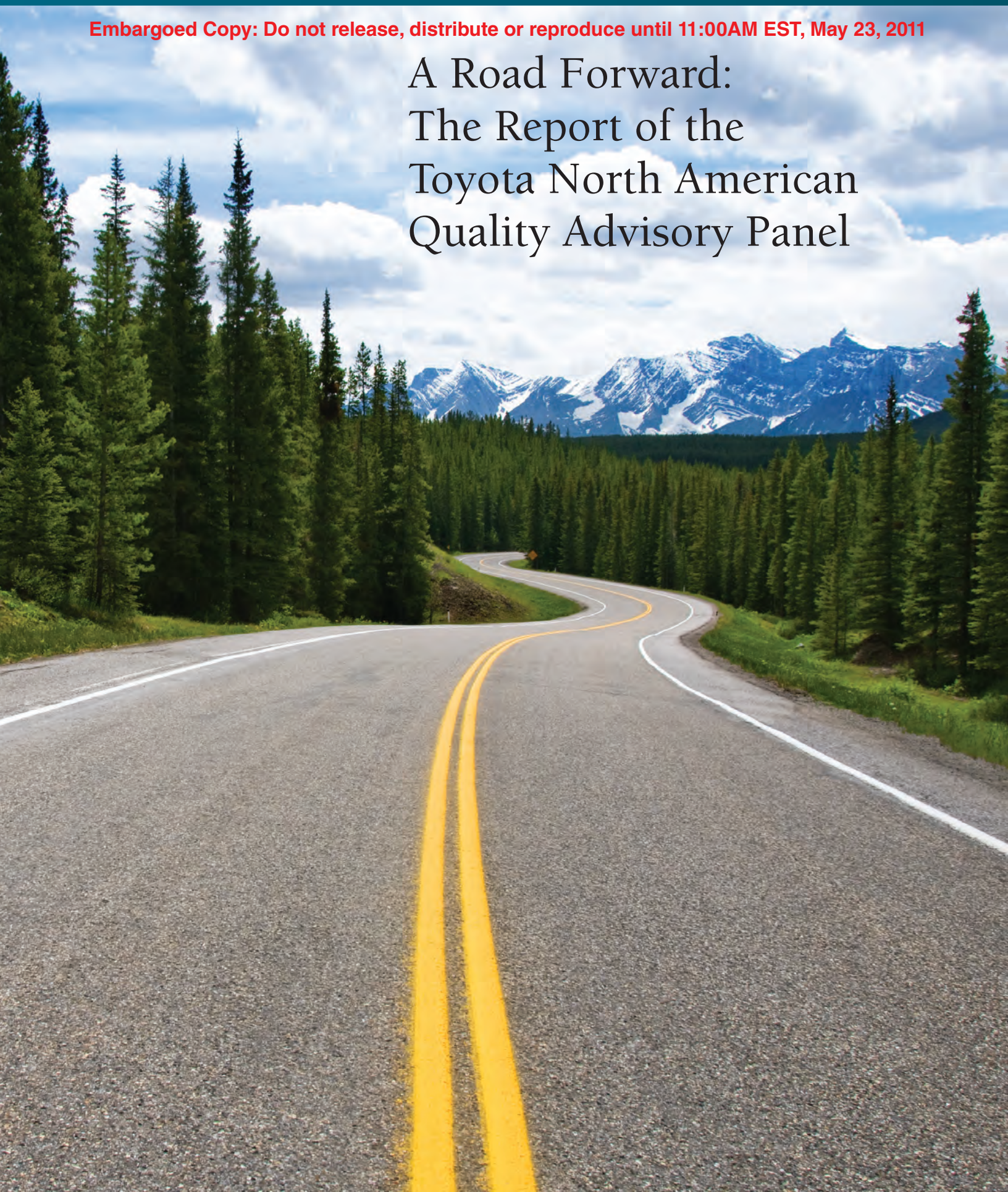
A Road Forward: The Report of the Toyota North American Quality Advisory Panel



A Road Forward: The Report of the Toyota North American Quality Advisory Panel

May 2011

The Toyota North American Quality Advisory Panel

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With the rest of the world, the Panel watched in horror as the tragic devastation of the recent earthquakes and tsunami unfolded in Japan. Our thoughts and prayers are with the tens of thousands of Toyota employees, their families, and other citizens of Japan affected by this terrible tragedy.

The Panel acknowledges and applauds Toyota's efforts to help the company—and the country—find the best road forward during this most difficult time.

The Report of the Toyota North American Quality Advisory Panel

Over the past several decades, Toyota has established itself as one of the preeminent automobile manufacturers in the world and has developed an excellent reputation for building high-quality vehicles. This reputation was severely threatened in 2009 and 2010 amid a series of high-profile government investigations and intense public scrutiny related to reports of unintended acceleration events in Toyota vehicles.

One of Toyota's many responses to this crisis was to commission this Panel of professionally-diverse leaders to examine Toyota's quality and safety processes and procedures and to make recommendations for a road forward for the company. After its first year of review, the Panel is optimistic about the way forward for quality and safety at Toyota. Toyota is clearly a great company that is capable of doing great things for drivers, for the countries in which it operates, and for the world of business.

There are three primary reasons for our optimism. First, extensive testing and analysis by the National Aeronautics and Space Administration (NASA) and the U.S. National Highway Traffic Safety Administration (NHTSA) have revealed no electronic problems or software errors that could have resulted in unintended acceleration in Toyota vehicles. Second, President Akio Toyoda has put forward the Toyota Global Vision 2020 that puts driver safety at the center of its aspirations. Third, Toyota management at all levels has been both cooperative with our work and eager to implement positive changes, some of them long before the Panel's formal recommendations were issued.

Optimism notwithstanding, there is still work to be done and sadly, that work will need to take place as Toyota helps its home country recover from the devastating and tragic earthquake and tsunami. The work is required on three fronts. First, the Panel believes Toyota needs to continue to adjust its balance between global and local control giving weight to local control in order to improve its communication and speed in responding to quality and safety issues. Second, the Panel believes that Toyota needs to ensure that it listens and responds as positively to negative external feedback as it does to negative internal feedback. Third, the Panel believes that Toyota must persist in more clearly distinguishing safety from quality and continue its efforts to enhance its safety practices and procedures.

The issue of leadership—the leadership of Toyota's top executives as they navigate the road forward, as well as the company's leadership in the industry—permeates this Report. The Panel believes that effective leadership is the key to Toyota's future, empowering it to grow stronger and adapt its historically successful culture to meet the new challenges of the increasingly competitive automobile manufacturing business. We hope the suggestions in this Report will help Toyota's senior management address some of those challenges as it negotiates the road forward.

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On February 24, 2010, Akio Toyoda, President of Toyota Motor Corporation and grandson of its founder, sat before the U.S. House Committee on Oversight and Government Reform to answer questions at a hearing entitled "Toyota Gas Pedals: Is the Public at Risk?" He told the Committee that Toyota's traditional priorities of safety first, quality second, and volume third "became confused, and we were not able to stop, think, and make improvements as much as we were able to before, and our basic stance to listen to customers' voices to make better products has weakened somewhat." By the time Mr. Toyoda spoke these words, the company had already recalled over five million vehicles to reduce the likelihood of unintended acceleration (UA) events potentially caused by accelerator pedals getting trapped by all-weather floor mats and by "sticky" accelerator pedals that were slow to return to idle position. The recalls came after several investigations by NHTSA into complaints of UA in Toyota vehicles and prior recalls to reduce the likelihood of UA events.

The 2009–2010 recalls—and the intense public scrutiny and criticism from regulators, lawmakers, the media, and the public that accompanied them—were a devastating blow to a company that had developed a stellar reputation for quality. The Toyota Production System (TPS) and the principles of The Toyota Way are renowned for their effectiveness in producing high-quality vehicles. In his testimony, Mr. Toyoda placed part of the blame on Toyota's aggressive growth over the past decade. But the root causes of Toyota's recent challenges go beyond the issue of growth. They are more complex and more subtle, and in many cases, are not unique to Toyota.

Against this backdrop, and to assist Toyota in its process of self-examination, Toyota created the Toyota North American Quality Advisory Panel. The Panel's members were announced on April 29, 2010. This Report provides the results of the Panel's review at the mid-point of its two-year term of service. The details of the Panel's review process and methodology over the past year are set forth below.

The Panel's purpose is to "bring an outside perspective and provide objective advice to the highest levels of Toyota's North American management with respect to content, implementation, and further development of [its] quality and safety processes."[1] Toyota asked the Panel to conduct a thorough and independent review of the soundness of these processes and "make recommendations to Toyota's senior management concerning additional approaches and best practices that should, in the Panel's judgment, be considered in the company's quality and safety efforts."[2] Toyota also directed the Panel to "evaluate all testing completed on the electronic throttle control system with intelligence (ETCS-i) installed in Toyota and Lexus vehicles, and release its findings to the public."[3]

The Panel has operated since its inception as an independent group of outside advisors and has conducted its review at arm's length from Toyota and its management. Toyota has been cooperative throughout the review process, has been responsive to the Panel's requests for information, and has been receptive to the Panel's comments and feedback. In fact, Toyota started making positive changes even before the Panel's formation and has already adopted some of its suggestions and recommendations made over the past year. In the coming year, the Panel looks forward to monitoring Toyota's progress in implementing the Panel's recommendations.

As part of its review, the Panel visited many Toyota facilities in the United States and Japan, including manufacturing plants, dealerships, research and development centers, and vehicle proving grounds. Each of these visits included extensive discussions with many Toyota executives and employees. The Panel met three times with the North American Quality Task Force, a special committee established by the top executives of Toyota's North American companies. In addition, the Panel met twice with Akio Toyoda and other members of Toyota's senior leadership team.

In addition to these meetings, the Panel met several times with engineers from Exponent, an engineering consulting firm retained by Toyota to study the ETCS-i, which was claimed by some to be a potential cause of UA in Toyota vehicles. The Panel also met with representatives from a number of independent groups, including Consumers Union, J.D. Power and Associates, the Insurance Institute for Highway Safety (IIHS), Public Citizen, and the Center for Auto Safety. The Panel hosted two roundtable discussions where a number of leading experts in the fields of organizational management, engineering, and electronics presented their perspectives on Toyota's quality and safety challenges. In addition, the Panel met with current NHTSA Administrator David Strickland and key members of his staff, as well as several former NHTSA Administrators. A more detailed list of all meetings, briefings, and site visits is attached as Appendix B.

As part of its review to date, the Panel analyzed many publicly-available reports, presentations, press releases, testimony, and articles from a variety of sources offering a diversity of perspectives on Toyota's quality and safety issues. The Panel also undertook an independent analysis of customer complaints reported to NHTSA's Office of Defects Investigation that were classified in the "speed control" complaint category.

In its review, the Panel did not seek to cast blame, assign fault, or apportion responsibility to any particular person or group. Nor did it conduct an independent investigation or analysis of any specific vehicle incident or recall. Although this Report relies on examples to explain or highlight certain observations and recommendations, nothing in this Report should be construed as being a thorough investigation of any particular incident or event. Nor should this Report be construed as an evaluation of Toyota's compliance with regulatory or other legal standards. Thus, the Panel's observations, statements, and recommendations are not intended for use in any legal proceeding in which Toyota is or may be a party. Instead, the Report is meant to provide observations and forward-looking recommendations designed to improve Toyota's overall quality and safety practices and procedures.

General Perspectives on Safety and Quality and the Challenge of Systems Integration

As the Panel undertook its review, it was mindful of the broader context of the modern automobile industry in which Toyota operates. Designing, manufacturing, and selling high-quality and safe vehicles on a global scale is a complex process. The vehicles themselves are a sophisticated combination of mechanical and electronic components with extensive software controlling many aspects of their performance. Vehicles must be designed so that they not only meet all applicable safety standards and regulations, but also have appeal to customers in their interior and exterior design features, vehicle controls, driving dynamics and feel, fuel economy, audio and navigation systems, and of course, price. Vehicles must also be designed in ways that anticipate how diverse driver populations will act and react when driving. Because some vehicle models are marketed in multiple countries and regions, designers must account for differences in climate, infrastructure, and driver habits. Added to this design complexity are the challenges of integrating vehicle components manufactured—and often designed by—suppliers across the world.

The Panel believes that effective leadership is the key to Toyota's future, empowering it to grow stronger and adapt its historically successful culture to meet the new challenges of the increasingly competitive automobile manufacturing business.

Listening to and incorporating the voice of the customer—both in the initial design of a new vehicle and after it is on the market—is a tremendous challenge for all auto manufacturers. Today's drivers expect good safety and reliability. Gone are the days when an auto manufacturer could differentiate itself from its competitors by simply making a car that didn't break down frequently. Many manufacturers today produce cars with very high levels of manufacturing quality and reliability, and their customers have come to expect this. With these raised expectations, however, design quality issues have assumed greater importance in the minds of many owners. Design quality relates to a vehicle's design features that can delight, or in some cases, annoy owners. Examples of design quality problems that annoy some owners include wind noise, complicated controls for electronic convenience features, expensive navigation systems and voice activation systems that perform poorly, etc. These design quality issues, and drivers' complaints about them, will increasingly differentiate manufacturers in independent quality ratings. Because these issues are a product of how the vehicle was designed, they are usually impossible to fix and can only be eliminated during the redesign process. Thus, avoiding these kinds of design problems is becoming more and more important to a vehicle's acceptability. Avoiding such design quality problems requires monitoring systems to not only hear customers' voices but also to *listen* to them. Truly listening to customers requires carefully considering, processing, and internalizing their feedback, even when it may be inconsistent with the company's instincts. The assumption that you know better than your customers can have devastating effects on manufacturers in any industry, and the automotive industry is no exception.

All manufacturers must also be vigilant in listening to customers when they lodge complaints that potentially could be safety related. These types of complaints can be made in a number of ways, including directly to the manufacturer through customer service numbers or dealers, indirectly through third-party consumer groups and analysts, or to government regulators such as NHTSA. Manufacturers must be able to carefully monitor and mine these sources and analyze them to spot troubling trends.

Preventing, to the extent practicable, reasonably foreseeable actions by drivers that could lead to injuries and deaths is deemed the role of a responsible vehicle designer. Hence, truly listening to the customer must include getting to know how drivers use their vehicles in everyday situations and designing fail-safes to minimize the likelihood of crashes and injuries. Manufacturers must also carefully consider how simple design changes, such as replacing a traditional ignition key with a push-button switch, can impact driver behavior (e.g., in the event of an emergency when the vehicle engine may need to be shut off while the vehicle is in motion). As NASA's April 2010 report on unintended acceleration cautions: "Care must be taken … to ensure that the design solution to one problem does not become the cause of another."[4]

The complexities described above present a multitude of management challenges for all auto manufacturers. These challenges are multiplied in a global operation where manufacturers must balance the diverse needs of local customers in different regions with the efficiencies and cost savings associated with centralized decision making and production.

As the Panel proceeded with its review of Toyota's operations and tried to better understand the genesis of its recent quality and safety issues and how to resolve them, it focused on how Toyota has managed these complex challenges. The Panel divided Toyota's challenges into five areas of inquiry:

- **The Balance between Global and Local Management Control**
  Is there an appropriate balance in the management and decision making between Toyota Motor Corporation (TMC) in Japan and its various regional operations, especially North America?

