North American operations, Panel members also met with Takata leadership in Tokyo, Japan. A detailed list of Panel and staff meetings can be found in Appendix A.

As part of its review, the Panel and its staff also reviewed many publicly available reports and documents addressing Takata practices and other literature related to automobile safety and airbag operation. The Panel and its staff reviewed all of the publicly available materials associated with NHTSA's Takata-related efforts, Congress' inquiry into the airbag inflator rupture problem, and all other publicly known efforts to evaluate Takata's practices. The Panel also reviewed materials addressing best practices in other industries with well-developed quality-related practices, such as the aerospace and pharmaceutical industries.

### Limitations

The Panel's efforts were forward looking only. The Panel did not attempt to assess past practices or evaluate Takata products in the automobile fleet. It did not attempt to evaluate the design of any Takata product. To not duplicate other inquiries, the Panel did not analyze any specific product failure or reported quality incident. The Panel did not form any conclusions regarding the root cause of Takata's current inflator ruptures during the course of its review. An assessment of that issue was not part of the Panel's mandate and a number of other organizations are looking into the matter.

This report should not be interpreted as an evaluation of whether Takata has complied with any relevant regulatory or other legal obligation. Accordingly, the Panel's findings, recommendations, and observations are not intended for use in any legal proceeding to which Takata may be a party or any other legal proceeding. The report is intended to provide forward-looking recommendations that can improve Takata's quality-related practices and procedures in the future.

Moreover, the Panel's efforts were necessarily constrained by the information available to it during its review. To the extent that additional information germane to the findings, recommendations, and observations contained herein comes to light after the report's release, it may be necessary to reconsider some of the Panel's conclusions.

## Executive Summary

After conducting an extensive review of Takata's quality-related operations and organization, the Panel concludes that Takata must improve in several areas. In particular, Takata needs to improve in three broad categories: (1) addressing quality-related concerns; (2) ensuring quality in Takata's design and manufacturing processes; and (3) promoting quality through improved management practices.

### Addressing Quality-Related Concerns

Refine the approach to monitoring in-fleet product performance. Takata should refine its process for identifying quality-related problems with its products in the automobile fleet and make better use of the information that it collects. The teams at Takata entrusted with this critical task lack clearly defined roles and processes for responding to quality concerns. Moreover, these teams primarily rely on reports from auto manufacturers about quality; there is no stand-alone Takata program aimed at identifying quality-related problems with Takata products once they are in the vehicle fleet. And there are limited formal systems for consolidating and analyzing what information Takata does collect.

This is an area where substantial improvement is necessary. The roles and duties of those employees responsible for responding to externally raised quality issues should be formalized and specific processes should be put in place governing how those teams manage (and elevate, if necessary) potential quality problems when identified. Those processes should put a premium on timely and accurate reporting. Takata should also explore the possibility of engaging in some form of independent in-fleet monitoring and put a system in place that allows the data it collects on product performance to be systematically studied.

Ensure quality and safety concerns can stop product development. Takata must improve when concerns about quality are raised internally as well. Quality personnel have indisputable authority to halt certain aspects

of the company's processes, such as operations or manufacturing, based on quality-related concerns. But the authority of quality personnel can be marginalized in the product design process. The Panel does not want to overstate the importance of this issue—there is no suggestion that a lack of indisputable authority for a quality team member to halt the product design process has had any direct impact on any specific Takata product. But in order to be a best-in-class quality organization, quality personnel must have the ability to stop any process at any point that they believe quality is at risk.

Takata should adopt policies that make clear that quality has a leading role in design and the power to stop the design process based on quality concerns. It should also train its quality personnel through examples and set standards on how to identify quality issues and on what constitutes an issue of sufficient gravity to halt product design.

Ensure that data from quality performance testing is recorded and reported accurately. Takata must ensure that any data it collects in connection with the design, manufacture, and testing of its products is recorded and reported accurately. Takata collects a substantial amount of data when designing a new product and developing the process through which that product will be manufactured. Sharing that information with its customers, as Takata is required to do, fosters important communication regarding product design and a potential crosscheck on Takata's internal processes.

It is imperative for Takata to make sure that systems are in place to ensure accurate recording and reporting. These systems should also include a monitoring program to track testing data in a standardized way.

### Ensuring Quality In Takata's Design And Manufacturing Processes

#### Develop a Takata standard for product safety specifications.

Takata's airbag inflators undergo extensive quality testing. The vast majority of that testing, however, is driven by specifications provided by automobile manufacturers, regulators, and industry organizations—not by Takata itself.

Takata should develop its own set of testing specifications based on its own view of what is best from a quality and safety perspective. Critical self-evaluation is a key attribute of any quality organization. Takata's independently developed test should attempt to account for the fact that vehicles now often remain on our Nation's roads for more than a decade and find themselves in multiple states with widely different climate conditions and operating environments during their lifetimes.

Adopt a standard practice for seeking and utilizing third-party review. Takata sometimes seeks the advice of outside experts regarding its products' design and operation and the Panel recommends that Takata continue to do so. However, there is no formal process in place for deciding when seeking outside review is necessary or for assessing and acting on the information received from such third-party review.

Takata should formalize both its process for obtaining third-party input on its product design and performance, and its process for evaluating and acting on the feedback it solicits. Takata should adopt a policy whereby it consults third-party experts in conjunction with making any major product or process change, such as shifting between propellant types. It also must develop a system for addressing feedback once it is received. This process should also include action steps that must be taken at Takata when information is received from third-party review.

Increase and standardize automation operations across facilities. Overall, the Panel was generally satisfied with Takata's North American manufacturing operation, much of which is state of the art. But Takata's

operations have room for improvement, particularly when it comes to automation and consistency. Some of the safety-critical aspects of Takata's operations are done manually. While there are significant process and quality checks in place to guard against human error, much of the loading of inflator propellant is done by hand. Relatedly, Takata's practices are not always consistent within and across facilities.

Takata should attempt to increase its level of automation overall and standardize its use of automation and other procedures across processes and plants. In particular, Takata should move toward full automation of propellant loading and look for opportunities to increase machine assistance in airbag folding. Takata should also work to standardize its use of automation across facilities and products. Takata needs to do an assessment of what level of automation is best from a quality perspective for all aspects of airbag inflator assembly and then align its practices globally.

Reduce the incidence of conditional approvals in the design review process. The Panel did not review the specific design of any Takata product and expresses no view on the matter. Product design issues fall outside the Panel's mandate. The Panel did, however, conduct a thorough review of Takata's design process and believes that the process has several quality-related gaps. Chief among them is that Takata is too tolerant of the use of "conditional approvals" in its design review process. More often than not, Takata allows a product to move through a design review gate with a "conditional approval," meaning that at least some of the issues that are part of that particular design review milestone have not been fully addressed. It is also sometimes the case that products are permitted to move through the next design review gate before the conditional approvals from the prior design review gate are fully resolved.

Takata should endeavor to lower the incidence of conditional approvals to below 20%. Takata should also adopt firm policies that a product in development cannot move through the next design review gate until all of the conditional approvals from the prior design

## Executive Summary

(cont.)

review gate have been resolved and that conditional approvals cannot be granted for items that are integral to quality without executive sign off.

Involve manufacturing earlier in the product design process. Another of the Panel's design process-related quality concerns is that manufacturing personnel are often not involved, if they are involved at all, until very late in the design process. In most cases, manufacturing does not get significantly involved until after a product's design reviews are complete. Moreover, manufacturing personnel do not have any sort of primary approval role in the design review process.

Takata should further involve manufacturing at two levels: (1) in the product design engineering phase of its overall product development workflow generally, and (2) in its design review process specifically. While design for manufacturability is a component of Takata's current design review process, consideration of that quality-critical issue would greatly benefit from consistent involvement by Takata's manufacturing team.

Ensure the design review process is outcome driven. The Panel is also concerned about the design review process's effectiveness as a mechanism for ensuring quality. In some instances, the design review process appears to be more of an exercise in completion than a rigorous quality evaluation. That may be due to the fact that the design review process is focused on covering a long checklist and there is sometimes a mismatch between the content of the process and the attendees.

Takata should reorient its design review process so that it is more outcome driven and quality focused. In the Panel's view, quality would be best served if design reviews focused on issues requiring cross-functional leadership input. These meetings should provide an opportunity for Takata's best minds to contribute to product development in a meaningful way.

Establish lifetime ownership over Takata product programs. Takata product programs (i.e. propellants, airbag inflators, and airbag modules in development) undergo

multiple handoffs during their lifetimes. No one person or team is currently specifically tasked with monitoring a product once it is in the fleet.

The Panel believes that entrusting one group with overall and lifelong responsibility for a product program would be consistent with best quality practices. Having one team focused on the product from its nascent stages through obsolescence minimizes the odds that quality issues will be missed in the confusion of passing projects from one person to another. More than this, it may make it easier to identify quality-related problems later in product life—the cradle-to-grave owner will be an expert in that particular product and well-positioned to identify performance and quality issues given the right information.

Increase consistency in monitoring and documenting critical specifications and processes. On the whole, Takata does a good job of providing its employees with the instructions that they need to do their work. In evaluating Takata's facilities, the Panel and its staff were generally satisfied with the amount of care that went into crafting engineering drawings and operator instruction cards and the detail that resulted from those efforts. The Panel and its staff did, however, identify instances where the instructions provided to Takata employees need to be improved such that they provide employees with the necessary guidance regarding critical specifications. Along the same lines, the instructions provided to Takata employees are not always consistent across facilities.

Takata could gain better control over its manufacturing and assembly processes if it more consistently identified and documented the critical aspects of its operations and passed that information along to its employees via clear and easily understandable instructions. Takata should identify the key characteristics of critical components across its array of products and make sure that those characteristics are known and understood by employees so that those characteristics can be evaluated.



### Promoting Quality Through Improved Management Practices

Cultivate a quality culture at Takata. Many of the Panel's recommendations require cultural change. Accordingly, Takata must take steps to drive quality into its culture. In the Panel's view, Takata should: (1) require that every employee at Takata undergo periodic quality-specific training; (2) create a system that rotates employees through quality team jobs; and (3) improve opportunities in the Takata quality organization in order to attract top talent. Taking these steps will ensure that Takata's culture fosters the achievement of the company's quality-related goals.