- **Responses to Problems Raised by Internal and External Sources**
  Are problems raised by sources outside Toyota treated as seriously as those identified inside the company? Is Toyota's acknowledged problem-solving strength in the Toyota Production System and the Toyota Way applied beyond its manufacturing processes in a way that helps it achieve optimal quality and safety throughout its business?

- **Management Responsibilities for Quality and Safety**
  Toyota has traditionally treated vehicle safety as a subset of quality. Has this approach resulted in less than clear management responsibilities for safety? How does Toyota's management ensure that safety concerns receive the same priority as those involving quality?

- **The Challenges of Integrating Electronics and Software**
  It is estimated that more than 50 percent of a vehicle's value is in electronics and software. As modern automobiles have incorporated more and more electronics and software into their designs, has this integration challenge created safety issues?

- **Management of Supplier Product Quality**
  Toyota has been a very vertically-integrated company with very tight controls to oversee the quality of the parts produced by its vertically-integrated (*keiretsu*) suppliers. As Toyota has expanded production to North America and elsewhere and has started using more local suppliers, has it been able to maintain the same high levels of control over these newer suppliers?

Summary of Panel Observations

The Balance Between Global and Local Management Control

In the modern world, major automotive manufacturers need to be global to be a consequential player, and like its primary competitors, Toyota has globalized. But with globalization comes an inevitable tension between global and local forces. Benefits of operating in a more globally centralized fashion are greater economies of scale, tighter operational control, and greater consistency. These are in direct opposition to the benefits of operating in a more locally-driven, decentralized fashion, which generates better adaptation to local markets, more flexibility, and quicker responsiveness to quality and safety problems. So Toyota, like all of its major competitors, must choose how best to balance global and local imperatives —and make trade-offs in doing so.

In the Panel's view, Toyota has erred too much on the side of global centralization and needs to shift the balance somewhat toward greater local authority and control. Toyota has traditionally structured its global operations to maximize control by TMC in Japan. Decision-making structures involving everything from recalls, communications, marketing, and vehicle design and development have historically been centrally managed and tightly controlled by TMC. To accomplish this, Toyota has structured its global operations around functional "silos," each of which reports separately to TMC. In North America, Toyota does not have one chief executive in charge of all its divisions (e.g., sales and marketing, general corporate, engineering, and manufacturing). Instead, there are individual heads of each division, each of which reports directly to TMC in Japan.

In its review, the Panel has determined that this structure contributed to several of Toyota's quality and safety issues in North America. Specifically, Toyota's tightly-controlled global structure: (1) hindered information sharing and contributed to miscommunication; and (2) delayed response time to quality and safety issues, fueling criticism that Toyota was being unresponsive to regulators and customers.

Responses to Problems Raised by Internal and External Sources

The Panel has observed that Toyota did not adequately apply the key principles of the TPS and the Toyota Way to its management and decision-making practices. The Toyota Way is founded on the core pillars of continuous improvement and respect for people. A fundamental principle of continuous improvement is *genchi genbutsu*, which means that one must "go and see" the source of the problem in order to determine its root cause. The Panel feels that Toyota applied this and other aspects of the TPS and the Toyota Way too narrowly in two respects.

First, while it is clear that Toyota applies the TPS process and the Toyota Way to problems or flaws found internally, Toyota does not appear to treat feedback from external sources, including customers, independent rating agencies, and regulators, the same way. For example, it doesn't appear that Toyota applied *genchi genbutsu* as quickly and thoroughly as it could have in investigating and seeking out the root causes of customer complaints regarding issues such as UA. On the vehicle assembly line in Toyota factories, when a problem on a vehicle is spotted, any line worker can pull a rope called an "andon cord" to stop production so that the problem can be quickly fixed. But when external sources have complained about quality and safety issues, it has often taken Toyota too long to pull a metaphorical andon cord and quickly try to solve the problem. Instead, Toyota initially reacted to consumer complaints such as UA, "sticky pedals," and other issues with a degree of skepticism and defensiveness.

Second, Toyota did not apply the principles of TPS and the Toyota Way adequately to identify and avoid repeating management decision-making errors with the same thoroughness and dedication with which it applies them in its manufacturing process. Although Toyota is in the car manufacturing business, it—like most modern corporations—is also a decision factory. Toyota's reputation in North America increasingly will be based as much on the quality of its decision making as on the quality of its vehicles.

Management Responsibilities for Quality and Safety

Toyota has traditionally treated safety as an integral subset of quality. In the Panel's view, this suggests that logically, if a quality vehicle is produced it will, by definition, be a safe vehicle. The Panel believes that safety and quality are different attributes and that a process that produces quality vehicles will not necessarily produce safe ones. In fact, comparatively few of Toyota's UA recalls over the past two years had anything to do with vehicle quality in the traditional sense, i.e., they were not related to defects traceable to the manufacturing or assembly processes.

Because Toyota incorporates safety into quality, Toyota did not have an senior executive designated with overall responsibility for safety until recently. Nor could the Panel identify a clear management chain of responsibility for safety. The Panel understands that from Toyota's perspective, everyone at the company has a responsibility for safety and that safety is ingrained in everything Toyota does. However, the Panel has been concerned that this safety philosophy might suffer from the old adage "when everyone is responsible, no one is accountable"[5] and that not having a single executive responsible for safety on either a regional or company-wide basis might diminish accountability for safety issues raised both inside and outside the company.

The Challenges of Integrating Electronics and Software

The Panel also had initial concerns regarding integration of mechanical and electrical engineering in Toyota's design and production processes. Specifically, the Panel was initially concerned that automotive manufacturers, which were historically dominated by mechanical engineering needs, could be challenged by the need to integrate increasing levels of electronics and software into modern vehicles. For example, the Panel was concerned that automotive manufacturers may be relying too heavily on suppliers that specialized in electronics and software and may have relinquished too much control over the design of key vehicle components. Furthermore, because it is easier to make changes to software than hardware, a related concern was that software changes could be made without adequate consideration of all the potential consequences. The Panel has not identified any significant issues with Toyota's ability to fully integrate electronics and software or its processes for ensuring that changes in software do not cause unintended consequences.

Management of Supplier Product Quality

Some commentators have suggested that Toyota's recent quality and safety problems may be partially the result of inadequate oversight of its suppliers. For example, Toyota recalled over one million Corolla vehicles because of defects in the engine control module manufactured by one of Toyota's suppliers. Even though Toyota engineers reviewed the supplier's proposed production process, there was a problem with that process resulting in some units developing electrical shorts that could not be found by inspection. Toyota has explained that it has already taken steps to strengthen its oversight of suppliers. Although the Panel did not undertake a detailed review of Toyota's supplier oversight in its first year, it looks forward to learning more about Toyota's initiatives in this area and their implementation in the coming year. Of course, the Panel recognizes that mitigating the adverse effects of the earthquakes and tsunami on the company's supply chain will remain Toyota's focus for the foreseeable future.

Summary of Panel Recommendations

The Panel recognizes that Toyota has not only acknowledged many of the challenges addressed in this Report, it has also taken steps to address some of them—in several cases before the Panel had started its work. During the Panel's second year, it looks forward to monitoring the implementation of those initiatives and their effectiveness in improving Toyota's safety and quality processes.

The Balance Between Global and Local Management Control

1) Work to further break down the regional "silo" structure in North America and consider appointing one chief executive for North American operations with responsibility for all regional functional organizations.

2) Identify additional critical cross-silo processes and organize decision-making teams around them. Toyota's inclusion of senior executives from North America in decisions regarding product recalls in North America appears to be a model for this. However, Toyota must be ever mindful that when responding to critical and emergent safety issues, decision making by committee can be inefficient and time-consuming. Toyota should consider what other decision-making models might be employed in emergency situations.

3) Strengthen communication among global regions, especially regarding reports of vehicle safety issues in vehicles that may share parts across regions. It is not enough to improve the channels of communication between Toyota's regional operations and TMC. Toyota should also find ways to facilitate communication across regions, especially regarding critical safety issues. As part of that effort, Toyota should consider appointing a director from one of its key regional markets such as North America.

4) Develop clearer lines of communication, authority, and decision making between North America and TMC. This is especially important as it relates to gathering and responding to direct feedback from customers, lawmakers, regulators, and other stakeholders. This will allow North America and other regions to benefit from the additional autonomy and authority they have been granted.

5) Continue to increase North American involvement in the product development and design process for vehicles in North American markets.

Responses to Problems Raised by Internal and External Sources

1) Develop an increased focus on incorporating external feedback and broaden the applicability of the TPS and the Toyota Way to include managerial decision making in a more comprehensive way. Toyota should do more to seek out external feedback and to integrate it into its decision-making processes. To accomplish this, Toyota should strengthen ongoing efforts to train the next generation of Toyota management on how to apply TPS and the Toyota Way to managerial decision making.

2) In addition to its initiatives to improve the collection and analysis of quality and safety data, Toyota should create an independent "Customer Representative Team" to report directly to Toyota's President. The team would be responsible for seeking out and reviewing all possible sources of information regarding the outside world's positive *and* negative views, experiences, and preferences regarding Toyota vehicles. Such sources should include complaint and accident data collected by regulatory agencies, complaints made to dealers and to Toyota's customer service numbers, warranty data, reports from consumer rating agencies, automotive enthusiast web sites and blogs, etc. The group would act

as an independent conduit and analyze the information it collects and look for trends, set priorities, identify early-warning signs, and make its work available to upper management for consideration in developing future vehicles.

3) Develop procedures to expand its quality focus more thoroughly and comprehensively beyond manufacturing and, as a result, enhance its ability to meet the ever-changing expectations of its customers.

4) TMC executives in Japan should strive to be fully informed about the perspectives of government officials and regulators in North America, especially NHTSA. Instead of viewing NHTSA proposals and defect investigations as adversarial processes, and rather than considering delayed or blocked regulations and minimized recalls as "wins," Toyota, at all levels, should recognize and understand that NHTSA's mission is to improve vehicle safety. Thus, a strong and competent NHTSA is good for Toyota and the industry because it will be less likely to propose poor regulations or push for inappropriate recalls. In this regard, Toyota should be more willing to show leadership in vehicle safety and take positions that differ from the Alliance of Automobile Manufacturers when appropriate.

Management Responsibilities for Quality and Safety

1) The newly-appointed Chief Safety Technology Officer (CSTO) should have the authority to determine the safety performance levels that the Chief Engineers and their design teams should achieve with all new models.

2) In markets such as the United States, Europe, Australia, and others where there are well-established consumer-oriented safety testing programs, Toyota should set a corporate goal of achieving the highest possible ratings for all new models. For example, in the U.S. this would mean 5 stars in NHTSA's New Car Assessment Program tests and "Top Safety Picks" in the IIHS evaluations.

3) Each local market should also have a designated chief safety officer to deal with and report on local safety issues, including safety-related defect investigations and recalls. These safety officers should also monitor warranty and other customer complaints that may be safety related. Local safety activities should be reported regularly to the CSTO who, in turn, should ensure that all of the other local safety officers are kept informed.

4) Take a leadership role in developing and implementing state-of-the-art electronic data recorders (EDRs). In particular, Toyota should consider a simplified process for downloading EDR data and web-based software for decoding, rather than having specialized decoding devices that need upgrades or redesigns each time the EDRs are changed.

5) Expand testing of new models to focus on:
(1) vehicle outputs and how they relate to reasonable driver expectations to decrease the likelihood of "drivability" problems, including those that may startle drivers; and (2) features that can distract drivers.

6) Be more proactive in communicating its safety philosophy, innovations, and accomplishments.

The Report of the Toyota North American Quality Advisory Panel

Founded in the 1930s, Toyota has enjoyed a stellar reputation in recent decades for building high-quality automobiles. The Toyota Production System (TPS) has become a model for automobile and other manufacturers worldwide. Similarly, the Toyota Way and its core principles, including *kaizen* ("continuous improvement") and *genchi genbutsu* ("go and see"), have been extensively studied and applied by corporations around the globe. As one researcher remarked, Toyota "reinvented the process of automobile mass production in the 1940s and 1950s and gradually established new standards for quality and productivity for the mass market."[6] Thus, it was surprising that in 2007, Consumers Union said it would no longer automatically assume that new Toyota models would have good reliability (an honor it previously shared with only one other auto manufacturer).[7] It was also a shock to many when in 2009 and 2010, Toyota recalled over 10 million vehicles to fix safety-related defects.[8] Toyota created this Panel to help it review its quality and safety processes and recommend possible ways to improve them. This Report reflects the Panel's current perspectives and recommendations at the one-year anniversary of its appointment.

It has been said that a good company takes problems and corrects them, but a great company takes problems and learns from them. Toyota has already acknowledged some of its quality and safety challenges and taken steps to address them. Toyota President Akio Toyoda recently announced Toyota's Global Vision 2020 (Toyota Global Vision)—a roadmap for Toyota's future that outlines the kind of company it wants to be. The Panel looks forward to learning more details about Toyota's Global Vision and studying the changes it has already made to improve quality and safety throughout the company and, in particular, in North America. The Panel looks forward to monitoring these initiatives and their implementation and impact in the coming year.

1. The Panel's Review Process

1.1 The Panel's Charter and Mission

Toyota does not have a North-American-based board of directors or similar governing body that oversees its operations in North America. Toyota sought "to approximate the benefits of outside directors by the appointment of the Panel, consisting of prominent individuals … widely respected for their experience in quality, business, and government and for their demonstrated understanding of the importance of quality and safety as critical business objectives."[9]

The Panel is guided by a Charter, which sets forth the Panel's structure, purpose, and goals, as well as its duties and responsibilities. The Panel's purpose is to "bring an outside perspective and provide objective advice to the highest levels of Toyota's North American management with respect to content, implementation, and further development of [its] quality and safety processes."[10] The Charter directs the Panel to conduct a thorough and independent review of the soundness of these processes and provide its assessment to Toyota's senior management. The Panel is also charged to "make recommendations to Toyota's senior management concerning additional approaches and best practices that should, in the Panel's judgment, be considered in the company's quality and safety efforts." Finally, the Charter directs the Panel to "evaluate all testing completed on the electronic throttle control system with intelligence (ETCS-i) installed in Toyota and Lexus vehicles, and release its findings to the public."[11]

Toyota not only charged the Panel with examining Toyota's quality and safety practices in North America but also requested that the Panel continue to monitor Toyota's progress after the Panel issued its Report. Thus, the Panel is responsible for making recommendations to Toyota as well as monitoring Toyota's progress in implementing those recommendations and assessing their impact. In order to fulfill this commitment, each Panel member was appointed for two years. This Report outlines the Panel's observations and recommendations at the mid-point of its term of service.

1.2 The Panel's Advisory Role

Consistent with the goal of providing Toyota with an "outside perspective" regarding its quality and safety processes, the Panel has operated since its inception as an independent board of advisors and has conducted its review at arm's length from Toyota and its management. Toyota has been cooperative throughout the process, has been responsive to the Panel's requests for information, and has been receptive to the Panel's suggestions and feedback.