Increase leadership support for and involvement in quality initiatives. Takata leadership should search for opportunities to celebrate quality and the accomplishments it enables. In the Panel's experience, the importance of leading by example and giving credit where credit is due on cultural issues of this sort cannot be overstated. Such actions are part and parcel of driving quality into an organization's cultural DNA. Takata leadership should also look for opportunities to involve themselves in quality checkpoints, such as the design review process, throughout Takata's operations. And Takata's global leadership needs to increase its involvement in quality issues.

Link quality performance and compensation at the individual level. In the Panel's view, overall product and process quality would be improved if there were direct ties between compensation and quality at appropriate points along the Takata chain of command. There are already some links between quality and compensation at Takata, but, in most cases, those links are not at the individual level. Compensation and quality-related key performance indicators—appropriately structured—would provide strong incentives for employees to raise quality-related issues as soon as they are identified and allow Takata to hold its employees accountable for quality-related lapses.

Guarantee sufficient resources are available in quality critical areas. Ensuring quality across the board will be a resource-intensive effort. It requires having the right people and the right systems in place. Given everything else going on at Takata right now, Takata should take steps to ensure that its quality support resources remain strong. Resources previously dedicated to quality should be jealously guarded and additional resources should be dedicated to quality where necessary and feasible.

### Implementing The Panel's Recommendations

In the Panel's view, Takata should do four things to facilitate implementing the Panel's recommendations: (1) create a dedicated quality team to supervise the implementation of the recommendations discussed; (2) develop a detailed plan to implement the Panel's recommended changes; (3) develop a companion monitoring program to track change completion and efficacy; and (4) construct a comprehensive quality training program to facilitate and guide implementation. Takata will provide a report to the Panel one year from now summarizing the company's progress in implementing the Panel's recommendations.

Before discussing the specifics of where Takata must improve its quality-related practices, the Panel thinks it is important to provide some context. The Panel believes that this context is important because it accentuates the requirement for best practices in design, testing, manufacturing, and vehicle integration across the entire industry and the necessity of putting quality and consumer safety as the top priority in each of these processes.

*The complexity of airbag inflator and module design, manufacturing, and operation.* Takata makes a product that can be found in every vehicle in the Nation and that is extremely complex. That complexity is necessitated by what automobile manufacturers and consumers rightly expect from the airbags installed in their vehicles—the airbag must deploy when it is supposed to and do so in a manner that prevents, not causes, injury.

The basics of airbag operation are relatively straightforward. When a vehicle’s airbag system is triggered during a crash, a fabric cushion rapidly inflates (in 0.05 seconds or less) and remains inflated throughout the duration of the crash. The specifics, however, are far more complicated. Airbag inflation is set off by an electrical signal that results from a “crash pulse” or rapid change in velocity of the vehicle, indicating contact with an obstacle. That signal is sent to an airbag inflator which sends gas through a nozzle gauged to the speed necessary for unfurling the fabric bag and maintaining inflation.

There are many different types of airbag inflators; some inflators are powered by compressed gas, others are powered by a propellant that burns and creates gas, and some are powered by a mixture of compressed gas and propellant. Across all methods, the point is to inflate the airbag cushion with sufficient speed such that it protects the vehicle occupant, but also in a controlled manner that does not generate a substantial independent risk of injury.

Each design has unique characteristics and associated pluses and minuses. Compressed gas inflators are generally the largest and heaviest inflators given that, as the name suggests, they contain the gas necessary to inflate the airbag cushion in a compressed form. They are also vulnerable to leaks which can result in a weak airbag deployment or no deployment at all. Weak deployments can harm, and in some cases severely harm or kill, a vehicle occupant, and a non-deployment means that the airbag simply does not operate.

Propellant-driven inflators are typically the smallest and lightest. Depending on the specific propellant used, different failure modes are possible. Some propellants can fail in a manner that tracks compressed gas inflator failure, resulting in weak deployments or non-deployments. Some propellants can fail such that gas production is greater than anticipated, resulting in an overly aggressive airbag cushion deployment or inflator rupture.

The choice of inflator is determined by the totality of an automobile manufacturer’s requirements based on various characteristics of the vehicle and by desired features of the inflator, including weight. Automobile manufacturers must meet Corporate Average Fuel Economy (CAFE) standards, so there is always pressure on suppliers to minimize weight of auto components. The variations in requirements and in vehicle integration result in a series of compromises that must be addressed by suppliers of all components, airbags among them.

Ensuring that the release of gas used to fill the airbag cushion is just right involves a number of factors. The type of gas or propellant used and how much is used are two of the critical drivers of cushion deployment and inflator manufacturers spend much of their design-related time dealing with those important issues. In inflators of all types, inflator geometry is critical as well. In a driver’s side propellant-driven inflator, for example, the orientation

of inflator chambers and baffling plays a defining role in controlling the rate of gas release. (see figure 1)

There are many components that go into the assembly of this safety-critical component, each aimed at ensuring reliable and interference-free operation. (see figure 2)

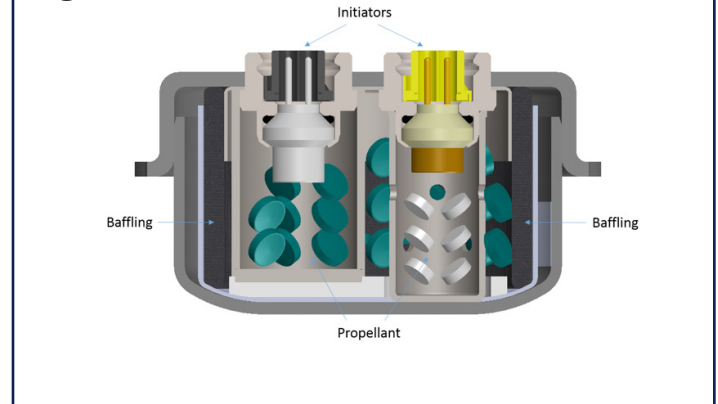
And the inflator itself is merely a component of the larger airbag module. (see figure 3)

This complicated product is created through an equally complicated process. For airbags powered by propellant, there are usually three distinct end-to-end processes required. The manufacturing of the propellant itself is a highly involved process that requires a substantial level of care and technical expertise. Propellant manufacturing requires the storage, analysis, and processing of potentially hazardous chemicals and the compressing of those chemicals into tablets. In many respects, this part of the process is similar to the process used to manufacture pharmaceutical tablets. Indeed, some of the machines involved—such as the machines used to press the propellant tablets—are exactly the same.

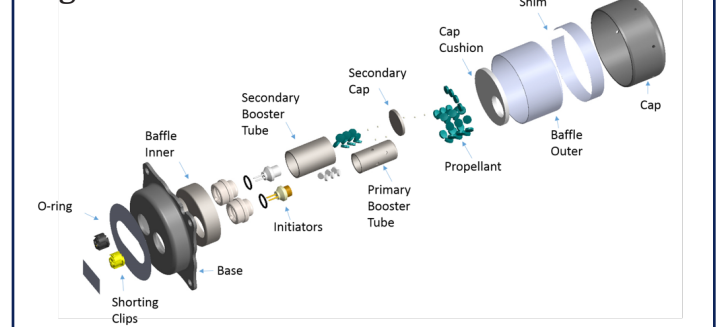
The next stage of the process—inflator assembly—is completely different and requires a distinct set of skills and expertise. The propellant must be loaded in the inflator chambers and then the various tubes, caps, cushions, shims, and filters must be crimped and welded into a leak-proof whole. They also must be tested (and are) both during and after assembly. Many of the individual inflator components are provided by separate suppliers, further increasing the complexity of the inflator assembly process.

Finally, the inflator is connected with a cushion and installed into the larger airbag module depicted above. And the complexity does not stop there. Some of Takata's core airbag inflator products have more than 50 different product variations. Across the 22 different inflator types that Takata currently manufactures there are 332 different product variants, which is a

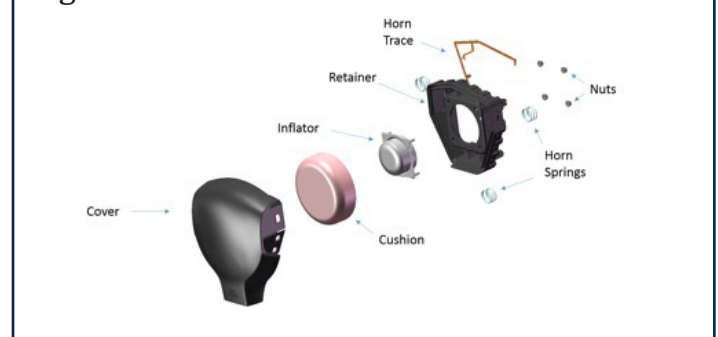
**Figure 1**



**Figure 2**



**Figure 3**



result of the differing needs and requirements of the automobile manufacturers Takata supplies. All of this complexity goes into making a part that typically costs automobile manufacturers around \$30.<sup>39</sup>

This complexity is, at least in part, a result of the fact that airbags are in many ways unique among the components found in automobiles. Many components in cars—tires, oil, brake fluid, windshield wipers, filters, headlamps, etc.—are subject to maintenance. In many instances, electronic prompts alert the consumer when a specific unit fails. In other cases, there are recommended replacement schedules based on miles or time of use. In all of these cases, the units are accessible for quick replacement. Airbags are different. They stay in place until they are needed and they are expected to work only once. Design constraints require that airbags integrate seamlessly into the vehicle design. Indeed, the objective is that all airbags be nearly invisible.

*The ubiquity of airbags.* Since 1997, the federal government has required frontal—driver and passenger—airbags in passenger vehicles sold and distributed in the United States. More recently, a new federally mandated side impact test has driven manufacturers to include additional head protection in the form of an airbag. Manufacturers have also voluntarily integrated multiple other airbags into their vehicles to mitigate the crash energy caused by smaller, stiffer vehicles manufactured and sold to meet the aforementioned congressional fuel economy requirements and consumer demand for safer small vehicles.

NHTSA estimates that airbags save thousands of lives every year. In 2012, for example, as many as 3,319 lives were saved by frontal, curtain, and side airbags.<sup>40</sup> At the same time, inclusion of these multiple airbags results in certain risks. As already explained, each airbag requires an inflator system that must inflate the bag in a time window of a few milliseconds, at precisely the desired rate, and remain inflated for a

precise amount of time of the crash duration. Given that there are anywhere from four to 12 or more airbag inflators in a single vehicle, and that those inflators may be manufactured by any or all of the inflator manufacturers and contain any or all of the different inflator types, there are a large number of risk exposures from different vectors over the universe of vehicles manufactured and sold every year.