Over the past year, the Panel has embraced its role as an advisory group to Toyota's senior management and has regularly shared its thoughts and suggestions regarding Toyota's quality and safety processes. Because Toyota has already implemented many changes to improve its quality and safety practices, the Panel felt strongly that it should not wait until the end of its second year of service to share its perspectives on what other initiatives might be needed to accomplish those goals. Accordingly, this Report is the culmination of a year-long dialogue between the Panel and Toyota designed to help shape Toyota's future. As discussed in more detail below, Toyota has listened to the Panel's feedback throughout the Panel's review process thus far and has already started to adopt some of its recommendations.

1.3 The Panel's Review Process and Methodology

Since its formation, the Panel has participated in a number of formal and informal meetings, presentations, and discussions with Toyota executives. The Panel visited Toyota facilities in the United States and Japan, including manufacturing plants, dealerships, research and development centers, and vehicle proving grounds. Each of these visits included extensive discussions with a wide range of Toyota executives and employees. The Panel also met three times with the Toyota North American Quality Task Force, a special committee of senior Toyota executives from North America. A more detailed list of meetings, briefings, and site visits is attached as Appendix B.

In addition to its extensive discussions with Toyota, the Panel met with representatives from a number of independent groups, including Consumers Union, J.D. Power and Associates (J.D. Power), the Insurance Institute for Highway Safety, Public Citizen, and the Center for Auto Safety. The Panel also hosted two roundtable discussions where a number of leading experts in the fields of organizational management, engineering, and electronics presented their perspectives on Toyota's quality and safety challenges.

The Panel met with current NHTSA Administrator David Strickland and key members of his staff, as well as three former NHTSA administrators. To gain additional insight on quality and safety from another auto manufacturer in North America, the Panel met with executives from Ford Motor Company. Finally, the Panel met with several different Toyota and Lexus dealers and communicated with Toyota owners.

During the last year, the Panel met several times with Exponent, an engineering consulting firm retained by Toyota to study Toyota's ETCS-i. In addition, the Panel has reviewed the NASA and NHTSA reports on ETCS-i and continues to monitor the National Research Council's broad review of unintended acceleration and electronic vehicle controls across the entire automotive industry.

As part of its review, the Panel analyzed a number of publicly-available reports, presentations, press releases, testimony, and articles from a variety of sources regarding Toyota's quality and safety practices and procedures. At the Panel's request, the Panel was given access to documents produced in the multi-district litigation pending against Toyota in the United States District Court for the Central District of California. Toyota also provided copies of deposition transcripts from that proceeding as well as other non-privileged materials. In addition, the Panel undertook an independent analysis of NHTSA customer complaints reported to the Office of Defects Investigation that were classified in the "speed control" category.

1.4 Limitations and Qualifications

Consistent with its Charter, the Panel's review was focused on Toyota's overall quality and safety processes and procedures. The Panel's Charter contemplates that the Panel would develop forward-looking recommendations on approaches to improve quality and safety that Toyota should consider. Accordingly, in its review, the Panel did not seek to cast blame, assign fault, or apportion responsibility for any problem to a particular person or group. Nor did it conduct an independent investigation or analysis of any specific vehicle incident or recall. Although this Report relies on examples to explain or highlight certain observations and recommendations, nothing in this Report should be construed as being a thorough investigation of any particular incident or event. Nor should this Report be construed as an evaluation of Toyota's compliance with regulatory or other legal standards. The Panel's observations, statements, and recommendations are not intended for use in any legal proceeding in which Toyota is or may be a party. Instead, the Report is meant to provide the Panel's observations and forward-looking recommendations that it believes will improve Toyota's quality and safety practices and procedures.

The Report is meant to provide observations and forward-looking recommendations designed to improve Toyota's overall quality and safety practices and procedures.

What is Unintended Acceleration?

Generally, unintended acceleration (UA) "refers to the occurrence of any degree of acceleration that the vehicle driver did not purposely cause to occur."[12] For purposes of this Report, the Panel adopts NHTSA's definition of UA as "a very broad term that encompasses sudden acceleration as well as incidents at higher speeds and incidents where brakes were partially or fully effective, including occurrences such as pedal entrapment by floor mats at full throttle and high speeds and incidents of lesser throttle openings at various speeds."[13]

Audi faced problems with UA complaints in the early 1980s. At that time, the primary concern was for vehicles that suddenly accelerated when drivers shifted the automatic transmission from park into drive or reverse. Audi announced recalls to reduce the possibility of pedal entrapment by floor mats, to alter pedal design, and to install a shift-lock mechanism that required drivers to push the brake pedal in order to shift into gear. Although the culprit causing these UA events in Audi vehicles was never conclusively determined, Audi's reputation suffered and its sales dropped dramatically.[14]

The Audi UA complaints prompted NHTSA to undertake a major investigation into this issue. The resulting study, together with findings from Canadian and Japanese government agencies, "concluded that [the] major cause of such incidents was drivers unknowingly depressing the accelerator instead of the brake pedal on automatic transmission-equipped cars."[15] NHTSA research also concluded "that the best known countermeasure to UA [defined at that time as acceleration when the driver shifted from park to drive to reverse] has been factory installation of automatic shift lock systems which prevent the driver from shifting the transmission out of park unless the brake pedal is simultaneously applied."[16]

2. Context for the Panel's Review: A Brief History of Toyota's Recent Quality and Safety Problems

2.1. NHTSA Investigations of Unintended Acceleration in Toyota Vehicles*

Between July 2003 and April 2009, NHTSA opened eight separate investigations of Toyota and Lexus models for possible defects that could cause UA events.[17] Those investigations were either prompted by petitions from consumers or patterns of consumer complaints. In most of those investigations, NHTSA never determined a cause and closed them without recommending any recalls.**[18]

The first of these investigations was prompted by a request from an individual to examine "problems of Vehicle Speed Control linkages which result in sudden, unexpected excessive acceleration even though there is no pressure applied to the accelerator pedal."[19] NHTSA denied this petition on the grounds that there was no evidence of a safety defect trend.[20] Similarly, in March 2004, NHTSA opened a petition review to determine whether the electronic throttle control system† could be a possible cause of UA complaints in 2002–2003 Camry, Solara, and Lexus ES models.[21] In June 2004, Toyota met with NHTSA and provided a detailed explanation and demonstration of its ETCS-i, including its fail-safe features.[22] NHTSA closed the investigation and stated that "[a] defect trend has not been identified at this time and further use of agency resources does not appear to be warranted."[23]

The early NHTSA investigations into UA in Toyota vehicles were prompted, in part, by increases in consumer complaints to NHTSA about "speed control" incidents involving the newly designed 2002 Camry and Lexus ES models compared to prior model years. For example, there were 29 speed control incidents reported to NHTSA in calendar year 2002 involving 2002 model Camrys, whereas the 2001 models in that same year had only four such complaints. These increased numbers of complaints for the 2002 and later model Camrys are apparent in Table 1. Despite these increases, however, the complaint rates per vehicle were still low, especially when compared to the rates of insurance claims for crash damage in the same periods. In calendar year 2002, the rate of NHTSA complaints per 100,000 insured vehicle years for 2002 model Camrys was 18.‡ In contrast, the frequency of claims filed under collision insurance coverage for crash damage to 2002 model Camrys in calendar year 2002 was 8,463 per 100,000 insured vehicle years.

*As indicated above, this Report is not meant to be a thorough analysis of any specific recalls, investigations, or events. However, some of these events help to illustrate the Panel's observations and provide a backdrop for its recommendations.

**In the United States, safety-related recalls are issued for a wide range of reasons. For example, recalls can be issued for failure to comply with particular regulatory provisions (e.g., improper labeling, minor failure of a compliance test for a safety standard) or for more serious safety-related defects, including significant design problems. Most recalls are conducted voluntarily by manufacturers, usually in consultation with NHTSA. *See* Motor Vehicle Safety Defects and Recalls Campaigns, NHTSA, *available at* http://www.nhtsa.gov/Vehicle+Safety/Recalls+&+Defects/Motor+Vehicle+Safety+Defects+and+Recalls+Campaigns. For additional information regarding NHTSA's investigation and recall process, *see* http://www-odi.nhtsa.dot.gov/recalls/documents/MVDefectsandRecalls.pdf. For recent monthly recall reports, *see* http://www-odi.nhtsa.dot.gov/cars/problems/recalls/recallmonthlyreports.cfm.

†For many years now, most new model vehicles have had an electronic, not mechanical, system to regulate the throttle. An electronic throttle control replaces the physical cable between the accelerator and the throttle. Instead of using the mechanical cable, an electronic throttle control uses sensors to regulate the throttle based on different inputs, including the position of the accelerator pedal. *See generally* NASA Engineering and Safety Center, Technical Support to the National Highway Traffic Safety Administration (NHTSA) on the Toyota (TMC) Unintended Acceleration (UA) Investigation, at 170–72 (Apr. 15, 2011), *available at* www.nhtsa.gov/staticfiles/nvs/pdf/NHTSA-UA_report.pdf (providing explanation and diagram of Toyota's ETCS-i). These systems can improve fuel economy and are necessary for the control of hybrid vehicles.

‡*Insured vehicle year* is an exposure measure indicating an accumulation of the time all Camrys are insured in each calendar year. Thus, for example, one vehicle insured for one full year equals one insured vehicle year, and two vehicles each insured for six months during the year also equals one insured vehicle year.

Table 1: **NHTSA Speed Control Complaints and Collision Coverage Insurance Claims for Crash Damage Involving Toyota Camry Models – Model Years 2001 to 2005**

		Calendar Year of Complaint or Insurance Claim					
	Model year	2001	2002	2003	2004	2005	2006
Number of Complaints	2001	4	3	1	3	3	6
	2002		29	25	62	18	12
	2003			36	52	14	15
	2004				43	19	15
	2005					40	21
Rate of Complaints*	2001	4	2	<1	2	2	3
	2002		18	9	22	6	4
	2003			25	22	5	5
	2004				33	9	7
	2005					22	8
Number of Collision Coverage Insurance Claims	2001	11,501	18,336	17,879	15,334	17,809	16,815
	2002		14,909	22,248	21,844	21,628	21,465
	2003			11,393	18,291	19,676	19,435
	2004				11,800	17,547	18,007
	2005					14,834	20,938
Frequency of Insurance Claims*	2001	9,743	8,965	8,168	7,338	7,480	6.963
	2002		8,463	7,831	7,230	6,914	6,558
	2003			7,617	7,322	7,118	6,726
	2004				7,761	7,387	6,996
	2005					7,659	7,300

*Per 100,000 insured vehicle years

Through April 2009, only two of the NHTSA investigations into reported UA events in Toyota vehicles resulted in recalls.[24] In one, Toyota agreed to recall 55,000 all-weather floor mats designed for 2007 and 2008 Camry and Lexus ES-350 models due to possible accelerator pedal interference.[25] In its report to NHTSA announcing its intent to recall the floor mats, Toyota stated:

> *Toyota has carefully evaluated the agency's concerns in the defect investigation EA07-010 and has concluded that the subject vehicles do not contain a safety related defect. With respect to the All Weather Floor Mats that are associated with the field incidents reported in EA07-010, Toyota concluded that the mats do not contain a safety-related defect; however, Toyota agrees that an unsecured All Weather Floor Mat, especially one that is stacked on top of another floor mat, can migrate toward the accelerator pedal, potentially preventing it from returning to idle.*[26]

At the time of the recall, Toyota issued a safety advisory not only to owners who purchased all-weather floor mats, but also to all 2007 and early 2008 Camry and Lexus ES-350 owners.[27] The advisory warned owners about the dangers of not properly securing the floor mats or stacking multiple floor mats on top of each other.[28]

In April 2008, NHTSA opened a preliminary evaluation to investigate a consumer complaint of UA in a 2004 Toyota Sienna minivan.[29] In responding to an information request from NHTSA in June 2008 about UA events in Sienna models, Toyota reported that during its dynamometer testing of the Sienna five years earlier in 2003, an accelerator pedal became trapped due to "a missing retaining clip that allowed the center console trim panel to interfere with (trap) the accelerator pedal after it had been depressed."[30] When Toyota discovered this problem in 2003, it instituted a special 100% inspection requirement for the retaining clip for vehicles in production.[31] This continued until Toyota changed the design of the trim panel in June 2003 to "eliminate the potential for pedal interference in the event the retaining clip is not present."[32] Toyota announced a "safety improvement campaign" in January 2009 to replace the retention clip and floor carpet cover in the 26,501 Sienna minivans manufactured between January 10, 2003, and June 11, 2003 (before the design change was implemented).[33]

2.2 A Pivotal Event: The Saylor Crash and its Aftermath

In August 2009, there was a highly-publicized crash in Santee, California, that killed California Highway Patrol Officer Mark Saylor and members of his family. This crash led to an onslaught of intense scrutiny by the media, lawmakers, and regulators and became the pivotal event in the UA investigations for both Toyota and NHTSA.

The Saylors were driving in a 2009 Lexus ES-350, a service loaner given to them by a Lexus dealer. In a recorded 911 call immediately before the crash, a passenger in the vehicle told the dispatcher that the accelerator was stuck and that there were "no brakes." A NHTSA inspection of the crashed vehicle concluded that the likely cause of the crash was "[v]ery excessive speed."[34] NHTSA's crash investigation report for the incident states that "[a]ccording to the 911 call made by the brother-in-law sitting in the back seat of the Lexus, the accelerator pedal was depressed in a full power condition and attempts by the driver to release the pedal were unsuccessful."[35] NHTSA's report noted that an all-weather floor mat in the driver's foot well "was not secured by either of the two retaining clips."[36] The report also explained that although the mat was a Lexus brand mat, it was the wrong mat for that particular vehicle. In addition, NHTSA's report called attention to the vehicle's "Push Button Ignition Start with no Emergency Instantaneous Shut off device."[37] The report stated that:

> *[i]n the event that this vehicle was producing unwanted power, there was no ignition key that could be mechanically actuated to instantaneously disconnect electrical power to the engine. In place of the key is a software push button that delays engine shutdown for three seconds once depressed. This instruction is not indicated on the dashboard.*[38]*

*In order to shut off the engine during vehicle operation, the push-button ignition on Lexus vehicles must be held down for three seconds. There is currently no industry standard in the United States for this shut-down procedure on vehicles equipped with push-button ignition systems. However, NHTSA is currently considering proposing a rule to standardize keyless ignition systems. *See* Neil Roland, *Keyless Ignition Rule Likely to Track SAE Plan*, Automotive News, Apr. 6, 2011, *available at* http://www.autonews.com/apps/pbcs.dll/article?AID=/20110404/OEM06/304049986/1128&template=printart.