Their ubiquity notwithstanding, airbags are intended to be the supplemental, not the primary, restraint system in vehicles. The primary restraint is the seat belt. Since 1960, seat belts have saved an estimated 330,000 lives while frontal airbags, in vehicles widely for about a quarter of that time, have saved approximately 43,000.<sup>41</sup>

There have been many unanticipated consequences of airbags in passenger vehicles with which government and industry have had to grapple, such as the fatal injury to children seated in the front seat of cars and light trucks. This resulted in the U.S. government requiring an additional level of complexity in airbag design and integration in the form of multiple-stage deployments with the goal of protecting all passengers, large or small, belted or unbelted. The multiplicity of these requirements for performance in large vehicles that deform at slower rates than small, stiff vehicles and multistage inflation in vehicles with dashboards of varying physical dimensions are but a few of the layers of complexity designers and integrators must address.

*Takata's quality-related strengths.* While the Panel has identified certain gaps in Takata's quality-related practices and has made significant recommendations to close those gaps, the Panel also found a number of quality-related strengths.

Takata's plants have received numerous awards from its customers and others for their performance. Its facilities hold a number of quality-related certifications, such as TS 16949—the ISO technical

<sup>39</sup> Consumer Affairs, *Feds Require Side Curtain Airbags by 2013* (Sept. 6, 2007) (online at [http://www.consumeraffairs.com/news04/2007/09/nhtsa\\_airbags.html](http://www.consumeraffairs.com/news04/2007/09/nhtsa_airbags.html)).

<sup>40</sup> C.J. Kahane, *Lives Saved by Vehicle Safety Technologies and Associated Federal Motor Vehicle Safety Standards, 1960 to 2012 (Passenger Cars and LTVs)*, NHTSA (January 2015), <http://perma.cc/PU3A-B8KF>.

<sup>41</sup> See *id.*



specification aimed at the development of a quality management system. Takata on the whole has robust prototyping lab and manufacturing operations and strong material analysis capabilities. It has knowledgeable personnel in key positions and the workforce to deploy resourceful teams that can quickly design and implement solutions to fix identified issues. Takata is also generally recognized as top tier when it comes to delivering on customer needs. This strength, of course, taken to the extreme can become a quality weakness. Takata cannot and should not allow its desire to satisfy the needs of its customers to trump its interest in providing safe and effective products. But, at this point in time, the Panel views Takata's responsiveness to its customers' concerns as a relative strength.

In addition to these longstanding strengths, Takata is in the process of improving in other quality-related areas. In connection with the consent order, Takata has created a new Chief Safety Officer position, and that safety head will work closely with a newly created Product Safety Office ("PSO"). While still in development, the PSO's intended role is to provide unbiased and fact-driven investigations into potential safety-related product anomalies for all Takata products, to educate Takata management, employees, customers, and regulators about the findings from those investigations, and develop corrective actions to fix the problems identified. Takata's intention is that the PSO will subsume the Product Safety Group ("PSG"), which was created in July 2014 in response to Takata's recent product failures and is currently overseeing Takata's response to those failures, including processing the return of potentially defective inflators, conducting root cause analysis on those inflators, and assisting with similar efforts undertaken by government and automobile manufacturers.

Another potentially quality-critical development is the movement to a more regionally empowered management structure. As already explained, Takata's global headquarters is in Japan, as is its board of

directors. In the past, Takata operations in North America were largely controlled from Japan. Since the summer of 2014, however, Takata has been moving to a more regional structure where a North American Executive Committee—comprised of a President, Executive Vice President for Non-Automotive Safety, Executive Vice President for Customer Business Units and Engineering, and Executive Vice President for Operations—is entrusted with substantial control of Takata's North American operations. Quality is a global issue, not a regional one. And shifting to a more regionally focused management structure should not mean that Takata's global leadership disengages from North American quality-related issues. But putting empowered decision makers closer to Takata's day-to-day operations should help increase management's role in promoting quality in all aspects of Takata's operations and provide an effective conduit through which to pass local and regional quality-related problems to global leadership.

### Addressing Quality-Related Concerns

#### Refine the approach to monitoring in-fleet product performance

Takata should refine its process for identifying quality-related problems with its products in the automobile fleet and make better use of the information that it collects. At present, there are two groups at Takata that handle identification and resolution of quality and safety issues: the warranty team and the Product Safety Group (“PSG”). As a general matter, PSG handles safety-critical issues and the warranty team handles everything else. For example, PSG is concerned with issues such as inflator performance while the warranty team focuses on issues such as non-retraction of a seat belt. But these roles are not as well defined as one might expect. And there are limited formal processes dictating which group deals with what problem and how to address the matter once it is allocated.

Moreover, both of these groups primarily rely on reports from others to identify quality issues. The majority of issues come to light through reports from manufacturer dealer networks or manufacturers themselves. If the manufacturer or dealer does not pass the information along, it may never find its way to Takata. When that information does make it to Takata, there is not a formal process for collating it such that it can be meaningfully analyzed. There is not an automated system in place for trendspotting based on the full set of data provided across manufacturers.

This is an area where there is substantial room for improvement. The roles and responsibilities of the warranty group and PSG—or the equivalent groups within the newly-conceived Product Safety Office once fully implemented—should be formalized and specific processes should be put in place codifying how those teams must manage (and elevate, if necessary) potential quality problems when identified. In formalizing those processes, Takata should strive to minimize the amount of time it takes the company to process information and provide any reports or notices that assessment requires.

Takata should also attempt to reduce the extent to which it relies on others to report quality problems with its products. The most direct way of doing so would be to engage in some form of in-fleet monitoring. The Panel recognizes that this is not an easy task, but thinks that post-manufacturing monitoring could pay substantial dividends in terms of anticipating and responding to larger quality issues.

There are several possible ways that Takata could accomplish this. It could purchase in-fleet used cars according to a sampling plan at predetermined intervals from geographically diverse locations and then analyze the airbag performance in those vehicles. That effort could focus on areas where Takata products have not performed as expected in the past. The Panel understands that there is a sizable population of cars that have been removed from the fleet that Takata could acquire—i.e., cars that are no longer drivable, but have not been destroyed.<sup>42</sup> This approach is, of course, far from foolproof and nowhere near comprehensive, but it might provide a valuable supplement to the information that Takata receives from dealers and manufacturers. At a minimum, it could increase the odds that Takata could ascertain whether its products are not performing as expected before that divergence results in injury. Takata’s efforts to isolate the root cause of its current inflator ruptures suggests that engaging in some form of in-fleet monitoring may yield actionable results.

In all events, whether or not additional in-fleet monitoring is practical, Takata should put a system in place that allows the data provided by dealers and manufacturers to be studied. It is also paramount that when there is a lesson to be learned from an in-fleet incident that the relevant information is provided to Takata’s design and manufacturing teams so that the information can be used when fashioning future Takata products.

<sup>42</sup> See Richard Truett, *Is Danger Lurking in Junkyards?*, *Automotive News* (May 11, 2015), <http://perma.cc/VEU6-B9CC> (suggesting there are more than 24,000 such cars).

### **Ensure quality and safety concerns can stop product development**

Takata has room to improve when concerns about quality are raised internally as well. Importantly, quality personnel currently have indisputable authority to halt operations or manufacturing based on quality-related concerns. Nothing the Panel has learned during its review suggests that quality issues have ever been ignored during the manufacturing process.

Earlier in the process, however—during the design process itself—it appears as if quality concerns can be marginalized due to the fact that quality team members lack indisputable authority to halt the design review process. To be clear, there is no suggestion that a lack of absolute authority for a quality team member to halt the design review process has had any direct impact, at least as far as the Panel and its staff are aware, on any specific Takata product. But in every best-in-class quality organization, quality personnel have the ability to press the pause button at every point in the process.

Giving quality personnel that authority will reduce the likelihood that a quality issue slips through the cracks. It will also send a clear signal that quality is to be Takata's defining characteristic that will hopefully echo across all of Takata's operations.

In order for quality personnel to effectively exercise this needed authority, they must be empowered to do so and have a comprehensive understanding of what sorts of quality issues warrant stopping the design process. Takata should adopt policies that make clear that quality has a leading role in design and the power to stop the process based on quality concerns. It should also train its quality personnel through examples and set standards on how to identify quality issues and what constitutes an issue of sufficient gravity to halt product design. These recommendations could be implemented through a series of pilot programs or development projects to ensure their efficacy.

Takata also needs to ensure that it has the right people on its quality teams such that when a quality

team member raises an issue others at Takata take it seriously if for no other reason than because it was raised by that person. Quality is highly cultural and Takata should strive to have only the best and brightest on its quality teams.

### **Ensure that data from quality performance testing is recorded and reported accurately**

Takata must ensure that any data it collects in connection with the design, manufacture, and testing of its products is recorded and reported accurately. Takata collects a substantial amount of data when designing a new product and developing the process through which that product will be manufactured. Pursuant to agreements with its customers, the results of these tests—known as design validation and process validation tests—are reported to Takata's customers. This information sharing is an important part of the supplier-customer relationship. Takata products are designed to meet specifications provided by automobile manufacturers, and providing those manufacturers with a comprehensive and accurate view of test results fosters the communication necessary to balance the manufacturer's design demands with quality design requirements. Moreover, transparently sharing testing results means that it is at least possible that someone outside Takata will be able to identify a quality-related problem that someone inside Takata might have missed.

Takata must take steps to ensure that this information is accurately recorded and reported. In response to past issues with testing recordation and reporting inaccuracies, Takata created a "data vault," which prohibits the manipulation of data once recorded. That solution, however, provides only limited assurance of data accuracy. A system must be put in place to ensure that no test result is ignored and that every test result that must be reported is reported. Additionally, given the paramount importance of this issue, a monitoring program should be put in place to ensure accurate and standardized reporting.

### Ensuring Quality In Takata's Design And Manufacturing Processes

#### Develop a Takata standard for product safety specifications

As just noted, Takata's airbag inflators undergo extensive quality testing. The vast majority of that testing, however, is driven by specifications provided by automobile manufacturers, regulators, and industry organizations and not Takata itself. From the Panel's perspective, it would be in keeping with best quality practices for Takata to develop its own independent test based on Takata's expertise. That test should be at least as rigorous as the tests required by auto manufacturers.

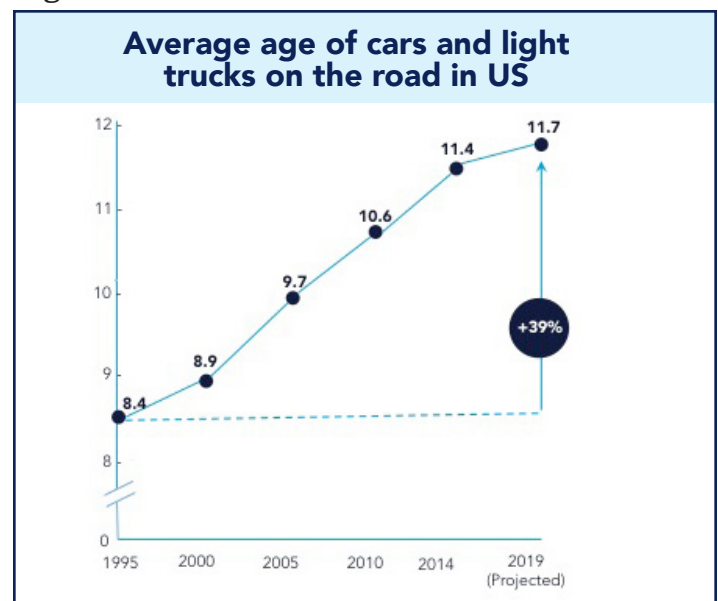
Manufacturers have not coalesced on a set of testing specifications that they view as the gold standard when it comes to inflator safety testing. To the contrary, required testing varies significantly from manufacturer to manufacturer based on whether a manufacturer subscribes to a particular standard, such as USCAR or AK-LV, or has developed its own standard. For example, under Manufacturer A's testing specifications, Takata is required to conduct, in order, (1) accelerated aging, (2) temperature cycle, (3) humidity cycle, (4) constant vibration, (5) random vibration, (6) dynamic shock, and (7) thermal shock tests. Under Manufacturer B's testing specifications, Takata must conduct, in order, (1) thermal shock, (2) dynamic shock, (3) vibration-temperature cycle, (4) humidity resistance, (5) salt spray, and (6) drop tests. And even when the same component tests are required, the requirements of each component test are often materially different. Manufacturer A mandates that thermal shock testing occur last in the testing process and requires 200 cycles transitioning the product temperature from -40° to +90°C with a four hour hold at each temperature. Manufacturer B requires that thermal shock testing take place first in the testing process and requires the same number of cycles in the same temperature range, but requires only a 30 minute hold at each temperature.

Takata should develop its own set of testing specifications based on its own view of what is best from a quality perspective. Critical self-evaluation is a key attribute of any quality organization. Adopting stringent and well-defined internal testing standards will send a clear message about Takata's renewed commitment to quality and provide confidence in Takata's products.

It is beyond the Panel's expertise to recommend a specific set of testing criteria. Takata is the expert here—more so than both the Panel and the manufacturers who generate the current testing specifications. The Panel is confident that Takata will be able to develop its own set of testing criteria based on its own view of what is most likely to ensure quality. To the extent Takata deems it necessary, this may be an instance where consulting a third-party expert adds value.

In developing that test, it is important that Takata keeps in mind that the in-fleet life of vehicles is increasing. Over the last 20 years, the average age of cars on our Nation's roads has increased by three years from 8.4 to 11.4.<sup>43</sup> And that trend is expected to continue such that by 2019 the average car on U.S. roads will be 39% older than the average in 1995.<sup>44</sup>

Figure 4



<sup>43</sup> See Nathan Bomey, *Average age of cars on U.S. roads breaks record*, USA Today (July 29, 2015), <http://usat.ly/1JRTtoML>.

<sup>44</sup> *Id.*



Takata's own test should thus be sure to account for the effects of aging. No product that depends on chemical compounds operating in a specific way lasts forever and Takata needs to understand the age-related limitations of its products. It should also account for the possibility that a vehicle may be exposed to several different environments over its lifetime. Since an average vehicle has more than two owners over its useful life, and in light of the national Internet-driven marketplace, it is likely not uncommon for a vehicle that is first sold in Ohio to spend time in California and end up in Florida.<sup>45</sup> Because there is no national database to track vehicles by Vehicle Identification Number (VIN) and location, testing should account for the variations in climatic exposure over the average life of the fleet.

By the same token, Takata should update its standard as it continues to learn more about how its products react in different conditions. Were Takata to increase its in-fleet monitoring along the lines already discussed or be able to harness the analytical power of advanced telemetry technology, the information gleaned from those efforts should be incorporated into Takata's independent testing profile.<sup>46</sup>

### **Adopt a standard practice for seeking and utilizing third-party review**

Takata has, on occasion, sought the advice of outside experts regarding its products' design and operation. To cite two examples, Takata has contracted with the Fraunhofer Institute and Pennsylvania State University's High Pressure Combustion Laboratory to obtain outside perspectives on the performance of its products.<sup>47</sup> There is no mechanism in place, however, for deciding when seeking outside review is necessary or appropriate. Nor is there a formalized program for assessing or acting on the information received from this third-party review.

Takata should formalize both its process for obtaining third-party input on its product design and

performance, and its process for evaluating and acting on the feedback it solicits. In doing so, Takata should adopt a policy whereby it consults third-party experts in conjunction with making any major product or process change, such as shifting between propellant types. This will provide an invaluable crosscheck on Takata's internal evaluations. Along the same lines, Takata must develop a formal system for addressing this feedback once received. Consulting third parties is pointless if the information provided is wrongly refuted, misunderstood, or ignored. At an absolute minimum, every person with an interest in the third-party evaluation should be afforded an opportunity to review it and a chance to weigh in on what actions, if any, the third-party recommendations require.

### **Increase and standardize automation operations across facilities**

The Panel and its staff spent a substantial amount of time in Takata's North American manufacturing facilities. Overall, the Panel was generally satisfied with what it saw. Many aspects of Takata's operations are state of the art and its workforce appears to be well-trained and well-suited for the tasks it performs.

Though strong in many areas, Takata's operations can improve in a number of respects. One key opportunity for improvement is to increase and standardize automation. When manufacturing critical parts and products, there is substantial correlation between the level of automation and standardization in the manufacturing process and the consistency of the end product. That is because standardization and automation result in predictable processes that yield predictable outcomes.

In light of these benefits, to the extent that variability matters in particular aspects of Takata's operations, Takata should work toward developing more standardized and automated manufacturing processes. Some of the critical aspects of Takata's operations are done manually. For instance, much of the loading of inflator propellant is done by hand.

<sup>45</sup> Cf. KBB.com Editors, *Average length of U.S. vehicle ownership hit an all-time high*, KBB (Feb. 23, 2012), <http://bit.ly/1EDDTam> (average vehicle has 2.33 owners over an 11 year span).

<sup>46</sup> See *infra* at p. 54.

<sup>47</sup> See, e.g., Report Details Four Reasons Takata Airbags Malfunction, *Cars* (June 2, 2015); Takata and Honda Kept Quiet on Study that Questioned Airbag Propellant, *N.Y. Times* (Oct. 21, 2015).

There are significant process checks in place to protect against human error during the propellant loading process, such as the use of pre- and post-loading weight checks and other process controls, but, in the Panel's judgment, this is an area where automation is likely preferable.

Relatedly, Takata's practices are not always consistent within and across facilities. In Monclova, for example, different welding processes (fiber optic welding and carbon dioxide laser welding) are used to perform similar operations in different parts of the plant. And similar operations within and across plants benefit from varying levels of automation and other technologies.

Best-in-class manufacturing processes are generally moving toward full automation, especially in safety-critical areas. Takata should follow suit as quickly as it is able. Doing so will increase the overall quality of Takata's operations and products. It would also put Takata at the leading edge of manufacturing technology in the automobile safety industry. To be clear, the Panel is not recommending automation for automation's sake, but in safety-critical areas where automation promises to pay significant safety- and quality-related dividends.

Whether the company increases its overall level of automation or not, or in concert with doing so, Takata should work to standardize its use of automation across facilities and products. For airbag inflators, Takata needs to do an assessment of what level of automation is best from a quality perspective in terms of propellant loading, component welding, pressing, crimping, electrical testing, and leak testing, and then standardize its processes across facilities. For airbag modules, it needs to do the same with respect to sewing, folding, molding, and conducting electrical checks.

Takata should also consider making additional investments in machine-assisted airbag folding technologies or breaking up airbag folding tasks into component parts. Some airbags require more than 200 steps in the folding process and full automation of that process may be impractical. Takata could adopt additional technologies to assist in the completion of those tasks or break up the task such that instead of

having one person complete 200 steps, multiple people complete a smaller number of steps in succession. In the Panel's judgment, short of full automation, machine assistance or task division could contribute to an overall improvement in the quality of operations.

### **Reduce the incidence of conditional approvals in the design review process**

The Panel has already discussed one of its overarching concerns regarding Takata's design process—namely that Takata's quality team does not have the indisputable authority to halt product development. The Panel also has several additional and specific concerns related to Takata's design process. The Panel did not review the specific design of any Takata product and expresses no view on the matter. Design issues fall outside the Panel's mandate. The Panel did, however, conduct a thorough review of Takata's design process and believes that this process has several quality-related gaps. Chief among them is that Takata is too tolerant of the use of "conditional approvals" in its design review process.

Takata's design and manufacturing process proceeds in roughly four steps: (1) concept generation; (2) product design engineering and validation; (3) process validation and review; and (4) production. During the second step—product design engineering and validation—the product is subjected to multiple design reviews. The first design review considers items such as potential patent infringement, bench mark study and analysis, concept verification testing, and supplier source review. The second design review considers items such as standardization, feasibility, tooling, design for manufacturability, and design safety margins. And the third design review reassesses many of these items and also looks to inspection standards, work instructions, and assembly line layout. Overall, as the product gets closer to being fully designed, the criteria get closer to approximating what is required in order for the product to be ready for manufacture.