Soon after the crash, on September 29, 2009, Toyota released a Consumer Safety Advisory regarding potential floor mat interference with the accelerator pedal.[39] The release stated that "[r]ecent events have prompted Toyota to take a closer look at the potential for an accelerator pedal to get stuck in the full open position due to an unsecured or incompatible driver's floor mat."[40] It advised owners of seven different Toyota and Lexus models for model years ranging from 2004 to 2010 to "take out any removable driver's floor mat and NOT replace it with any other floor mat."[41]

On October 5, 2009, at NHTSA's request, Toyota informed NHTSA of its intent to conduct a recall to address UA in Camry and Lexus ES models, as well as for its Prius, Avalon, Tacoma, Tundra, and Lexus IS models.[42] Toyota explained that it would notify all owners of those vehicles to take out any removable driver's floor mats as a precaution and to not replace them with any other floor mats until further notice.[43] Toyota further stated that it would contact those owners again once it established the particular actions it would undertake in the recall to remedy the UA problem.[44]

On November 2, 2009, Toyota announced that it would conduct a recall affecting approximately 3.8 million vehicles to remedy possible pedal entrapment by floor mats.[45] Toyota also sent an "interim notice" to Toyota owners of the affected vehicles regarding the recall and providing a warning about floor mat entrapment.[46] In a press release announcing that the letters were being sent, Toyota stated that the letter to customers "confirms that no defect exists in vehicles in which the driver's floor mat is compatible with the vehicle and properly secured."[47] NHTSA issued a statement two days later calling Toyota's claim that no defect exists "inaccurate and misleading" and explaining that Toyota's interim solution of telling customers to remove the recalled floor mats "does not correct the underlying defect in the vehicles involving the potential for entrapment of the accelerator by floor mats, which is related to accelerator and floor pan design."[48] Toyota subsequently stated it "agrees with NHTSA's position that the removal of the floor mats is an interim measure and that further vehicle-based action is required."[49]

On November 25, 2009, Toyota notified NHTSA that the "vehicle-based actions" it would undertake included reshaping accelerator pedals, reconfiguring the floor surface to increase the spaces between accelerator pedals and floors, and installing a brake override system in the recalled vehicles with push-button ignitions.[50] It stated to NHTSA that it would inform its dealers in mid-December of the details of the campaign and would begin customer notification on a rolling basis beginning in late-December with Camry, Avalon, and Lexus ES models.[51]

Later, on December 15, 2009, NHTSA officials met with Toyota executives in Japan "to explain NHTSA's defect recall process and underscore Toyota's obligations under U.S. law to find and report defects promptly."[52] Toyota committed to NHTSA that it would make improvements at that time.[53]

January 2010 saw the beginning of a series of inquiries, investigations, lawsuits, and more recalls that kept Toyota in the heat of the public spotlight for many months. On January 21, 2010, Toyota announced a recall of 2.3 million vehicles to remedy accelerator pedals that could become "sticky" and slow to return to idle when released.[54] This issue was unrelated to the aforementioned November 2009 accelerator entrapment recall, although 1.7 million vehicles were subject to both recalls.[55] Six days later on January 27, 2010, Toyota expanded the November 2009 accelerator entrapment recall to include additional Toyota models, increasing the recall by approximately 1.1 million vehicles.[56] In February, Secretary of Transportation Ray LaHood told Congress that the Saylor crash "made clear that the entrapment problem could occur in unexpected ways and that recalling the worst performing mats and educating drivers and dealers about not using unsecured, improper, or stacked mats was not going to adequately address the risk."[57]

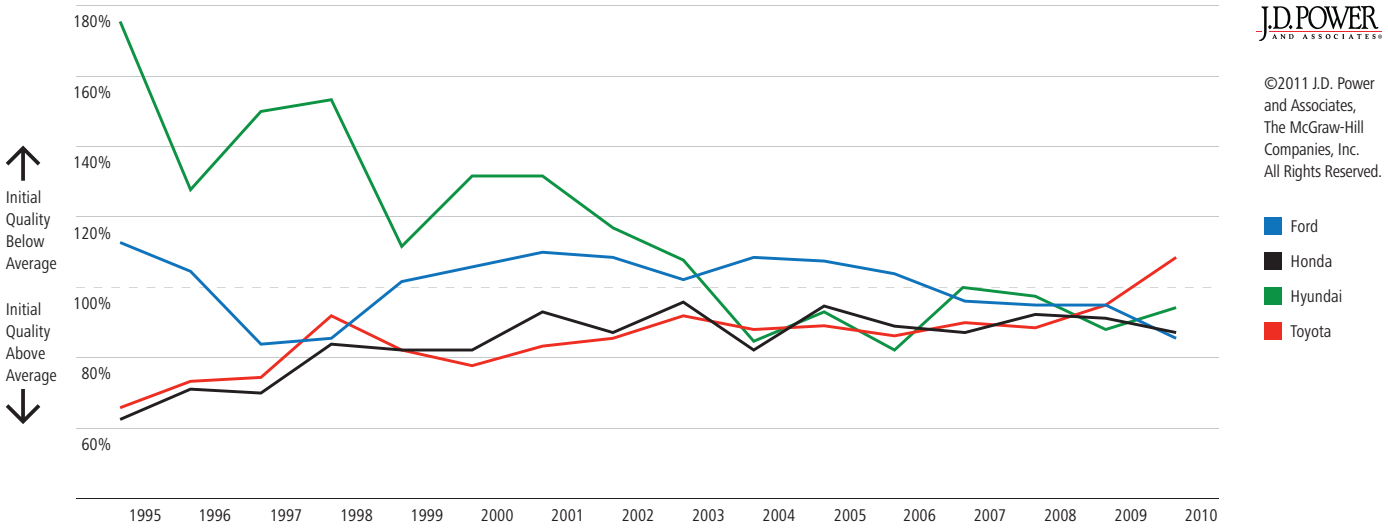
2.3 Quality Assessments and Surveys of Toyota Vehicles

The NHTSA investigations into UA in Toyota vehicles began in 2003, not long after the newly re-designed 2002 model Camry generated increased numbers of "speed control" complaints to NHTSA, many related to "drivability" issues. At that time, however, Toyota's reputation for high-quality vehicles was still flawless. According to Consumers Union product testing, Toyota models were still at or close to the top of its quality ratings during that period.[58] Thus, for example, in its assessment of the 2002 Camry, Consumers Union noted as high points: "Ride, quietness, powertrain, brakes, accommodations, build quality. The luxurious interior is flawlessly finished."[59] For the 2005 Camry, Consumers Union reported that "[t]he sizable interior is quiet and uses quality, well-fitting materials."[60] For subsequent models, these reports became less favorable. In 2007, for example, Consumers Union reported that "[t]he Camry is roomy and comfortable. Most of the interior materials look nice, but some interior trim pieces were misaligned."[61] The Toyota Matrix suffered a similar drop in Consumers Union's ratings. In 2003, Consumers Union said the Matrix interior was "well put together."[62] But for the 2009 Matrix, Consumers Union's assessment of quality had deteriorated, stating that "[h]ard plastics make the interior feel cheap. Some edges aren't well finished, and the headliner looks like cardboard."[63] For the 2011 Toyota Sienna, Consumers Union reported that "[r]oad noise is more pronounced now, and interior fit and finish and ergonomics also took a step back."[64]

Another U.S. organization that assesses vehicle quality is J.D. Power, which conducts a number of consumer surveys each year. Two key J.D. Power surveys on vehicle quality are: (1) the Initial Quality Survey (IQS), which reports on vehicle "mechanical quality (i.e., defects and malfunctions)" and "design quality (how well a particular feature works or operates)" based on surveys of new vehicle owners after they have used the vehicles for an average of 90 days;[65] and (2) the Vehicle Dependability Survey (VDS), which focuses on vehicle reliability and durability from owner surveys after approximately three years.[66] Toyota models have had better IQS ratings than most competitors over the last 15 years. However, this lead has steadily narrowed as competitors' ratings have improved, as shown below. In the VDS ratings, Toyota also has had very good results for many years.[67] In the 2011 VDS ratings of 2008 models, Toyota won seven segment awards, more than any other automaker.[68] But, as with IQS ratings, the gap with key competitors has narrowed over the past 15 years.

Toyota's Initial Quality Lead Over Most Competitors has Narrowed Over the Past 15 Years and Toyota Fell Below Average for the First Time in 2010.

Initial Quality Problems as Percentage of Industry



Source: J.D. Power and Associates 1995–2010 U.S. Initial Quality Studies

The IQS ratings for all major manufacturers have improved over time. Yet, the ratings for Toyota models—although still somewhat better than most competitors—did not show much improvement from 2003 to 2008. In 2010, they took a severe turn for the worse. J.D. Power attributes much of the poor Toyota IQS ratings in 2010 to the numerous recalls and the effect those had on customers' perceptions.[69] However, in addition to the sharp decline in the 2010 IQS ratings, the J.D. Power surveys show that Toyota has experienced a moderate, yet steady decrease in quality survey results over the past four years compared to its competitors.

There are many lessons to be learned from Toyota's handling of the NHTSA investigations of UA beginning in 2003, the recalls that followed, and Toyota's decline in quality ratings by Consumers Union and J.D. Power. In reviewing Toyota's actions during this period, several themes emerged that form the basis of the Panel's observations and recommendations. One over-arching theme relates to how Toyota manages the complex challenge of comprehensive systems integration.

As with many products today, the pace of innovation in vehicle design is much faster than it used to be. This requires constant reassessments of how customers' expectations are changing as well as fully understanding how typical users will interact with new design features and capabilities.

3. The Challenge of Comprehensive Systems Integration

Modern automobiles are safer than they have ever been. In 2009, there were approximately 23,000 occupant deaths in passenger vehicle crashes, compared to approximately 32,000 deaths in 2000.[70] These reductions are due to many factors, including improved vehicle safety designs. Despite these improvements, deaths and injuries from motor vehicle crashes are still a serious problem and manufacturers have an important role to play in their reduction by continuing to improve vehicle safety designs. This challenge has many dimensions, including:

1) Not inadvertently designing safety-related defects into vehicles;

2) Incorporating as many fail-safe systems as possible in vehicle designs so that if drivers err in operating the vehicle or inappropriately respond to vehicle outputs, the likelihood or consequences of serious crashes are reduced; and

3) Striving for the highest possible quality during the assembly process and careful oversight of suppliers to avoid safety-related defects in the manufacturing process.

Just as vehicles are safer now than they have ever been, the process of designing, building, and selling automobiles is also more complex and competitive today than it has ever been. The modern automobile is a sophisticated combination of mechanical and electronic components with extensive software controlling many aspects of its performance. Despite this complexity, automotive manufacturers such as Toyota substantially redesign their big selling models every four or five years in order to remain competitive. The redesigns typically incorporate new technologies, which are increasingly electronics and related software. Of course, the new designs must meet all regulatory requirements for safety, emissions, and fuel economy. Designers must also pay attention to independent rating agencies that conduct comparative assessments of some aspects of vehicle safety and quality, which are aimed at influencing consumers in the marketplace. Complicating the design and manufacturing processes is the fact that automotive manufacturers rely on multiple suppliers to produce—and in many cases, design—much of a vehicle's content.

The vehicle design process requires multidisciplinary teams of mechanical, electrical, and software engineers. These teams need a focus that goes beyond the traditional engineering skills to understand customers' needs and expectations to ensure that they are met throughout a vehicle's lifetime. The mix of mechanical components, electronics, and software in modern automobiles requires very sophisticated systems design and integration. For example, the users of hybrid vehicles expect seamless transitions back and forth between the gasoline engines and electric motors, and this requires complex control systems. Computerized engine control units—which constantly make adjustments to optimize performance and fuel economy while also minimizing emissions—produce much better performance and smoother drivability than cars had before the advent of electronic control systems. Such control systems and many other systems are invisible to drivers. However, the improved performance these systems produce has raised drivers' expectations.

Computer-aided designs, which allow extensive virtual testing before the first prototypes are built, also produce improvements in many other aspects of vehicle performance. Examples of such improvements include crashworthiness, fuel economy, wind or road noise, etc. But these improvements have changed customers' expectations. Today's drivers expect, among other things, good acceleration even with smaller engines, good fuel economy, and quiet interiors with high-quality stereo systems. Of course, they also expect high levels of safety and reliability. For an auto manufacturer to be successful today, it is essential for it to meet the ever-changing expectations of drivers. In this regard, auto manufacturers that produce a wide-range of vehicles, from small economy models to large luxury models, must recognize that customer expectations will differ depending on the models they are used to driving. Thus, for example, drivers of luxury brands such as Lexus are conditioned to expect a quieter ride with very little road noise compared to less expensive models.

As with many products today, the pace of innovation in vehicle design is much faster than it used to be. This requires constant reassessments of how customers' expectations are changing as well as fully understanding how typical users will interact with new design features and capabilities. For global manufacturers, it is essential that differences in customers' behaviors and expectations in their various markets be carefully considered in the vehicle design phase.

When a new feature is added that in any way changes the driving experience—even a relatively simple convenience feature—designers must consider all potential ramifications of such a change. For example, the introduction of the push-button ignition presented all manufacturers with the concern "that the driver (or passenger) might inadvertently turn off the vehicle when it is in motion.[71] As NASA has explained:

> *To prevent such an error, the safeguard was added that the button must be held for three seconds to turn off the vehicle when the vehicle is in motion. However, this procedure is certainly not well practiced by drivers. Indeed, many owners are not even aware of this "hold the button" requirement. In any case, the most common behavior in an emergency situation is to revert to the well-learned, oft-practiced, always-successful procedure: push the button briefly to turn off the vehicle. However, this procedure fails in this off-nominal situation, no matter how many times the driver executes it in rapid succession.*[72]

The complexities described above present a multitude of management challenges for all automotive manufacturers, and especially for large global manufacturers such as Toyota. As the Panel proceeded with its review of Toyota's operations and tried to better understand the genesis of its recent quality and safety issues and how to resolve them, the Panel focused on how Toyota has managed these systems integration challenges. The Panel divided Toyota's systems integration challenges into five areas of inquiry: (1) the balance between global and local management control; (2) responses to problems raised by internal and external sources; (3) management responsibilities for quality and safety; (4) the challenges of integrating electronics and software; and (5) management of supplier product quality.

4. The Balance Between Global and Local Management Control

4.1 Observations

In the modern world, major automotive manufacturers need to be global in order to handle the high costs of vehicle development and remain competitive. Like many of its competitors, Toyota has expanded its markets and manufacturing capacity to regions across the globe. Toyota currently sells vehicles in approximately 170 countries. It manufactures vehicles and parts using 51 affiliate manufacturing companies in 26 countries and regions. But with globalization comes an inevitable tension between global and local forces. Benefits of operating in a more globally-centralized fashion are greater scale economies, tighter operational control, and greater consistency. These are in direct conflict with the benefits of operating in a more locally-driven, decentralized fashion, which generates better adaptation to local markets, more flexibility, and more effective and efficient responses to quality and safety issues raised by local stakeholders.

Of course, Toyota is not unique in its struggle to find the right balance between global and local imperatives. Manufacturers in many industries across the world have struggled with this issue for many years.[73] Some analysts have even argued that truly global companies are actually quite rare and that multinational companies often masquerade as global ones. Toyota's recent bout with quality and safety problems in North America has forced it to ask itself a critical question: is our global-local structure out of balance, and if so, what must we do to adjust it?

Toyota has historically structured its global operations to maximize control from Japan to achieve global consistency and leverage its global scale. It does so by having very strong and centrally-managed functions rather than having unified leadership in each region or country. Toyota's North American operations are divided into separate operating companies with differing functions and responsibilities, including Toyota Motor North America, Inc. (TMA); Toyota Motor Sales U.S.A., Inc. (TMS); Toyota Motor Engineering & Manufacturing, North America (TEMA); Toyota Financial Services; and Toyota Canada Inc. (TCI). Each of these operating companies functions as an independent "silo" and reports directly to TMC in Japan. There is no single executive with overall authority for all operations in North America.