Something that raises significant concerns is that, more often than not, Takata allows a product to move through a design review gate with a "conditional approval," meaning that at least some of the issues that are part of that particular design review milestone have not been fully addressed or completed to the

reviewers' satisfaction. It is also sometimes the case that products are permitted to move through the next design review gate before the conditional approvals from the prior design review gate are fully resolved. And, in some cases, products receive conditional approvals at consecutive design reviews. The majority of conditional approvals occur in the later stages of the design process and may be due, at least in part, to timing-related pressure from automobile manufacturers.

The Panel is not aware of a specific instance where Takata's practice of sometimes allowing cascading conditional approvals has directly resulted in a quality problem. But it is clear that commonplace conditional approvals are not in keeping with best quality practices. They require the company to retrace its steps—sometimes repeatedly—to identify the issue that resulted in the conditional approval in the first place. They also contribute to the creation of an environment where quality issues could slip through the cracks. More fundamentally, at least from a quality perspective, granting conditional approval for early-in-the-process design milestones can impact design quality in a way that reverberates throughout the entire design process. If a design issue is conditionally approved in an early-stage design review and not fixed until later reviews, testing done before the final approval may not capture the impact of any related design changes on quality and performance.

Conditional approvals can also impact Takata processes beyond design. As just one example, manufacturing often begins setting up a part assembly line as a product nears final design approval. Late changes made to a product design as a result of resolving outstanding conditional approvals could lead to hastily made assembly line changes and the quality control related issues that result.

The Panel is of the view that conditional approvals should be the exception, not the rule. Takata should endeavor to lower the incidence of conditional approvals to below 20%, which would be more consistent with best automotive industry practices. Takata should also adopt firm policies that a product in development cannot move through the next design review gate until all of the conditional approvals from the prior design gate have been resolved and that

conditional approvals cannot be granted for items that are quality or safety related without executive sign off. Additionally, an action plan should be required addressing how conditional approval issues will be resolved before granting conditional approval is even considered.

This recommendation breaks down into two parts. One relates to Takata's culture. Takata needs to create a culture where conditional approvals are viewed as exceptional and where they are resolved as efficiently as possible. Takata also needs to identify why conditional approvals have become so prevalent and alter that problem-creating dynamic. If, for example, it turns out that conditional approvals are related to late-breaking design changes requested by manufacturers, Takata needs to create a culture where those requests are accounted for within its accepted design framework. Conditional approvals are not a tool for fixing problems created elsewhere.

The other part is more structural. Takata needs to make clear what constitutes "conditional" approval and what constitutes "final" approval lest the informal definition change while the underlying practice remains the same. This entails developing a clear set of guidelines for each requirement at every design review milestone and ensuring that those guidelines are enforced. Takata also needs a system in place that more efficiently tracks conditional approvals and allows any reviewer to easily ascertain where a product is in the design review pipeline and the status of any associated conditional approvals—the planned versus actual completion date of any design review milestone. A robust system along these lines will also enable Takata to identify, and hopefully eliminate, common issues that lead to conditional approvals.

### **Involve manufacturing earlier in the product design process**

Another of the Panel's design process-related quality concerns is that manufacturing personnel are often not involved, if at all, until very late in the design process. As already explained, Takata's design and manufacturing process proceeds in roughly four steps: (1) concept generation; (2) product design engineering and validation; (3) process validation and review; and (4) production. During the second step—product

design engineering and validation—the product is subjected to multiple design reviews. As it stands, in most cases, manufacturing does not get significantly involved until the third step, after the design reviews are complete. And manufacturing personnel do not have any sort of primary approval role in the design review process.

Relatedly, some Takata facilities have only very limited prototyping capabilities. This can result in late product launches and other issues as manufacturing difficulties are not identified until manufacturing has already begun. Takata has informed the Panel that its Monclova, Armada, and Torreon facilities are currently in the process of ramping up their prototyping capabilities.

Takata should further involve manufacturing in the product design engineering phase of its overall product development workflow generally, and in its design review process specifically. While design for manufacturability is a component of Takata's current design review process, consideration of that quality-critical issue would greatly benefit from involvement by Takata's manufacturing team. Timely and effective involvement of manufacturing in the product development process could improve overall design quality, minimize product launch delays, and prevent manufacturing capability driven quality and conformity issues. It could also potentially reduce overall product complexity by working toward a more standardized component design that is consistent with current manufacturing capabilities. All else being equal, a design that is easier to manufacture typically will have fewer quality issues.

### **Ensure the design review process is outcome driven and that relevant stakeholders are fully invested**

The Panel is also concerned about the design review process's effectiveness as a mechanism for ensuring quality. In some instances, the design review process appears to be more of an exercise in completion than a rigorous quality evaluation. That may be due to the fact that the design review process is focused on covering a checklist with often more than 30 items to be reviewed. Moreover, it is not

clear that the Takata personnel who could make the greatest contribution to the design review process, or who could benefit most from being present, are always in attendance. Takata's general practice is to invite large numbers of people, in some cases 100 or more, to its design review, but only a handful of those invited actually attend.

Takata should reorient its design review process so that it is more outcome driven and quality focused. In the Panel's view, quality would be best served if design reviews focused on issues requiring cross-functional leadership input (i.e. input from manufacturing, marketing, quality, and design leadership) such as design for manufacturability and whether inflator components are adequately traceable in light of post-production identification of a component problem. These meetings should provide an opportunity for Takata's best minds to contribute to product development in a meaningful way—to conduct an actual assessment of whether the design is performing well and whether it can be improved.

More technical issues could be handled at a separate meeting and prior to the broader design review meetings. Adopting this approach would improve cross-functional communications and hopefully contribute to early resolution of potentially safety-critical issues.

Additionally, Takata should revise its approach to who is required to attend these reviews. Once consensus on that key point is reached, attendance should be mandatory and Takata should devise a system for keeping track of and incentivizing attendance. While it is unlikely that every member of Takata's executive management team needs to attend every design review, at least one member of that team should always be present. Moreover, the objectives of these meetings should be clear; Takata should ensure that everyone present is adequately advised on why their presence is required, the design review's purpose, and the desired outcome of the process.

### **Establish lifetime ownership over Takata product programs**

As one would expect given the complexity of



Takata's products and processes, a number of individuals and departments are involved with a product over its lifetime. As it stands, however, no one individual or team stays with a product program (i.e. propellants, airbag inflators, and airbag modules in development) from beginning to end. Takata product programs undergo multiple handoffs during the lifetime of the product. The baton is passed from someone in the commercial business unit to a program manager who then shepherds the product through the concept generation, product design engineering and validation, and process validation and review already discussed. The product is then passed to someone who oversees vehicle testing and delivery to the customer. Currently no one person or team is specifically tasked with monitoring the product once it is in the fleet.

Whatever the merits of this division of labor from a non-quality perspective, the Panel believes that entrusting one team with overall and lifelong responsibility for a product program would be consistent with best quality practices. Having one group focused on the product from its nascent stages through obsolescence lowers the odds that quality issues will be missed in the confusion of passing projects from one person to another. It also will make it easier to identify the origins of a quality issue by eliminating a dynamic where those who controlled the product program at different points in time can attempt to pass responsibility to others. More than this, it may make it easier to identify quality-related problems later in product life—the cradle-to-grave owner will be an expert in that particular product and well-positioned to identify performance and quality issues given the right information.

In the Panel's view, this responsibility must come with both authority and accountability. The program owner must be empowered to raise quality issues across the product's life span. And the team and its members must be held accountable for problems encountered along the way and, correspondingly, be rewarded for successes.

In order for an initiative of this scope to work as intended, Takata will need to ensure that it puts the right people in charge of its programs. The Panel believes that Takata likely already has the personnel it needs to do so, but if additional resources are needed

Takata should consider acquiring them.

### **Increase consistency in monitoring and documenting critical specifications and processes**

On the whole, Takata does a good job of providing its employees with the instructions that they need to do their work. In evaluating Takata's facilities, the Panel and its staff were generally satisfied with the amount of care that went into crafting engineering drawings and operator instruction cards and the detail that resulted from those efforts.

The Panel and its staff did, however, identify instances where the instructions provided to Takata employees need to be improved. As an example, when reviewing engineering drawings at one of Takata's plants—a drawing for an airbag diffuser—the Panel's staff found that the "critical specifications" for that component were not defined. Despite that lack of definition, the reviewing employee was tasked with giving that component a thumbs up or down based on whether it met the required specifications. Along the same lines, the instructions provided to Takata employees are not always consistent across facilities such as in Takata's airbag folding and molding operations.

Takata could gain better control over its manufacturing and assembly processes if it more consistently identified and documented the critical aspects of its operations and passed that information along to its employees via clear and easily understandable instructions. Under the current structure, it is possible that some things are being over or under validated. Takata should identify the key characteristics of critical components across its array of products and make sure that those characteristics are known and understood by employees. On a going forward basis, this task could be accomplished during the course of the design review process; one of the required design review milestones could be identifying and recording the safety-critical specifications of a product's components. The Panel believes that this will reduce variability in manufacturing and contribute to an overall increase in quality.

## Promoting Quality Through Improved Management Practices

### Cultivate a quality culture at Takata

Many of the recommendations outlined thus far implicate cultural issues. While the extent to which quality is an integral part of the culture at Takata is difficult to estimate, it is safe to say that there is substantial room for improvement on this score given the numerous quality-related issues identified herein. By the same token, an integral component of implementing the recommendations discussed thus far will be cultural. It is unlikely that even the most herculean isolated efforts to improve quality at Takata will succeed unless there is an accompanying shift in Takata's culture.

Takata must dedicate itself to driving quality into its culture. Any effort to do so should have three interconnected attributes:

- Every employee at Takata should undergo periodic quality training. That training should stress quality as a governing norm at Takata and provide clear examples of when quality principles have been honored or compromised. It should also aim to ensure that all Takata departments, including its commercial business unit, are aligned when it comes to quality's paramount importance.
- All employees should spend time working directly on quality issues. Employees from all levels of the company should rotate through Takata's quality team so that they better understand quality's role, can internalize quality principles, and have a relationship with the individuals who they should reach out to should they encounter a quality issue.
- Perhaps most importantly, Takata should improve opportunities in the quality organization to attract top talent. Takata should endeavor to make quality positions at Takata highly coveted jobs—both internally and externally.

Taking these steps will go a long way toward ensuring that Takata has the culture necessary to foster quality-related gains.

### Increase leadership support for and involvement in quality initiatives

The Panel recognizes that Takata leadership is attempting to make strides on the quality front. Among other things, the creation of the Product Safety Office is a clear signal that the company is focusing on quality-related issues.