This functional silo structure has allowed TMC to maximize control over regional operations and decision making. However, as Toyota rapidly grew into a global powerhouse selling millions of vehicles outside of Japan, its ability to maintain such control was stretched to its limits. As Jim Olson, a former Toyota executive, explains:

> *[T]he Company did not sufficiently change its mindset, structure, and governance processes as it grew from a national company serving overseas markets with Japan-built products into a company with large manufacturing operations all over the world. Instead of sufficiently training and fully empowering the non-Japanese managers of its growing overseas subsidiaries, the company continued to make most of the important decisions affecting major markets in Japan and then directed regional management to implement them.*
>
> *This "divide-and-conquer" structure separates decision making from execution, slowing the company down by hampering communication, planning, and cross-training among the company's regional operations that could benefit Toyota.*[74]

Toyota has recognized that the distance between the customers in a given region experiencing an issue and the decision makers at TMC in Japan has contributed to inadequacies in its response to quality and safety issues. In a speech to the Japan National Press Club in October 2009, Toyota President Akio Toyoda admitted that "Toyota has become too big and distant from its customers" and was critical of company executives for their "undisciplined pursuit of more."[75]

The key to overcoming the global-local integration challenge is balance—a balance between the efficiencies and economies of scale associated with centralized control of a global operation, and the necessity to maintain trusted relationships with local customers and other stakeholders and to act quickly to identify and address the root causes of small problems before they become large ones.

4.1.1 Decision Making at Toyota

Toyota's recent quality and safety issues—and criticisms about its slow response to those issues—are also partly attributable to Toyota's decision-making processes. As one commentator has explained "[a]s the company grew, its Japanese leaders never relinquished the iron grip they exercised over the company's operations all over the world and continued to make all important decisions in Japan. Instead of globalizing, Toyota colonized."[76]

In addition, Toyota has arguably outgrown its ability to make decisions by consensus. One of the principles behind the TPS and the Toyota Way is *nemawashi*, which is "the process of discussing problems and potential solutions with all of those affected, to collect their ideas and get agreement on a path forward. This consensus process, though time-consuming, helps broaden the search for solutions, and once a decision is made, the stage is set for rapid implementation."[77] As Toyota has grown rapidly, its decision-making processes have not adapted to meet the demands of a truly global corporation. Given Toyota's size, decision making by consensus has become impracticable and inefficient in some situations. That is especially true when responding to a crisis, when decisions must be made quickly. In such circumstances, following the traditional consensus-building process creates significant delays in response time and fuels allegations that Toyota is not committed to safety and generally not responsive.

4.1.2 Information Sharing and Toyota's Global Structure

Part of Toyota's *kaizen* process of continuous improvement is the concept of *yokoten*. It means to share best practices and to transfer knowledge across the organization.[78] The Panel has observed that Toyota's global structure has contributed to problems with *yokoten*. Akio Toyoda has said that the company is "putting in place steps to do a better job within Toyota of sharing important quality and safety information across our global operations. This shortcoming contributed to the current situation."[79] Regarding the sticky accelerator pedal issue, Mr. Toyoda said that the company "failed to connect the dots between problems in Europe and problems in the United States."[80] As one example, in 2000 there was a recall in the United Kingdom of Lexus IS-200 models (the predecessor of the Lexus IS-250/350) because "there is a possibility that the driver's side carpet mat may rotate around the central fixing and interfere with the operation of the accelerator pedal."[81] With improved *yokoten*, the circumstances and details of that recall would likely have been communicated to North America and the interaction between pedal designs and floor mats examined in more detail. Hence, Toyota could have responded faster to complaints made to NHTSA about floor mats trapping accelerator pedals in subsequent years. When asked about this before Congress, a Toyota executive explained that "a weakness in our system has been that within this company, we didn't do a very good job of sharing information across the globe. Most of the information was one way. It would flow from the regional markets, like the United States, Canada or Europe back to Japan."[82] Another example of how Toyota's corporate structure may have contributed to delays in finding the root cause of a vehicle issue is Toyota's response to complaints it was receiving in North America about "hesitation" in the 2007 Camry.

"Knock" vs. "Hesitation" in the 2007 Camry

Prior to the 2007 Camry's sale in the U.S., drivers in Japan had complained of a "knocking" problem in that model. This problem was eventually determined to have been caused by an error in the "knock" sensor software (to reduce the likelihood of the air/fuel mixture prematurely igniting, modern engines are equipped with a knock sensor, which detects the engine "knocking" sounds that result from this condition and the engine control unit then adjusts spark timing as needed to produce more efficient combustion). Toyota remedied the problem in Japan in approximately August 2006 by making changes to the knock sensor software.

About one year later, not long after the newly-designed 2007 model Camry was introduced in the United States, some U.S. drivers with 4-cylinder engines complained about engine "hesitation" when trying to accelerate their vehicles. Some of these drivers complained about this to NHTSA, resulting in yet another jump in "speed control" complaints. Because customers in the United States described the issue differently than drivers in Japan, Toyota failed to recognize quickly that both sets of customers were actually complaining about the same problem. It took almost two years after the 2006 changes in Japan (one year after the 2007 Camry was available in the U.S.) to make the same knock sensor adjustments to vehicles affected in the U.S. This illustrates inadequate communication and information sharing between engineers in the United States and Japan.

4.1.3 Toyota's Global Structure and its Impact on Responsiveness to Regulators and Customers.

Toyota's corporate structure, which centralizes authority for key decisions such as recalls with TMC in Japan, fueled allegations that Toyota was slow to act as the UA crisis unfolded. Toyota was criticized for delays in responding to customer complaints and to U.S. regulators. As one report explained, Transportation Secretary Ray LaHood "sharply criticized Toyota Motor Corp. on Tuesday for dragging its feet on safety concerns over its gas pedals, suggesting the automaker was 'a little safety deaf' to mounting evidence of problems."[83] Toyota has agreed to pay almost $50 million in fines to NHTSA to settle allegations it did not timely report safety problems relating to sticky accelerator pedals, UA due to floor mat entrapment, and steering relay rods.[84] As part of these settlements, Toyota did not admit to violating its obligations under the U.S. Safety Act.[85]

Toyota was also criticized by lawmakers for only having one device in the U.S. that could decode crash data from event data recorders (EDRs) installed in Toyota vehicles.[86] Neither law enforcement personnel, regulators, nor Toyota dealers could access the data in Toyota's EDRs. To many, this was another example of an attempt by TMC in Japan to maximize and maintain control—in this case, of vehicle crash data.

Event Data Recorders

Most modern automobiles contain a device called an event data recorder—sometimes referred to as a "black box"—that stores information in the event of a crash. Most EDRs continuously record data in short increments (e.g., five seconds) such as vehicle speed, brake application, throttle status, and accelerator angle. On impact, several seconds of this pre-crash data, along with certain types of crash data (e.g., deceleration vs. time measurements) are stored by the EDR.

In 2001, Toyota began phasing EDRs into vehicles sold in North America.[87] By 2007, all Toyota vehicles sold in the United States were equipped with an EDR, though the type varied from model to model and some were not capable of storing pre-crash data.[88] It was not until the end of 2010 that all newly-manufactured Toyota and Lexus vehicles sold in North America came equipped with EDRs capable of recording both pre-crash and crash data.[89]

While Toyota made the decision to install EDRs in vehicles sold in North America more than ten years ago, until very recently it maintained only a single decoding unit in the United States—which it described as a "prototype"—to extract and read the data from EDRs following crashes.[90] Toyota maintained exclusive possession of this decoding unit and considered the software and operation manual for the EDR readout tool to be proprietary. However, Toyota would comply with reasonable requests from law enforcement and government entities to obtain data stored in a particular vehicle's EDR. This is in stark contrast to the policies of other car manufacturers, such as General Motors and Ford, who for years have allowed their EDR decoding devices to be purchased by any interested parties.[91]

4.2 Toyota's Global Vision 2020

On March 8, 2011, Toyota unveiled the Toyota Global Vision 2020:

> *Toyota will lead the way to the future of mobility, enriching lives around the world with the safest and most responsible ways of moving people. Through our commitment to quality, constant innovation and respect for the planet, we aim to exceed expectations and be rewarded with a smile. We will meet challenging goals by engaging the talent and passion of people, who believe there is always a better way.*[92]

The Vision calls for a "global framework" in which TMC "will provide overall direction and furnish support for initiatives undertaken by the regional operations." Each region will be asked to develop its own mission and management strategy to support the Toyota Global Vision. The regional operations "will decide on their own how best to serve their customers."[93] Toyota also plans to give local operations "leading roles" in product development and design.[94] North America is expected to be a leader in this endeavor.

Toyota has indicated its desire to increase decision-making authority by its regional operations and transfer regional-management divisions at TMC into the actual regions they oversee.[95] According to Akio Toyoda:

> *This will enable us to quickly reflect feedback from our customers around the world in our R&D, production and sales operations. Formerly, we at headquarters received information from operations outside Japan through separate channels for different functions. Now, we will receive information from each region through a single channel for that region. Dealing with our overseas operations on a regional basis, rather than a functional basis, will enable us to conduct decision making on a more-comprehensive basis.*[96]

In addition, Toyota has created the North American Executive Committee, comprised of nine senior executives from across Toyota's North American companies. The Committee will have direct responsibility for North American business and operations, including product planning and development, manufacturing, marketing, sales, service, and financial planning.

On March 8, 2011, Toyota announced that it was taking several steps to streamline its executive leadership and revise its organizational structure.[97] As part of this reorganization, Toyota reduced the size of its board of directors from 27 to 11.[98] It also eliminated an entire layer of its executive management structure, shifting from three management levels to two and decreasing the number of executives from 77 to 60.[99]

In addition to these changes, Toyota has stated that it will change its management structure to increase local decision making by regional affiliates and will establish regional advisory committees for North America, Europe, and Asia. Although encouraged by Toyota's efforts to form regional advisory committees, they appear to be just that—advisory. The Panel noted that Toyota's newly-constituted board of directors is made up entirely of executives from TMC in Japan and that no director was appointed from any of the regions outside Japan in which Toyota operates. To foster inclusion and avoid the dangers of insularity, Toyota should consider appointing a director from one of its key regional markets such as North America. Such an appointment is not without precedent—James Press, a former Toyota executive in North America, was the first executive outside of Japan to be appointed to Toyota's Board of Directors until his departure in 2007.

Prior to the announcement of its Global Vision, Toyota had taken several steps to address some of its challenges balancing global and local control. For example, Toyota appointed four North American leaders to join five others as presidents of plants in the U.S., Canada, and Mexico, providing more regional autonomy. In addition, decisions regarding recalls in North America now directly involve Toyota executives from North America. Because these initiatives are still in their formative stages, the Panel has not yet examined them in detail. However, the Panel looks forward to learning more about their implementation and impact in the coming year.

The Panel recognizes that Toyota's Global Vision is exactly that—a vision. It paints an aspirational picture for Toyota's future. However, the details of the Vision have not yet been specified. Over the course of the coming year, the Panel looks forward to learning more about the specifics of the Global Vision, how Toyota North America views its own mission in implementing it, and how Toyota will support that mission in the future.

4.3 Recommendations Regarding Global and Local Management Control

In consideration of the observations discussed above, the Panel makes the following recommendations regarding Toyota's balance between global and local management control:

1) Work to further break down the regional "silo" structure in North America and consider appointing one chief executive for North American operations with responsibility for all regional functional organizations.

2) Identify additional critical cross-silo processes and organize decision-making teams around them. Toyota's inclusion of senior executives from North America in decisions regarding product recalls in North America appears to be a model for this. However, Toyota must be ever mindful that when responding to critical and emergent safety issues, decision making by committee can be inefficient and time-consuming. Toyota should consider what other decision-making models might be employed in emergency situations.

3) Strengthen communication among global regions, especially regarding reports of vehicle safety issues in vehicles that may share parts across regions. It is not enough to improve the channels of communication between Toyota's regional operations and TMC. Toyota should also find ways to facilitate communication across regions, especially regarding critical safety issues. As part of that effort, Toyota should consider appointing a director from one of its key regional markets such as North America.

4) Develop clearer lines of communication, authority, and decision making between North America and TMC. This is especially important as it relates to gathering and responding to direct feedback from customers, lawmakers, regulators, and other stakeholders. This will allow North America and other regions to benefit from the additional autonomy and authority they have been granted.

5) Continue to increase North American involvement in the product development and design process for vehicles in North American markets.

5. Responses to Problems Raised by Internal and External Sources

5.1 Observations

In any corporation, there is a tension between maintaining a consistent, well-controlled internal environment and adjusting to the vagaries of the outside world. If a corporation errs too much to the side of adjusting to input from the outside world, it will lose its identity, consistency of purpose, and internal alignment. If instead, it ignores the outside world in order to ensure consistency and control, it may lose touch with the marketplace and fail to respond to changes in customer needs and desires. Toyota has a powerful approach to aligning and focusing its resources as well as problem solving in the world-renowned TPS and the Toyota Way. A key area for the Panel's review was how Toyota applies the principles of the TPS and the Toyota Way to input about quality and safety from external sources as well as in management decision making.

The TPS, Toyota's manufacturing system, is widely recognized as one of the premier approaches to manufacturing in the world. It has been analyzed and studied by management experts and adopted by other corporations worldwide. The Toyota Way is a broader philosophy that helps define Toyota's values and way of doing business. Together, the TPS and the Toyota Way "are the double helix of Toyota's DNA."[100]

The Toyota Way is built on two primary pillars: continuous improvement (*kaizen*) and respect for people. A key principle of continuous improvement is *genchi genbutsu*—go to the source of the problem yourself to understand its root causes and make correct decisions. Another key principle of the Toyota Way as well as the TPS (as characterized by Jeffrey Liker, a leading authority on the TPS and Toyota Way) is that "the right process will produce the right results."[101] The Panel has observed that these and other TPS and Toyota Way principles are applied too narrowly in two important respects. First, those principles are applied less frequently and adequately to feedback from external stakeholders (e.g., customers, regulators, consumer groups, and third-party rating agencies) as compared with internal sources within Toyota. Toyota seems to be eager to hear and take action on negative feedback generated from inside sources. However, Toyota sometimes responds less constructively, often with defensiveness, to criticism from outside sources. That defensiveness may inadvertently be inherent in the Toyota Way. That is, if Toyota believes that it is using the right process, and the right process produces the right results, the cause of any wrong result must lie outside Toyota.

Second, the Panel also observed that Toyota does not apply TPS and Toyota Way principles thoroughly enough outside of the manufacturing processes. In the modern automotive corporation, the processes outside manufacturing are at least as important, if not more important, than the manufacturing process itself. To have a superior error detection and correction process that is rigorously applied to Toyota's manufacturing processes—but apparently not applied rigorously enough to identify management decision-making errors to improve future decision making—is unhelpfully narrow. Toyota's reputation in North America increasingly will be based as much on the quality of its decision making as on the quality of its vehicles. Thus, the Panel feels it is important for Toyota to apply TPS principles more comprehensively and systematically to its management decision-making processes in vehicle design, corporate governance, customer feedback, and regulatory affairs.

An example of problems that can be created when management errors occur and are not recognized and corrected for the future involves two generations of Camry models. In 2001, Toyota introduced a new design for the 2002 model Camry. Not long after it had been on sale, customers began complaining about "drivability" problems, including "shudder" during automatic gear shifting, engine surging during light throttle input, and vibration during upshifting.[102] Starting in 2002, Toyota issued a number of Technical Service Bulletins to fix these problems, which presumably occurred because of insufficient real-world test driving before the vehicles were offered for sale.[103] Although Toyota eventually recognized these problems and fixed them, it doesn't appear that it identified the management errors that allowed them to happen in the first place. When the next generation 2007 model Camry was introduced, it also had drivability problems, in this case hesitation due to a problem with the knock sensor software. This again suggests that there was insufficient real-world test driving during the vehicle's development. The drivability problems with these two generations of Camry models resulted in unhappy customers and increases in complaints to NHTSA.

5.1.1 Toyota's Incorporation of External Feedback

The Panel believes that Toyota has not consistently applied the problem-solving methodologies that are central to the TPS and the Toyota Way to issues and criticisms raised by stakeholders outside the company. One leading authority in the TPS and automotive product development has observed that:

> *[M]iddle managers, particularly at headquarters, started to deviate from the Toyota Way by being arrogant, being overconfident, and also they started not to listen to the problems that customers raised. Toyota is a problem-finding, problem-solving company. This culture is still there in the factories and in product development centers. But in some parts of the headquarters, someone started to say, "Hey, this is our problem. I am responsible for finding my problems and solving my problems. It's not [for] you [outside Toyota] to find our problems."*[104]

Toyota has recognized that many of the challenges it faced in 2009 and 2010 were a result of failures to adequately listen to and incorporate external feedback from various stakeholders, including consumers, third-party rating agencies, and regulators. As James Lentz told the House Committee on Energy and Commerce in February 2010: "With respect to pedal entrapment, Toyota conducted investigations of customer complaints which focused too narrowly on technical issues without taking full account of the way customers used our vehicles."[105]

In his remarks when the Toyota Global Vision was announced, Toyota President Akio Toyoda explained how Toyota's quality problems helped him see Toyota's challenges in listening more clearly to the voice of the customer. He said "I keenly became aware of the importance of better listening to customer feedback, of being more attentive to what is happening on the ground so that we can make quicker management decisions based on information from each region, and of continuously monitoring how customers and other members of the community perceive such management decisions."[106]

This is not to say that Toyota has been unsuccessful in designing and selling vehicles that appeal to a wide array of customers. Such is clearly not the case. Toyota makes extensive efforts to understand customer needs during the vehicle design process, including conducting multiple formal surveys, focus groups and on-line surveys, as well as observing use patterns for most of its vehicles. These efforts have been instrumental in Toyota's path to become one of the most successful car manufacturers in the world. Toyota's rapid sales growth in North America and other global regions is a clear indication of its ability to understand the needs of potential customers and to produce high-quality and reliable vehicles that meet those needs. However, being ahead of the competition can sometimes be the most dangerous place for any corporation to be. That is because a well-deserved sense of pride at being number one can slowly and subtly transform into arrogance and foster complacency. Akio Toyoda may have been referring to this phenomenon when he said that Toyota's executives were suffering from "hubris born of success."[107]

There also appears to be a weakness in the way Toyota responds to customer feedback collected by independent rating agencies about design-related vehicle issues (as opposed to mechanical or electronic defects). Generally, there are two types of quality problems that manufacturers must address today. The first are manufacturing quality problems, such as rattles, bad fit and finish, and mechanical and electronic failures. Today, these types of quality problems are rare for Toyota as well as for most of its competitors. The second type are design quality problems—features that function as designed but for various reasons do not meet the expectations of some customers. Such design quality problems include wind noise, brake pad dust on wheels, complicated electronics, navigation systems that fail to find correct routes, ineffectual voice recognition systems, etc. Although these design quality problems rarely cause mechanical breakdowns, they are in some respects more important to customers because they constantly cause annoyance, and in most cases, cannot be easily fixed. As noted above, J.D. Power has reported that Toyota has experienced a relative increase in customer complaints related to design quality problems as compared to its competitors. Many Toyota and Lexus owners have told Panel members "I love my Toyota/Lexus, but …." What follows the "but" is inevitably one or more design quality problems that create constant annoyance or aggravation despite overall satisfaction with the vehicle.

Increasingly, design quality problems will become the differentiators among manufacturers' quality ratings from J.D. Power and Consumers Union. This is potentially a special challenge for Toyota, which has built much of its success on its laser-like focus on manufacturing quality. The various design teams are understandably proud of their products and may not have particularly favorable responses to complaints that indicate a possible issue with their designs—or worse—imply that the right process did not produce the right results. Thus, designers may be more receptive to complaints about manufacturing quality defects such as vehicle rattles because they are the result of the manufacturing process and can typically be remedied. Such is not the case with design quality problems such as wind noise, for which there is usually no short-term fix until the vehicle is redesigned.

Toyota should develop strategies to expand its focus on quality beyond manufacturing to include design quality problems. This requires not only *hearing* customers when they complain about such issues, but also carefully *listening* to them (and of course, not dismissing their negative feedback). When incorporating customer needs and preferences collected during the design phase, Toyota and other manufacturers try to determine what new features customers would like in their next vehicle. It is also just as important to find out what features they dislike in their current one.

5.1.2 Listening to Customer Complaints

Customer complaints typically are first made to dealers. Only those that cannot be quickly resolved through the warranty system are escalated up to the company level. A manufacturer can use warranty records to understand and help eliminate manufacturing quality problems, but since design quality problems cannot usually be fixed, it is harder to quantify them reliably.

There is a challenge for Toyota embedded in the philosophy of the Toyota Way and TPS, particularly the principle that "the right process will produce the right results."[108] While this philosophy has resulted in a healthy discipline toward process improvement, it could possibly discourage employees from listening carefully to customer dislikes or complaints. It could also lead to the erroneous belief that if the right process is doing what it should be doing—i.e., producing the right results—then complaining customers must be ill-informed and the problem is probably their fault.

Great organizations as varied as Four Seasons Hotels & Resorts and the Mayo Clinic have taken an alternative approach that may be instructive for Toyota. Their core assumption is that no matter how carefully a process is thought through, errors will occur. For such organizations, "the right process will produce the right results *most of the time*," but errors will still occur. The key to quality and safety for them, therefore, is the rapid and thorough detection of errors and their comprehensive correction. This requires creating a culture that encourages employees to identify errors so that they can be corrected. This also requires having management processes that catalogue and quickly remediate errors to minimize their negative impact on customers.

For example, at Four Seasons, there is an explicit "service recovery" process for errors that in any way inconvenience a guest. The error is immediately catalogued on what is known as the "Glitch Report," and a remediation plan is immediately developed and deployed. Every morning, the hotel manager leads a session with other managers to review the Glitch Report to make sure that every error is successfully remediated. When corporate managers visit hotels, they come to the Glitch Report review meeting and make sure to laud the staff for having a sufficient number of items on the report—or in some cases, chastise them if there are too few. In the latter case, a low number of glitches (as compared to historical norms) may indicate that there is not enough attention to guest problems that may be unreported by the staff.

It is important for Toyota not to let its philosophy that "the right process will produce the right results" discourage managers throughout the Toyota enterprise from looking carefully for errors and reporting them so that there is thorough detection of errors and prompt remediation.

5.1.3 Systems Engineering and the Toyota Way

An additional area of interest for the Panel has been Toyota's process for analyzing and incorporating human factors into its design regime, both proactively and reactively. This inquiry required reviewing Toyota's application of the technical engineering discipline of Systems Engineering.[109] Systems Engineering involves, among other things, carefully considering and accounting for many human factors early-on in the vehicle design process. This includes anticipating how drivers might err in operating their vehicles as well as how they will react to automated vehicle behavior. It also includes building fail-safes into the vehicle design to mitigate these problems. In other words, Systems Engineering projects *genchi genbutsu* into the future—manufacturers must "see" what problems *could* arise because of their design choices and possibly alter those choices accordingly. That is the proactive aspect of Systems Engineering. Systems Engineering also has a reactive aspect, which involves incorporating crash data, customer complaints, and other sources and adjusting designs as warranted. For example, anticipating and then adjusting a pedal and floor design to account for the fact that vehicle owners might add poorly-fitting or improperly installed all-weather rubber floor mats to their vehicles—which could entrap the accelerator pedal—is an example of human factors analysis in Systems Engineering.

NHTSA study of LEXUS ES-350 Floor Mats and Pedal Entrapment

In March 2007, NHTSA's Office of Defects Investigation opened an Engineering Analysis to investigate reports of UA in 2007 Lexus ES-350 vehicles.[110] As part of this investigation, engineers at NHTSA's Vehicle Research and Test Center (VRTC) studied a 2007 Lexus ES-350 and concluded that the accelerator pedal was easily entrapped in the groove of the optional all-weather rubber floor mat if the mat was not properly secured with at least one of the two restraining hooks.[111]

The VRTC also surveyed 1,986 owners of 2007 ES-350 models.[112] Fifty-nine of the respondents stated they had experienced UA and several commented that the incident had occurred when the accelerator had become trapped in a groove of the all-weather floor mat.[113]

In "trapped throttle acceleration testing," NHTSA determined that "[s]ignificant brake pedal force in excess of 150 pounds was required to stop the vehicle, compared to 30 pounds required when the vehicle is operating normally."[114] With the throttle open, "the vacuum power assist of the braking system cannot be replenished [e.g., after being depleted from pumping the brakes] and the effectiveness of the brakes is reduced significantly."[115] The VRTC report explained that other methods to defeat vehicle acceleration were effective but not intuitive.[116] Those methods included turning off the engine or shifting it into neutral.

Similar to many other luxury cars, the Lexus ES-350 uses a push-button ignition instead of an ignition key to turn the engine on and off.[117] To shut the engine off in the Lexus ES-350 while the vehicle is in motion, the engine start/stop button must be depressed for three seconds.[118] The VRTC report noted that the Lexus owners surveyed were unaware of this procedure and that the three-second hold requirement was not mentioned in the owner's manual.[119]

Shifting the Lexus ES-350 into neutral also proved to be problematic. Many Lexus owners surveyed by NHTSA complained that the neutral position on the shifter was not immediately obvious because it was placed on the same plane as the "sport" shifter indentation (which allows the driver to change gears manually).

After coordinating with NHTSA, Toyota announced a recall in September 2007 of 55,000 all-weather mats designed for 2007 and 2008 Camry and Lexus ES-350 models due to potential interference with the accelerator pedal.[120] Later, in 2009, NHTSA urged Toyota to install brake override system in all Toyota and Lexus models with a push-button ignition system as part of a large-scale UA recall. This system "automatically reduce[s] engine power when the brake pedal and accelerator pedal are applied simultaneously under certain driving conditions."[121] A brake override system has been included in all 2011 Toyota and Lexus models.

The NHTSA investigation of the Lexus ES-350 described in the accompanying sidebar suggests that Toyota did not adequately apply TPS and Toyota Way principles to investigage the root causes of UA incidents and drivers' responses to such incidents in the Lexus ES-350. Ironically, it was NHTSA that applied the principle of *genchi genbutsu* by not only conducting extensive tests of the vehicle but also surveying almost 2,000 Lexus owners. In contrast, in an internal Toyota presentation made public by Congress, Toyota's Washington, D.C. office noted its success in saving over $100 million by negotiating a limited recall of all-weather floor mats.[122] The presentation also discussed how Toyota's Washington, D.C. office saved the company millions in costs and man hours by delaying new vehicle safety rules proposed by NHTSA.[123]

5.1.4 Toyota Performance in Independent Safety Ratings

There are three organizations in the U.S. that conduct vehicle safety tests intended to influence consumer purchase decisions: IIHS, Consumers Union, and NHTSA. In 2009 and 2010, Toyota had problems with test results from each of these groups.

Each year IIHS awards "Top Safety Picks" for vehicles with electronic stability control (ESC) that meet specified performance requirements in a number of crash-related tests. In order to ensure that all current models have the opportunity to earn this award, IIHS asks manufacturers to nominate models that they expect to achieve good results and to reimburse IIHS for the purchase cost of models it would not otherwise have tested in that year. (As with all testing groups, it is not feasible to test every make and model each year.)

Toyota declined to nominate any of its 2010 models for testing in late 2009, even though it had done so in prior years. However, IIHS did test the Toyota Camry, RAV4, and Yaris as part of its regular testing rotation. When IIHS announced the 2010 Top Safety Pick winners, it noted that "[n]ot a single model from the world's biggest automaker by sales is represented among this year's winners. Toyota and its Lexus and Scion subsidiaries had a strong showing in 2009 with 11 winners but were shut out for 2010."[124] This led to significant negative media coverage for Toyota. Toyota has since nominated models and had Top Safety Picks for its 2011 models.[125]

Consumers Union conducts safety tests for vehicle handling on every model it tests each year. In these tests, Consumers Union pushes the vehicles to their limits to assess their performance. In 2010, Consumers Union tested the new Lexus GX-460 and reported that in one maneuver the vehicle was close to losing control and that it took a long time for the ESC systems to respond and bring the vehicle under control.[126] As a result, Consumers Union issued a "Don't Buy" recommendation for this model. This was the first such recommendation for any vehicle in nine years.[127] Only 12 vehicles have received a "Don't Buy" rating (or its equivalent) since Consumers Union started testing 31 years ago.[128] Toyota responded rapidly and withdrew the model from sale until it was able to reprogram the ESC.[129] Toyota also recalled those vehicles already on the road so the company could make the same adjustment.[130]

The oldest consumer testing program in the United States is the New Car Assessment Program (NCAP) conducted by NHTSA. This program began in 1979 with frontal crashes and was later expanded to include side-impacts and measures of rollover risk. Each tested vehicle is given a star rating from 1 (lowest) to 5 (highest). Since September 2007, the NCAP test results must be placed on new vehicle price sticker (Monroney) labels. The NCAP vehicle safety ratings have improved significantly since the program's inception, and by the mid-2000s, virtually all tested models received either 4 or 5-star ratings. In response to this, NHTSA proposed to enhance the program to provide more differentiation among new models.

In 2007, NHTSA proposed new protocols for the tests and ratings it was considering using for the NCAP program and requested comments.[131] Toyota and other manufacturers and organizations responded to these proposals. Toyota provided its own comments to NHTSA on the proposed protocols and also relied on submissions from the Alliance of Automobile Manufacturers (AAM), a trade association.[132] On July 11, 2008, NHTSA announced its final testing and rating protocols that would take effect in 2010.[133] After the adoption of the new protocols, Toyota and other automakers still had concerns and, through the AAM, requested that NHTSA review and revise aspects of the new protocols.[134] Despite its own concerns, Toyota declined to communicate them separately to NHTSA and instead relied on the AAM's submission. As a trade association, AAM must represent the views of all of its members and, as such, its comments to NHTSA's proposals inevitably represent the lowest common denominator among the views of its members.