There is room for additional improvement, though, and the Panel believes that there is more Takata's leadership can do to improve the company's quality culture. At a high level, Takata's leadership should search for opportunities to celebrate quality and the accomplishments it enables. In the Panel's experience, the importance of leading by example and giving credit where credit is due on cultural issues cannot be overstated. Doing so is part and parcel of driving quality into an organization's cultural DNA.

More specifically, Takata leadership should look for opportunities to involve themselves in quality checkpoints throughout Takata's operations. One such opportunity is in the design review process already discussed. As noted, at least one member of executive leadership should be present at and actively involved in every design review. That involvement will put executive leadership closer to quality and let Takata employees know that management's commitment to quality is absolute. It could also assist in reducing the number of conditional approvals. To ensure that leadership is appropriately invested in the process, an executive level signoff could be required at each design review gate.

While the Panel's focus was on Takata's North American operations, Panel members met with Takata's global leadership in Japan as part of the Panel's review. Those meetings suggested that Takata's global leadership needs to increase its involvement in quality issues. Every Takata executive needs to be fully invested in quality in order for Takata to become a best-in-class quality company. Global leadership's involvement will be a significant signal that quality is of paramount importance to Takata.

### **Link quality-related performance and compensation at the individual level**

Another way to drive quality into the culture at Takata is to create a stronger nexus between quality metrics and compensation. There are already some links between quality and compensation at Takata, but, in most cases, those links are not at the individual level.

In the Panel's view, overall product and process quality would be improved if there were direct ties between compensation and quality at appropriate points along the Takata chain of command. Creating that relationship will require Takata to develop quality-related key performance indicators for, at a minimum, its management-level employees that can be tracked at the individual level and training regarding those metrics. Intertwining quality and compensation is particularly important for the product development team. As it stands, variable compensation for Takata's product development employees is primarily driven by factors such as cost, timing, and part performance. Quality should be at least on par with these factors when it comes to determining a product development employee's variable compensation.

While the costs of creating more direct ties between individual compensation and quality are evident, the benefits of doing so are equally clear. Compensation and quality-related key performance indicators—appropriately structured—will provide strong incentives for employees to raise quality-related issues as soon as they are identified. These indicators will need to be constantly evaluated so as to ensure that they are doing as much as possible to promote quality in all aspects of Takata's operations. Quality-related key performance indicators will also allow Takata to hold employees accountable for quality lapses and track overall quality-related trends more effectively.

### **Guarantee sufficient resources are available to support quality**

Ensuring quality across the board will be a resource-intensive effort. It requires having the right people and the right systems in place. With an insufficient staff, both as to numbers and capability, true quality in every facet of a company's work is unobtainable. The same is true of other resources such as time and funding. There is no substitute for allowing sufficient time to focus on quality issues and sufficient funding to ensure that the right people are hired and appropriately trained.

Takata should take steps to ensure that its quality support resources remain strong. Resources previously dedicated to quality should be jealously guarded and additional resources dedicated to quality where necessary and feasible.

Additionally, Takata should adopt a forward-looking approach to managing its work force in order to head off any potential quality gaps that might result from labor fluctuations or shortages in the areas in which it operates. The current recall campaign has stressed Takata's workforce and that stress is only going to increase as Takata increases the production of replacement kits. Takata is facing substantial challenges in terms of hiring and retaining a qualified workforce given the additional workload on its workers and industry competition.

## Summary of Recommendations

### Addressing Quality-Related Concerns

Refine the approach to monitoring in-fleet product performance. Takata should refine its process for identifying quality-related problems with its products in the automobile fleet and make better use of the information that it collects. The roles and responsibilities of those entrusted with responding to externally raised quality concerns should be formalized and specific processes should be put in place governing how those teams must manage (and elevate, if necessary) potential quality problems when identified. Takata should also explore the possibility of engaging in some form of independent in-fleet monitoring and put a system in place that allows the data it collects on product performance to be systematically studied. It is also paramount that when there is a lesson to be learned from that information that it finds its way back to Takata's design and manufacturing teams so that it can be utilized when fashioning future Takata products.

Ensure quality and safety concerns can stop product development. Takata should adopt policies that make clear that quality has a leading role in design and the power to stop the design process based on quality concerns. Giving quality personnel that authority will reduce the likelihood that a quality issue slips through the cracks. It will also send a clear signal that quality is to be Takata's defining characteristic that will hopefully echo across all of Takata's operations. The company should also train its quality personnel through examples and set standards on how to identify quality issues and what constitutes an issue of sufficient gravity to halt product design.

Ensure that data from quality performance testing is recorded and reported accurately. Takata must ensure that any data it collects in connection with the design, manufacture, and testing of its products is recorded and reported accurately. A system must be put in place to ensure that no test result is ignored and that every test result that must be reported is reported. Additionally, given the paramount importance of this issue, a monitoring program should be put in place to ensure accurate and standardized reporting.

### Ensuring Quality In Takata's Design And Manufacturing Processes

Develop a Takata standard for product safety specifications. Takata should develop its own set of testing specifications based on its own view of what is best from a quality and safety perspective. Takata's independently developed test should take account of the fact that vehicles now often remain on our Nation's roads for more than a decade and find themselves in multiple states during their lifetimes. Once Takata develops its independent standards those standards should be reviewed on a regular basis. And as Takata continues to learn more about how its products operate in real world environments it should continue to refine its own testing methodology to attempt to account for that information.

Adopt a standard practice for seeking and utilizing third-party review. Takata should formalize its process for obtaining third-party input and for evaluating and acting on the feedback it solicits. Takata should adopt a policy whereby it consults third-party experts in conjunction with making any major product or process change. It also must develop a system for addressing this feedback once received.

Increase and standardize automation operations across facilities. Takata should attempt to increase and standardize its level of automation across processes and plants. In particular, Takata should move toward full automation of propellant loading and look for additional opportunities to increase machine assistance in airbag folding. Takata should also work to standardize its use of automation across facilities and products. Takata needs to do an assessment of what level of automation is best from a quality perspective for all aspects of airbag inflator assembly and then align its practices globally.

Reduce the incidence of conditional approvals in the design review process. Takata should endeavor to lower the incidence of conditional approvals to below 20%. Takata should also adopt firm policies that a product in development cannot move through the next design review gate until all of the conditional approvals from the prior design review gate have been resolved and



## Summary of Recommendations

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that conditional approvals cannot be granted for items that are quality or safety related without executive sign off. Additionally, an action plan should be required addressing how conditional approval issues will be resolved before granting conditional approval is even considered.

Involve manufacturing earlier in the product design process. Takata should further involve manufacturing in the product design engineering phase of Takata's overall product development workflow and in the design review process.

Ensure the design review process is outcome driven. Takata should reorient its design review process so that it is more outcome driven and quality focused. Design review meetings should provide an opportunity for Takata's best minds to contribute to product development in a meaningful way and focus on issues requiring cross-functional leadership input. Takata should also revise its approach to whom is required to attend design reviews, limiting attendance to those who are most likely to benefit and contribute. At least one member of Takata's management team should be required to attend each review. And Takata should ensure that everyone present is adequately trained on why their presence is required, the design review's purpose, and the desired outcome of the process.

Establish lifetime ownership over Takata product programs. Takata should establish cradle-to-grave ownership over individual product programs and empower program owners to drive quality in Takata products.

Increase consistency in monitoring and documenting critical specifications and processes. Takata should more consistently identify and document the critical aspects of its operations and pass that information along to its employees via clear and easily understandable instructions. Takata should also identify the key characteristics of critical components across its array of products and make sure that those characteristics are known and understood by the relevant employees.

## Promoting Quality Through Improved Management Practices

Cultivate a quality culture at Takata. Takata should take additional steps to imbed quality into its culture by: (1) requiring that every employee at Takata undergo periodic quality training; (2) creating a system that rotates employees through quality team jobs; (3) improving opportunities in the Takata quality organization.

Increase leadership support for and involvement in quality initiatives. Takata leadership should search for opportunities to celebrate quality and the accomplishments it enables. Takata leadership should also look for opportunities to involve themselves in quality checkpoints throughout Takata's operations. One such opportunity is in the design review process already discussed. As noted, at least one member of executive leadership should be present at every design review. To ensure that leadership is appropriately invested in the process, an executive level signoff should be required at each design review gate. And Takata's global leadership needs to increase its involvement in quality-related issues.

Link quality performance and compensation at the individual level. Takata should create direct ties between compensation and quality at the individual level at appropriate points along the Takata chain of command. Creating that relationship will require Takata to develop quality-related key performance indicators that can be tracked at the individual level and training regarding those metrics.

Guarantee sufficient resources are available in quality critical areas. Takata should take steps to ensure that its quality support resources remain strong. Resources previously dedicated to quality should be jealously guarded and additional resources dedicated to quality where necessary and feasible.

## Implementing Change

The Panel recognizes that even if Takata fully embraces all of these recommendations, which the Panel expects and hopes that it will, change will not be instantaneous. Change takes time and patience and that is particularly true when it comes to changes at the cultural level. The Panel is certain, however, that with the right resources and focus all of its recommendations can be implemented and that effecting the changes discussed will be worth the effort.

In the Panel's view, Takata should do four things to facilitate implementing the Panel's recommendations.

- Takata should create a dedicated quality team to supervise the implementation of the recommendations discussed. This team will need to have the personnel, resources, and authority necessary to drive change. Takata may be able to assemble this team entirely from members of its current workforce, but it may require bringing in additional personnel to ensure that the team has the tools necessary to succeed. To the extent Takata builds this team from existing personnel, it will be critical that team members be relieved of other duties such that they can focus on implementing the Panel's recommendations.

Implementing the Panel's recommendations may fall naturally within the ambit of the Product Safety Office and thus may be supervised by the Chief Safety Officer—the new position required by NHTSA's consent order. If a separate office or individual is entrusted with implementing the Panel's recommendations, that individual should provide regular reports to the North American

Executive Committee and Takata's Board (as is required of the Chief Safety Officer) regarding the company's efforts to implement the Panel's recommendations.

- This quality team—working hand-in-hand with Takata leadership—must develop a detailed plan to implement the Panel's recommended changes. As discussed, Takata self-identified many of the quality issues noted herein and is already effecting change in a number of key areas. But a comprehensive quality improvement plan will be critical to ensuring follow through on the full range of the Panel's recommendations.

A key component of this plan will be developing success metrics. With respect to many of the Panel's recommendations, what constitutes success is inherent in the recommendation itself. For example, if Takata develops an ironclad data collection, reporting, and tracking system and adopts a standard practice for seeking and utilizing third-party evaluations, then it will have successfully implemented two of the Panel's recommendations. With respect to some of the remaining recommendations, what constitutes success may be harder to measure. But developing a success metric is equally important for all of the Panel's recommendations, and establishing meaningful goals regarding these recommendations will be one of the critical roles of the quality team.

- The quality team and Takata need a reliable and robust monitoring program to track change completion and efficacy. The program will be a

## Implementing Change

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complement to and reinforce the quality change plan developed by the quality team and Takata management.

- Takata and the quality team need to develop a comprehensive quality training program. One of the common threads of many of the Panel's recommendations is the need for training—quality training for Takata employees generally and for specific personnel on specific quality-related issues. In many respects, the implementation of the Panel's recommendations will only be as strong as the training program that supports them. Takata and the quality team should make every effort to ensure that its quality-related training efforts are a success.

The Panel and Takata have agreed that Takata will provide the Panel with a report one year from now summarizing the company's progress in implementing the Panel's recommendations.

The Panel wants to underscore that while it believes implementing its recommendations are of paramount importance, the Panel does not mean to suggest that Takata should divert resources from its current recall-related efforts to address the Panel's concerns. Takata is currently producing one million inflators per month as part of the recall.<sup>48</sup> The Panel appreciates that these efforts may make it difficult for Takata to act quickly with respect to some of the Panel's recommendations. But, in the view of the Panel and its staff, implementing these recommendations is critical and the Panel strongly encourages Takata to do everything that it can to do so to the extent those efforts do not undermine the current recall campaign or root cause analysis.

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<sup>48</sup> National Highway Traffic Safety Administration, *Notice of Intent to Open a Coordinated Remedy Program Proceeding for the Replacement of Certain Takata Air Bag Inflators*, 80 Fed. Reg. 29791 (May 22, 2015), <http://1.usa.gov/1JfiD10>.

## Additional Observations

During the course of its review over the past year, the Panel often discussed larger issues surrounding airbag safety and automobile safety more broadly. While not in the heartland of the Panel's mandate, the Panel believes it is obligated to share, at least briefly, some of these observations and related recommendations.

Several themes emerged during the course of the Panel's review, many of which are related to issues that NHTSA, Congress, and other automobile safety stakeholders have grappled with for decades:

- The problems associated with aging vehicle parts that are integral to critical safety systems, especially in view of the increasing average age of the operating vehicle fleet
  - Suppliers' dependence on vehicle manufacturers and lack of leverage with respect to
    - Variances in specifications and testing of discrete critical safety system components
    - Design specifications for component integration into vehicles with varying geometries and other characteristics that may affect life cycle performance in ways beyond the control of the component supplier
    - Notification and collaboration with suppliers on early warning data possessed by vehicle manufacturers
  - The deficits in the government's surveillance and detection of anomalies that may point to defects
  - The inability of Federal and State governments to effect recalls of defective vehicles, even when the defects present a material risk to public safety
- The need to take advantage of technologies deployed in related industries to monitor safety-critical systems and their components

The Panel's efforts, while Takata focused, have brought its views on many of these issues into stark relief. The Panel believes that it would benefit the motoring public and all those concerned with public safety to share its thoughts on these critical issues. These observations and recommendations are addressed to the Nation's motor vehicle safety enterprise broadly, which includes manufacturers, suppliers, regulators, Congress, State governments, and the insurance industry.

### Addressing The Problems Presented By The Aging Vehicle Fleet

Over the last 20 years, the average age of cars on our Nation's roads has increased 35%, and that number is expected to continue to grow for the foreseeable future.<sup>49</sup> In the 1990s, NHTSA expected that the vast majority of cars and light trucks purchased 20 years prior would be off the road and out of service. Pursuing failures of safety systems in older cars was thus not a priority—the scope of the problem was relatively small compared to identifying defects in newer vehicles that made up a larger and growing part of the fleet. But, as is often the case, reality defied prediction and there is now a much higher percentage of older vehicles on our country's roads than anticipated. As a result, some of our previously held notions about vehicle safety warrant reexamination.

Components that were adequate to protect vehicle drivers and passengers for a vehicle's expected on-road lifespan 20 years ago may no longer be suited for that purpose. Safety systems such as airbag inflators, which depend on chemicals performing as anticipated, are likely more vulnerable to the effects of aging than other physical materials. Any other chemically driven product we purchase for health and safety—from pharmaceuticals to carbon monoxide detectors—has

<sup>49</sup> See Nathan Bomey, *Average age of cars on U.S. roads breaks record*, USA Today (July 29, 2015), <http://usat.ly/1JRtoML>.



## Additional Observations

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a “use by” date with a margin of safety, beyond which the manufacturer cannot reasonably be expected to guarantee performance. Yet, even with the advancing age of the vehicle fleet, there is no plan in place for replacing these components or for dealing with the impact of the aging fleet more broadly.

Lest there be any doubt, the issue of component aging and related chemical degradation is not confined to airbag inflators. NHTSA encountered a similar problem in the wake of the failures of Firestone Wilderness AT tires installed on SUVs in the 1990s.<sup>50</sup> While those component failures were multi-factorial, a key factor was the age of the tire. Over time, rubber exposed to air oxidizes and cannot be expected to perform at the same level of quality as a new tire, and this degradation was identified as a major factor in the catastrophic tread separations that led to loss of vehicle control and corresponding injuries. NHTSA recognized at the time that the aging tests used by manufacturers varied widely, as did other manufacturer specifications for tires that were driven by various regulatory and market forces. The lack of a standardized aging test either agreed to by manufacturers or mandated by NHTSA enabled this variance to occur. NHTSA ultimately addressed this issue by mandating an aggressive testing protocol that only the best heat- and oxidation-resistant chemistry could pass.

Against this backdrop, the Panel makes two recommendations. First, the Panel believes that there is much to recommend—and affirmatively supports—adoption of a fleet-wide airbag inflator safety standard. Takata and its competitors currently apply different safety standard evaluations to their airbag inflator products. There is no standard that has been deemed sufficient to ensure public safety by the government, as was true for tires prior to 2001. Everyone involved should consider the possibility that a generally applicable safety standard, developed through a collaboration between suppliers, manufacturers, and regulators, may help minimize the possibility of safety

issues in the future. That agreed-upon standard should include a consensus about how to account for the potential effects of aging. Stakeholders should keep in mind that while government action would be the most definitive, it is by no means necessary. An airbag inflator safety standard could be developed through the use of an automotive safety standard setting organization akin to those operating in the technology sector or through the collaboration of the membership of an automotive safety trade group.

Second, the Panel also believes that stakeholders should consider adopting “use by” dates for vehicle safety systems that degrade over time. During the course of its review, the Panel had the benefit of comparisons to other regulated products that are dependent upon the integrity of certain chemicals performing as expected over a given time range and irrespective of the conditions under which they are maintained—namely, pharmaceuticals. As already noted, there are similarities between the airbag inflator propellant production and pharmaceutical production processes. Unlike pharmaceuticals, however, most consumers expect airbag inflators and other vehicle safety systems to last forever, or at least as long as a vehicle is drivable. When the integrity of a safety system component cannot be guaranteed for the useful life of the vehicle, replacement of that component should be required (or at least recommended).

To be sure, making it such that certain vehicle safety systems are a maintenance item will impose some costs on the driving public. But, in the Panel’s view, those costs are likely more than justified by the potential safety benefits. In the airbag inflator context, for example, the cost of the inflator itself is minimal (around \$30). The major cost would be the cost of maintenance associated with replacement installation given that vehicles are not generally configured for an easy and quick replacement. It is the Panel’s understanding, however, that some vehicles are, in fact, designed for easy airbag inflator and module replacement, which means that ease in replacement is

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<sup>50</sup> See Engineering Analysis Report and Initial Decision Regarding EA00\_023: Firestone Wilderness AT Tires, <http://www.nhtsa.gov/nhtsa/announce/press/Firestone/firestonesummary.html>.

## Additional Observations

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feasible even under current market conditions. And if replacement of inflators were required, manufacturers would likely engineer vehicles for replacement, thus substantially decreasing the costs associated with imposing a “use by” date.

### Building On The Supplier-Manufacturer Relationship

It is clear from the Panel’s review that the relationships between vehicle manufacturers and suppliers such as Takata—companies that design, test, manufacture, and deliver an end-product to vehicle manufacturers—are highly interdependent. It is equally clear that these relationships are of paramount importance for the quality and safe performance of suppliers’ products. This is true in other industries as well, such as the aircraft industry. The stakes, however, are much higher in the automobile industry than in the aircraft industry given that there are more than 6 million road crashes per year and auto-related injury and fatality numbers are orders of magnitude higher than in aviation. The auto environment is also more challenging. Aircraft component suppliers cater to a relatively small number of manufacturers that, in turn, market to a relatively small number of consumers and do so under the shadow of comprehensive regulation. By contrast, auto suppliers provide components to many more manufacturers that sell their products to more than 10 million different consumers every year and do so in an environment where regulation is limited essentially to a driver’s license and registration.

In all events, it is important to ensure that the interdependent relationship between auto suppliers and manufacturers is as fruitful as possible. Suppliers may be able to offer unique insights into the performance of their products once installed into a complete system and could assist in ferreting out risk to integrated system performance. Suppliers are also well-positioned to assist manufacturers in developing systems that minimize the likelihood of potentially problem causing design changes and

ensuring that manufacturer-imposed time constraints do not compromise design, manufacturing, and testing processes. For their part, manufacturers are well-positioned to collect data on component and system performance in the automobile fleet.

With this in mind, the Panel recommends that suppliers and manufacturers work together to standardize safety system design features to the extent doing so is practical. As explained at various points in the Panel’s report, airbag suppliers are subject to a multiplicity of requirements from the vehicle manufacturers they supply. That dynamic is by no means unique to airbag inflators and modules. The Panel believes that, building on the already-existing relationships between suppliers and manufacturers, automobile safety stakeholders should work toward developing standardized design features for safety systems generally, and for airbag inflators and modules specifically. Doing so will minimize the likelihood that idiosyncratic design requirements have unforeseen results. It will also help to isolate the root cause of potential problems with auto safety systems moving forward to the extent that those problems manifest in some manufacturers’ products and not others.