The first results using the new NCAP protocols were released in October 2010. Of 33 models tested, 30 had overall ratings of 4 stars (out of 5).[135] Two of the three models with the worst overall ratings were the Toyota Camry and Camry Hybrid, each with 3 stars.[136] Only the Nissan Versa had a lower rating with 2 stars. Camry's closest competitors had better ratings: Hyundai Sonata received 5 stars and the Chevrolet Malibu received 4 stars.[137] Toyota has explained that the 2011 Camry that NHTSA initially tested was designed to achieve 5 stars under the old NCAP protocols and did so. However, Toyota initially chose not to make any vehicle alterations to improve the 2011 Camry's anticipated performance under the new protocols. After receiving the 3-star rating, Toyota worked to improve the Camry's performance. In January 2011, a "later release" 2011 model Camry tested under the new protocols received 4 stars from NHTSA.[138]

5.2 Toyota's Steps to Address These Issues

In response to its challenges responding to external complaints, Toyota has established a "Voice of the Customer" database to increase the visibility of customer data, boost efforts in data analysis and data mining, and improve the flow of information from dealers. Toyota also created Swift Market Analysis Response Teams (SMART teams) in the United States to respond to customer complaints about UA events.[139] The SMART teams are made up of engineers and field technicians who contact customers within 24 hours and, when necessary, conduct an on-site inspection of the vehicle.[140] In addition, Toyota has refined its global Early Detection, Early Resolution system to include a wider variety of sources to help monitor quality and safety, including customer calls, web-based feedback, and government databases. Toyota has also worked to respond much faster to inputs from consumer groups and third-party rating agencies.

In addition to these initiatives, much of the management restructuring Toyota announced as part of its Global Vision is intended to simplify reporting structures and bring the decision makers closer to the customers and other stakeholders affected by their decisions. Toyota's Global Vision 2020 acknowledges that Toyota has a responsibility to connect with external stakeholders in a broader way and develop strong ties with communities in which it operates worldwide. As Akio Toyoda has said, "[o]ur regional operations need to earn a welcome place in their host nations through locally based corporate activity. All of us at Toyota worldwide need to stand united in support of each other's activity in addressing local needs and circumstances."[141] The Panel looks forward to learning more about Toyota's efforts to advance this vision and monitoring its efforts to elevate the voices of external stakeholders in its decision-making processes.

Much of the management restructuring Toyota announced as part of its Global Vision is intended to simplify reporting structures and bring the decision makers closer to the customers and other stakeholders affected by their decisions.

5.3 Recommendations Regarding Toyota's Responsiveness to Problems Raised by Internal and External Sources

In consideration of the observations discussed above, the Panel makes the following recommendations regarding Toyota's application of the Toyota Way and the TPS as well as its incorporation of the voice of the customer in decision-making processes:

1) Develop an increased focus on incorporating external feedback and broaden the applicability of the TPS and the Toyota Way to include management decision making in a more comprehensive way. Toyota should do more to seek out external feedback and to integrate it into its decision-making processes. To accomplish this, Toyota should strengthen ongoing efforts to train the next generation of Toyota management on how to apply TPS and the Toyota Way to managerial decision making.

2) In addition to its initiatives to improve the collection and analysis of quality and safety data, Toyota should create an independent "Customer Representative Team" to report directly to Toyota's President. The team would be responsible for seeking out and reviewing all possible sources of information regarding the outside world's positive *and* negative views, experiences, and preferences regarding Toyota vehicles. Such sources should include complaint and accident data collected by regulatory agencies, complaints made to dealers and to Toyota's customer service numbers, warranty data, reports from consumer rating agencies, automotive enthusiast web sites and blogs, etc. The group would act as an independent conduit and analyze the information it collects and look for trends, set priorities, identify early-warning signs, and make its work available to upper management for consideration in developing future vehicles.

3) Develop procedures to expand its quality focus more thoroughly and comprehensively beyond manufacturing to incorporate design quality, and as a result, enhance its ability to meet the ever-changing expectations of its customers.

4) TMC executives in Japan should strive to be fully informed about the perspectives of government officials and regulators in North America, especially NHTSA. Instead of viewing NHTSA proposals and defect investigations as adversarial processes, and rather than considering delayed or blocked regulations and minimized recalls as "wins," Toyota, at all levels, should recognize and understand that NHTSA's mission is to improve vehicle safety. Thus, a strong and competent NHTSA is good for Toyota and the industry because it will be less likely to propose poor regulations or push for inappropriate recalls. In this regard, Toyota should be more willing to show leadership in vehicle safety and take positions that differ from the AAM when appropriate.

6. Management Responsibilities for Quality and Safety

6.1 Observations

Toyota has traditionally treated safety as an integral subset of quality. In the Panel's view, this suggests that logically, if a quality vehicle is produced, it will, by definition, be a safe vehicle. The Panel believes that safety and quality are different attributes and that a process that produces quality vehicles will not necessarily produce safe ones. Toyota has built its reputation for quality vehicles on the strength of the TPS in reducing manufacturing defects. Safety, however, is almost entirely determined by the vehicle's design. Hence, it is no surprise that most of Toyota's safety-related recalls in 2009 and 2010 were related to vehicle design, not manufacturing quality problems. In fact, virtually all of the serious safety-related defects in the U.S. since NHTSA was created have been related to design issues, not manufacturing errors.

One example of how Toyota subsumes safety into quality can be found in the name of the Panel itself—The North American Quality Advisory Panel. Toyota gave the Panel this title despite the fact that an examination of Toyota's *safety* processes and procedures is at the core of its mission. In another example, when the Panel began its review, many of Toyota's senior management were identified as having responsibility for quality, but none listed safety as a primary responsibility. At one point, the Panel asked Toyota to identify the chief executive in charge of safety. When Toyota named the individual, the Panel reviewed his official biography and discovered that it never mentioned the word safety—it was entirely focused on quality. Toyota has stated that this is because it defines quality broadly to include safety and that safety is incorporated in every aspect of the vehicle development and design process.

Another issue of concern to the Panel was that until recently, Toyota did not have an executive clearly identified as having overall responsibility for safety. Nor could the Panel identify a clear management chain of responsibility for safety. The Panel understands that from Toyota's perspective, everyone at the company has a responsibility for safety and that safety is ingrained in every aspect of the vehicle design, development, and production process. The Panel fears that this safety philosophy might be suffering from the old adage "when everyone is responsible, no one is accountable."[142] Without one executive with overall authority and responsibility for safety across every aspect of the vehicle development process, accountability for responding to safety issues—both proactively and reactively—might be diminished. As addressed below, Toyota has now appointed a Chief Safety Executive for North America and a Chief Safety Technology Officer for the entire company.

6.2 Toyota's Steps to Address These Issues

In 2010, Toyota appointed a Regional Product Safety Executive for North America to "oversee the processes that [will] improve the visibility of customer concerns, expedite North American safety-related proposals, and play a key role in decision-making with regard to recalls and other safety issues in the field."[143] Also, at the Panel's recommendation, Toyota announced in April 2011 that it had appointed a Chief Safety Technology Officer (CSTO) for the entire corporation. According to Toyota, the CSTO was created to promote technological development, improve accountability, and demonstrate Toyota's technological competence in order to enhance communication with external stakeholders. The CSTO will be responsible for creating global safety policies for Toyota, gathering technical information related to safety, promoting safety in research and development globally, and being the spokesperson regarding safety technology and policy issues. Toyota has indicated that it will maintain a structure in which each executive is responsible for product safety in his area. The Panel eagerly awaits more details about the CSTO's authority and responsibilities.

In January 2011, Toyota announced the creation of its Collaborative Safety Research Center, which will partner with universities, hospitals, federal agencies, and other research institutions on projects focused on reducing the number of traffic fatalities and injuries. The Center will initially focus on reducing the risks of driver distractions and protecting the most vulnerable populations, including children, teens and seniors. Toyota has also developed the next-generation virtual test dummy, called the Total HUman Model for Safety (THUMS), to help assess internal organ injury risks—which in most cases cannot be measured with crash test dummies—during the vehicle design process. Toyota has also licensed this technology to other automakers and made it available at a 90% discount to universities doing research into injury biomechanics. The Panel suggests Toyota consider offering it to the universities at no cost.

6.3 Recommendations Regarding Management Responsibilities for Quality and Safety

In consideration of the observations discussed in this Report, the Panel makes the following recommendations regarding the distinction between quality and safety at Toyota:

1) The newly-appointed CSTO should have the authority to determine the safety performance levels that the Chief Engineers and their design teams should achieve with all new models.

2) In markets such as the United States, Europe, Australia, and others where there are well-established consumer-oriented safety testing programs, Toyota should set a corporate goal of achieving the highest possible ratings for all new models. For example, in the U.S. this would mean 5 stars in NHTSA's NCAP tests and "Top Safety Picks" in the IIHS evaluations.

3) Each local market should also have a designated chief safety officer to deal with and report on local safety issues, including safety-related defect investigations and recalls. These safety officers should also monitor warranty and other customer complaints that may be safety related. Local safety activities should be reported regularly to the CSTO, who, in turn, should ensure that all of the other local safety officers are kept informed.

4) Take a leadership role in developing and implementing state-of-the-art EDRs. In particular, Toyota should consider a simplified process for downloading EDR data and web-based software for decoding, rather than having specialized decoding devices that need upgrades or redesigns each time the EDRs are changed.

5) Expand testing of new models to focus on: (1) vehicle outputs and how they relate to reasonable driver expectations to decrease the likelihood of "drivability" problems, including those that may startle drivers; and (2) features that can distract drivers.

6) Be more proactive in communicating its safety philosophy, innovations, and accomplishments.

7. The Challenges of Integrating Electronics and Software

The Panel had initial concerns regarding the integration of mechanical and electrical engineering in Toyota's design and production processes. Specifically, the Panel was initially concerned that automotive manufacturers, which were historically dominated by mechanical engineering needs, could be challenged by the need to integrate increasing levels of electronics and software into modern vehicles. For example, the Panel was concerned that automotive manufacturers might be relying too heavily on suppliers that specialized in electronics and software and may have relinquished too much control over the design of key vehicle components. Furthermore, because it is easier to make changes to software than hardware, a related concern was that software changes could be made without adequate consideration of all the potential consequences.

The Panel received considerable input on the processes Toyota uses to integrate electronics and software into its products and has identified no significant concerns in this regard. When complicated electronics and software are first added to a product (for example, the electronic drive controls for hybrid vehicles that provide seamless transitions from gasoline to electric motors) they are first developed by Toyota engineers. Only after the first generation designs does Toyota use suppliers for such technology. Furthermore, software changes go through the same rigorous evaluations as mechanical changes before they are implemented.

The Panel recognizes that electronics and software have significantly improved vehicle safety. For example, electronic stability control systems and airbags prevent many thousands of deaths and serious injuries each year. However, the introduction of some new technologies into vehicles, such as lane departure warning systems, also present new human-interface challenges for all manufacturers. As the NASA report on UA noted, "[i]f the vehicle being driven behaves in an unexpected manner, the driver may be unable to determine whether the vehicle is malfunctioning or simply exhibiting an unexpected 'smart' feature."[144] Great care must be taken by all auto manufacturers to anticipate drivers' reactions to these vehicle outputs and account for those reactions in vehicle designs.

8. Management of Supplier Product Quality

Most of the components and parts in today's automobiles come from suppliers. Management and oversight of the design and production processes involved in producing components and parts is extremely complex and varies considerably among auto manufacturers. Some manufacturers have very detailed oversight of all aspects of the development, design, and manufacturing processes used by their suppliers, while others expect their suppliers to do basic research and development and then jointly implement new design features. If safety or quality problems arise with supplier products, however, consumers and regulatory agencies typically will hold the vehicle manufacturer responsible. Japanese auto manufacturers typically have had more control and oversight over suppliers than domestic and European ones, in part because of the interlocking relationships with their *keiretsu* suppliers (affiliate companies with close corporate alliances). However, as Japanese manufacturers are now producing more and more vehicles in local markets, they are also using more local suppliers.

Some commentators have suggested that Toyota's management of its suppliers—especially newer ones—might have contributed to some of its quality and safety problems that arose in 2009–2010.[145] Others have suggested that Toyota's rapid growth led to lapses in supplier oversight because Toyota's engineering resources were stretched too thin.[146]

Two of the major Toyota vehicle recalls in 2010 were related to parts manufactured by North American suppliers. First, in January 2010, Toyota announced a recall of 2.3 million vehicles to remedy "sticky" accelerator pedals.[147] In that case, Toyota engineers reviewed the redesign of the pedal that the supplier ultimately developed.[148] A second recall in August 2010 involved over 1 million Toyota Corollas for a manufacturing defect in the vehicles' engine control module, also made by a supplier in North America.[149] Toyota engineers had previously reviewed the manufacturing process used by the supplier.[150]

These recalls prompted the Panel to question whether there might be an issue related to Toyota's oversight of its suppliers, especially newer suppliers. Toyota officials briefed the Panel on this issue and explained that it exercises the same level of oversight over new suppliers as it does with long-established *kieretsu* companies. It also explained new initiatives to further strengthen its supplier oversight processes and procedures. Recognizing the complexity of the relationships between auto manufacturers and their suppliers, the Panel did not undertake a more detailed review of this issue. However, Toyota has made changes intended to improve the quality of components and parts produced by its suppliers, and the Panel looks forward to learning more about those initiatives and their implementation in the coming year. Of course, the Panel is mindful that Toyota's current focus is on mitigating the adverse effects that the earthquakes and tsunami have had on the company's supply chain.

9. Evaluation of ETCS-i

In 2009 and 2010 and before, there were allegations that many of Toyota's reported UA events were likely due to Toyota's ETCS-i. Toyota hired an engineering and scientific consulting firm, Exponent, to conduct an investigation and analysis regarding its ETCS-i and the possibility that it could be the cause of some UA events.[151] The Panel met with Exponent on several occasions to learn about its research and methodologies. The Panel was impressed by the depth and thoroughness of its investigations and anticipates that Exponent's reports will be made public in the near future.

In 2010, NHTSA undertook its most extensive investigation to date into possible causes of UA in Toyota vehicles. In March 2010, NHTSA asked NASA to help it analyze Toyota's ETCS-i and "determine whether it contained any vulnerabilities that might realistically be expected to produce UA in a consumer's use of those vehicles."[152]

After extensive testing, NASA and NHTSA both released reports in February 2011. In sum, "NASA did not find an electronic cause of large throttle openings that can result in UA incidents. NHTSA did not find a vehicle-based cause of those incidents in addition to those already addressed by Toyota recalls."[153]

The NASA and NHTSA investigations were extremely comprehensive. Both agencies performed an analysis of vehicle owner questionnaires (VOQs) submitted to NHTSA and warranty data. Both agencies also conducted tests on a number of different Toyota vehicles, including vehicles purchased from consumers who submitted VOQs involving descriptions of UA to NHTSA, and performed destructive physical analyses of certain parts. NHTSA conducted field inspections of vehicles alleged to have been involved in UA incidents during 2010 and analyzed objective evidence obtained during those inspections, including information stored in the vehicles' EDRs. "NASA engineers evaluated the electronic circuitry in Toyota vehicles and analyzed more than 280,000 lines of software code for any potential flaws that could initiate an unintended acceleration incident."[154] NASA also bombarded vehicles with electromagnetic interference at levels far above what would be expected in real-world conditions.