The Panel also encourages increased data sharing between manufacturers and suppliers. Suppliers and manufacturers already share data on manufacturer requirements and component performance in the vehicle fleet. But, in the Panel’s view, more can and should be done. Suppliers and manufacturers should have an open and ongoing dialogue regarding their relationship whereby suppliers can make suggestions about how to optimize product performance and minimize time-related pressures. Manufacturers should also share information on component performance with suppliers as quickly as possible from all sources (incident reports, dealer and customer notifications, brand call centers, warranty work reimbursements) so as to maximize the odds of early detection of a diagnosable problem. The Transportation Recall Enhancement,

## Additional Observations

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Accountability and Documentation (or TREAD) Act requires manufacturers to report component failure information to NHTSA, but it does not require that it be shared with component suppliers.<sup>51</sup>

### Enhancing The Government's Surveillance Capability

Vehicle component suppliers and vehicle manufacturers have a duty to monitor the performance of their products in the fleet. The government has a role to play here as well. In the Panel's view, the government's surveillance and detection function should be fortified and relevant resources augmented as necessary.

The TREAD Act required NHTSA to establish an early warning system that would warn regulators of defects before those defects resulted in a widespread problem. The congressional goal was far from modest and was characterized by some as "finding a needle in a haystack when no one knows that a needle is missing." The aggressive nature of the goal, however, was not supported by similarly robust financing. Congress appropriated \$5 million for both the creation of a database that could handle terabytes of manufacturer-provided data and for NHTSA to establish a regulatory scheme for monitoring manufacturer compliance. Creation of the data acquisition system alone consumed the entire appropriation, and while the acquisition of data is a critical element in anomaly surveillance, the necessary analytic tools and expertise are equally critical and were not developed.

The Panel firmly believes that NHTSA has done its best in a resource-constrained environment to try to augment its analytic capabilities with assistance from other agencies. Yet there is little evidence that there is a sufficient and ongoing commitment on behalf of Congress and the Executive Branch to achieve the original objective of detecting—at the earliest possible point in time— anomalies in field data suggesting

safety defects.

The Panel encourages adoption of a renewed effort to enhance the government's surveillance and detection capabilities. Specifically, the Panel recommends that the Administration and the Congress support NHTSA undertaking a re-scoping of the requirement for surveillance, detection, and investigation of possible safety defects using a big data approach. This activity should involve government agencies that have developed state of the art categorical data and text analysis to assist in identifying and adopting best practices. The level of investment to do so should be included in the President's budget, reflecting the seriousness of the potentially lurking threats to the safety and health of the public.

### Increasing Recall Efficacy

Takata's current recall efforts have crystalized the numerous already known shortcomings in the Nation's recall system. Federal and State governments are unable to effect recalls of defective vehicles, even if and when those defects would pose a material danger to occupants of those vehicles or of other vehicles on the road. The Panel recognizes that NHTSA is well aware of this issue, having solicited ideas for improving the effectiveness of and compliance with recalls from numerous sources, internal and external.<sup>52</sup> But the need for a fresh look at a coordinated effort across governments at all levels and with the private sector has never been more urgent.

The Takata recall is one of the largest consumer product recalls in U.S. history, but it is unfortunately not an isolated incident. Numerous airbag suppliers have been involved in recalls of varying sizes in recent years.<sup>53</sup> And automobile-component-driven recalls are becoming more commonplace. (*see figure 5*)

In spite of letters sent to registered owners of vehicles and, in many cases, months-long media coverage, compliance rates of owners bringing vehicles in for service are underwhelming. This is true, not

<sup>51</sup> See 49 U.S.C. §§ 30101-30170.

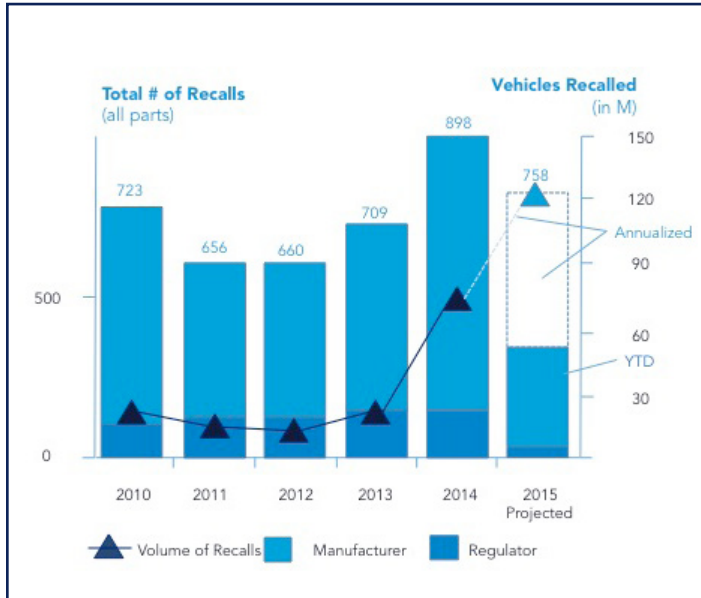
<sup>52</sup> See NHTSA, Closing Remarks, Retooling Recalls Workshop (Apr. 28, 2015).

<sup>53</sup> See, e.g., *U.S. Regulators Probe Autoliv Airbag Components*, Reuters (Feb. 21, 2012) <http://reut.rs/1WR5fj0>; Yoko Kubota, *Toyota to Recall 1 Million Vehicles for Airbag, Wiper Glitches*, Reuters (Jan. 30, 2013) <http://reut.rs/1EUzskO>.

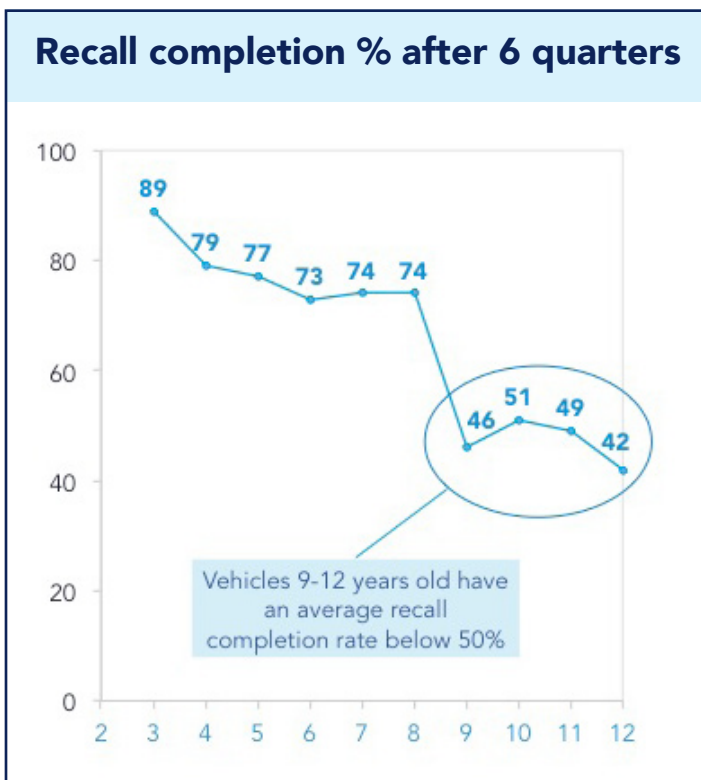
# Additional Observations

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**Figure 5**



**Figure 6**



only in the case of the airbag recall, but for many other recalls past and present. And the efficacy of a recall tends to decline in correlation with a vehicle’s age. (see figure 6)

There are a number of possible explanations for this. One is that, over time, vehicles change hands—often multiple times—and there is not a comprehensive system for tracking vehicles as they age. As a result, when a recall notice is sent out, it may never find its way to the vehicle’s current owner. In other cases, owners may not take the recall seriously or the recall notices may be viewed as junk mail. In all events, without being notified by NHTSA or the manufacturer that a vehicle is being recalled, owners have no way of knowing that a failed component may be under their hood or dashboard. Even well-publicized recalls may differentiate by lots or VIN or whether the vehicle has been domiciled in one state or another. The current system requires diligence by the vehicle owner, even when notification goes well. Since the efficacy of these recalls is highly correlated with the age of the vehicle, and the cause of many component failures is related to age, there is a certain urgency especially to address this older population of recalled vehicles.

The Panel thus recommends that NHTSA and Congress work with state and local governments and the private sector to increase the efficacy of recalls. One way to do so would be through adoption of a VIN tracking program. The ability to track vehicles by VIN and location over time would increase the efficacy of recall efforts, at least to the extent that the ability would foster the delivery of recall notice to current vehicle owners. This capability could also assist automobile component suppliers, vehicle manufacturers, and regulators in understanding safety problems that may be exacerbated by the location where vehicles are domiciled over time.

The Panel recognizes the need to respect the privacy of owners who may not want their vehicles to be “tracked.” However, implementing this capability



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may not require any additional data acquisition on vehicles or their owners over what is already available from state departments of motor vehicles, insurance companies, and registered automobile service outlets, all of whom collect the VIN for their own business purposes. The Panel is well aware of States' resistance to "unfunded mandates" from the Federal government, such as DMVs collaborating in a national registry of VIN locations and owners. But the Panel believes that the safety benefits of being able to identify owners and the locations of vehicles by VIN justifies the data sharing necessary to accomplish it. State insurance commissioners could, for example, require insurance companies to be part of such a collaborative effort. And State DMVs working with NHTSA have the ability to license and renew licensure for only vehicles that have no outstanding safety recalls.

### **Incorporating Non-Automotive Technological Advances Into Automotive Safety Systems**

The Panel also wants to highlight the role that advanced sensors and telemetry could play in the coming years in identifying failing components and warning owners and vehicle maintenance professionals of component failure. Technologies that are used in other fields to monitor and transmit information on pressure, temperature, humidity, and electronic performance could play an important role in monitoring the status of automobile components—including airbag inflators—in the not-too-distant future. For instance, an internal sensor in an airbag inflator could provide a warning to the vehicle owner and airbag supplier that the environment in the inflator has changed such that there is a risk that the inflator will no longer perform as designed. Automobile safety stakeholders should look for opportunities to promote the development of, and encourage the adoption of, technologies of this sort in safety-critical auto components.