In its report, NASA concluded that "[r]eported UAs are rare events"[155] and found, among other things:

- "Safety features are designed into the TMC ETCS-i to guard against large throttle opening UA from single and some double ETCS-i failures";[156]
- There are no identifiable throttle control vulnerabilities due to electromagnetic interference;[157]
- There are no identifiable software defects in the ETCS-i that could unilaterally cause a UA;[158] and
- There are no identifiable electrical failures in the ETCS-i that impact the braking system as designed, but "[a]t large throttle openings (35 degrees (absolute) or greater), if the driver pumps the brake, then the power brake assist is either partially or fully reduced due to loss of vacuum in the reservoir."[159]

However, NASA noted that vehicles have "nominal design features which will result in an increased engine speed and these are not considered faults."[160] A few examples of these nominal design features cited by NASA include: (1) "The vehicle is designed to increase the engine speed under the increased load of the air conditioning"; (2) "The engine fuel injection and ignition timing was delayed as part of the knock sensor software"; and (3) "When the cruise control is in use on hilly terrains, the automatic transmission may downshift to maintain set speed which results in significantly higher engine speeds."[161] NASA also stated that "[d]esign features, such as sport shifter and push button stop, might compromise the driver's ability to recover from a UA event. Such features may be indicative of broader driver-vehicle integration issues and therefore may merit further consideration."[162] NASA cautioned vehicle manufacturers to ensure that all design decisions, including those that "may seem benign or even positive," do not compromise safety.[163]

While the NHTSA-NASA investigation did not reveal an electronic cause of UA in Toyota vehicles or any new mechanical issues that could cause UA, NHTSA plans to take action as a result of observations made during its investigation. Such actions include:

- Considering whether to initiate "rulemaking[s] on brake override systems, keyless ignition systems, and event data recorders";
- Conducting research on "the reliability and security of electronic control systems by examining existing industry and international standards for best practices and relevance to automotive applications";
- Conducting research "on the placement of accelerator and brake pedals and drive[r] usage of pedals … [to learn] whether the frequency of pedal misapplication can be significantly reduced through pedal placement specifications and operational characteristics"; and
- Enhancing "its knowledge and capabilities in the area of safety-critical vehicle electronics, including electronic control systems, both by ensuring that current staff continues to be well informed on the developing technologies and potential safety issues and by hiring (as agency needs dictate and funding permits) more staff with the necessary expertise."[164]

In addition to the joint NASA-NHTSA investigation, NHTSA has also contracted with the National Research Counsel (NRC) of the National Academies to convene a panel of experts to "[c]onduct a broad review and assessment of electronic vehicle controls, systems, and UA across the industry and safeguards used by manufacturers and suppliers to insure safety."[165] The Panel continues to monitor the NRC's investigation and looks forward to reviewing its final report once available.

10. Summary of Panel Recommendations

10.1 The Balance Between Global and Local Management Control

1) Work to further break down the regional "silo" structure in North America and consider appointing one chief executive for North American operations with responsibility for all regional functional organizations.

2) Identify additional critical cross-silo processes and organize decision-making teams around them. Toyota's inclusion of senior executives from North America in decisions regarding product recalls in North America appears to be a model for this. However, Toyota must be ever mindful that when responding to critical and emergent safety issues, decision making by committee can be inefficient and time-consuming. Toyota should consider what other decision-making models might be employed in emergency situations.

3) Strengthen communication among global regions, especially regarding reports of vehicle safety issues in vehicles that may share parts across regions. It is not enough to improve the channels of communication between Toyota's regional operations and TMC. Toyota should also find ways to facilitate communication across regions, especially regarding critical safety issues. As part of that effort, Toyota should consider appointing a director from one of its key regional markets such as North America.

4) Develop clearer lines of communication, authority, and decision making between North America and TMC. This is especially important as it relates to gathering and responding to direct feedback from customers, lawmakers, regulators, and other stakeholders. This will allow North America and other regions to benefit from the additional autonomy and authority they have been granted.

5) Continue to increase North American involvement in the product development and design process for vehicles in North American markets.

10.2 Responses to Problems Raised by Internal and External Sources

1) Develop an increased focus on incorporating external feedback and broaden the applicability of the TPS and the Toyota Way to include managerial decision making in a more comprehensive way. Toyota should do more to seek out external feedback and to integrate it into its decision-making processes. To accomplish this, Toyota should strengthen ongoing efforts to train the next generation of Toyota management on how to apply TPS and the Toyota Way to managerial decision making.

2) In addition to its initiatives to improve the collection and analysis of quality and safety data, Toyota should create an independent "Customer Representative Team" to report directly to Toyota's President. The team would be responsible for seeking out and reviewing all possible sources of information regarding the outside world's positive *and* negative views, experiences, and preferences regarding Toyota vehicles. Such sources should include complaint and accident data collected by regulatory agencies, complaints made to dealers and to Toyota's customer service numbers, warranty data, reports from consumer rating agencies, automotive enthusiast web sites and blogs, etc. The group would act as an independent conduit and analyze the information it collects and look for trends, set priorities, identify early-warning signs, and make its work available to upper management for consideration in developing future vehicles.

3) Develop procedures to expand its quality focus more thoroughly and comprehensively beyond manufacturing and as a result, enhance its ability to meet the ever-changing expectations of its customers.

4) TMC executives in Japan should strive to be fully informed about the perspectives of government officials and regulators in North America, especially NHTSA. Instead of viewing NHTSA proposals and defect investigations as adversarial processes, and rather than considering delayed or blocked regulations and minimized recalls as "wins," Toyota, at all levels, should recognize and understand that NHTSA's mission is to improve vehicle safety. Thus, a strong and competent NHTSA is good for Toyota and the industry because it will be less likely to propose poor regulations or push for inappropriate recalls. In this regard, Toyota should be more willing to show leadership in vehicle safety and take positions that differ from the AAM when appropriate.

10.3 Management Responsibilities for Quality and Safety

1) The newly-appointed CSTO should have the authority to determine the safety performance levels that the Chief Engineers and their design teams should achieve with all new models.

2) In markets such as the United States, Europe, Australia, and others where there are well-established consumer-oriented safety testing programs, Toyota should set a corporate goal of achieving the highest possible ratings for all new models. For example, in the U.S. this would mean 5 stars in NHTSA's NCAP tests and "Top Safety Picks" in the IIHS evaluations.

3) Each local market should also have a designated chief safety officer to deal with and report on local safety issues, including safety-related defect investigations and recalls. These safety officers should also monitor warranty and other customer complaints that may be safety related. Local safety activities should be reported regularly to the CSTO who, in turn, should ensure that all of the other local safety officers are kept informed.

4) Take a leadership role in developing and implementing state-of-the-art EDRs. In particular, Toyota should consider a simplified process for downloading EDR data and web-based software for decoding, rather than having specialized decoding devices that need upgrades or redesigns each time the EDRs are changed.

5) Expand testing of new models to focus on: (1) vehicle outputs and how they relate to reasonable driver expectations to decrease the likelihood of "drivability" problems, including those that may startle drivers; and (2) features that can distract drivers.

6) Be more proactive in communicating its safety philosophy, innovations, and accomplishments.

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Chairman, Rodney E. Slater

Chairman Slater is a partner in the premier public policy law firm, Patton Boggs LLP in Washington, D.C., with a focus on promoting a more secure, environmentally sound, and sustainable global transportation infrastructure. Chairman Slater served in the cabinet of President William J. Clinton as U.S. Secretary of the Department of Transportation (DOT) from February 1997 until January 2001. During his tenure, Chairman Slater championed and received bipartisan congressional support for the passage of several historic legislative initiatives, including the Transportation Equity Act for the 21st Century (TEA-21), which guaranteed a record $200 billion in surface transportation investment through 2003, and the Wendell H. Ford Aviation Investment Reform Act for the 21st Century (AIR-21), which provided a record $46 billion to further enhance the safety and security of the U.S. aviation system.

As Secretary of Transportation—and with safety as the Department's top transportation priority (its North Star)—he worked with Congress to secure passage of the Transportation Recall Enhancement, Accountability and Documentation (or TREAD) Act. He also worked with Congress and various constituency groups on the adoption of a national .08 Blood Alcohol Content law, and other major safety initiatives, as well as numerous measures designed to improve access to transportation opportunities for the disabled, the elderly, and those moving from welfare to work.

As DOT Secretary, Chairman Slater and his leadership team pioneered the unifying philosophy "One DOT" to collaborate and govern across the diverse offices and modal administrations within the 100,000 member Department, and in 2000 released "The Changing Face of Transportation," a 25-year vision for the future of transportation in the United States and around the world. He and his team also produced the number one strategic plan and the number one budget performance plan in the Federal Government.

Chairman Slater is a Harvard Senior Advanced Leadership Fellow. He is also a Fellow with the National Academy of Public Administration and the Clinton Global Initiative, as well as a NCAA Silver Anniversary Award recipient. He is on the Board of Directors of Delta Airlines, Verizon, Kansas City Southern and the Transurban Group. He is a former director of Northwest Airlines and former Chairman of the United Way of America Board of Directors.

Norman R. Augustine

Panel Member Augustine, an aerospace engineer, is the retired Chairman and Chief Executive Officer of the Lockheed Martin Corporation and a former Under Secretary of the Army. Widely recognized for his leadership in technology, Mr. Augustine served for 16 years on the President's Council of Advisors on Science and Technology. Mr. Augustine also chaired the Obama Administration's Review of U.S. Human Space Flight Committee, a 2009 blue-ribbon panel charged with conducting an independent assessment of the country's planned human space flight activities. Among Mr. Augustine's many honors are the National Medal of Technology, the AAAS Philip Hauge Abelson Prize, the NAS Public Welfare Medal and the Defense Department Civilian Distinguished Service Medal, which was given to him five times. Mr. Augustine chaired the NAS panel that conducted the 2005 study, Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future, which recommends ways to strengthen research and education in science and technology.

Mr. Augustine served as Chairman of the National Academy of Engineering, President and Chairman of the Association of the United States Army, Chairman of the Aerospace Industries Association, Chairman of the Defense Science Board, President of the American Institute of Aeronautics and Astronautics, and a member of the Princeton University engineering faculty.

He is a former member of the Board of Directors of ConocoPhillips, Black and Decker, Proctor & Gamble, and Lockheed Martin. He is a trustee emeritus of Johns Hopkins University, and a former member of the board of trustees of Princeton and the Massachusetts Institute of Technology (MIT). He holds 26 honorary degrees.

Patricia Goldman

Panel Member Goldman is a former Vice Chairman of the National Transportation Safety Board. Ms. Goldman is currently President Emeritus of the Ovarian Cancer National Alliance, which she co-founded in 1997 and has built into a leading source for advocacy, information, and support for ovarian cancer patients and their families. Ms. Goldman has had a distinguished career as a senior executive in numerous corporate, government, and non-profit organizations, with significant experience managing diverse issues and constituencies across all transportation sectors. In addition to her many corporate and non-profit leadership positions, Ms. Goldman served from 1979 to 1988 as Member and then Vice Chairman of the National Transportation Safety Board, where she supervised major accident investigations in all modes of transportation and played an instrumental role in the enactment of safety regulations, such as the mandatory use of child safety seats. From 1988 to 1994, Ms. Goldman was Senior Vice President for Corporate Communications at US Airways, where she served as a member of the airline's Executive Committee, which coordinated all aspects of daily management.

Dr. Mary L. Good

Panel Member Good is the founding Dean and Donaghey Professor at the Donaghey College of Engineering and Information Technology at the University of Arkansas at Little Rock, in Little Rock, Arkansas.

Dr. Good is widely recognized for her distinguished career in academia, industry and government, having served on the National Science Board (NSB) under presidents Carter and Reagan and chairing the NSB from 1988 to 1991. She further served on the President's Council of Advisors on Science and Technology for President George H.W. Bush and as Under Secretary for Technology in the U.S. Department of Commerce for President Clinton. In addition, Dr. Good spent 25 years teaching and researching at Louisiana State University and the University of New Orleans before becoming a guiding force in research and development for Allied Signal. Dr. Good is the recipient of numerous awards and commendations, including the Vannevar Bush Award and the National Science Foundation Distinguished Service medal from the National Science Foundation, the American Chemical Society Priestly Medal, the 6th Annual Heinz Award, and the Philip Hogue Abelson prize from the American Association for the Advancement of Science, which also elected her to serve as president.

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Roger Martin

Panel Member Martin is the Dean of the Rotman School of Management and a professor of Strategic Management, in Toronto, Ontario. Mr. Martin also holds the Premier's Chair in Competitiveness and Productivity and directs the Michael Lee-Chin Family Institute for Corporate Citizenship at the School. Previously, he spent 13 years as a director of Monitor Company, the global strategy consulting firm based in Cambridge, Massachusetts, where he served as co-head of the firm for two years.

In 2010, Mr. Martin was named one of the most influential designers in the world by BusinessWeek. In 2009, he was named one of the 50 top management thinkers in the world by The Times (of London) and Forbes.com. Mr. Martin is a regular contributor to leading publications including: BusinessWeek, The Washington Post, Financial Times, and Harvard Business Review. He has published three books: The Design of Business (Harvard Business School Press, 2009); The Opposable Mind (Harvard Business School Press, 2007); and The Responsibility Virus (Basic Books, 2002). He also co-wrote The Future of the MBA (Oxford University Press, 2008) and Diaminds (Rotman/UTPress, 2009).

Mr. Martin is Chair of the Ontario Task Force on Competitiveness, Productivity and Economic Progress and serves on the boards of Thomson Reuters Corporation and Research in Motion, among others.

Brian O'Neill

Panel Member O'Neill is former President of the Insurance Institute for Highway Safety and currently serves on the Board of Directors of the Pacific Institute for Research and Evaluation (PIRE), a non-profit organization whose mission is to promote, undertake, and evaluate activities, studies, and programs that improve individual and public health, welfare, and safety.

From 1969 to 2005, Mr. O'Neill served at the Insurance Institute for Highway Safety, helping found the Highway Loss Data Institute in 1972 and leading both organizations as President for more than 20 years. He was directly responsible for the research programs of both organizations and over the years he has been personally involved in research covering virtually all aspects of highway loss reduction, including vehicle and highway design, emergency medical care, the effectiveness of traffic laws, and driver behavior. Mr. O'Neill is a member of the Society of Automotive Engineers, has authored numerous articles and presentations on automobile and traffic safety, and is the recipient of many of the industry's highest honors, including the Society of Automotive Engineers' Arnold Siegel International Transportation Safety Award, the National Highway Traffic Safety Administration Special Award of Appreciation, the American Public Health Association's Public Service Award, and the Washington Automotive Press Association's Golden Gear Award for Outstanding Achievements in Vehicle Safety.

Dr. Sheila E. Widnall

Panel Member Widnall is Institute Professor and Professor of Aeronautics and Astronautics and Engineering Systems at the Massachusetts Institute of Technology (MIT). From 1993 through 1997, she served as Secretary of the Air Force, where she was instrumental in the development of the organization's long range vision, "Global Engagement: A Vision for the 21st Century Air Force." Dr. Widnall was responsible for all the Department's affairs, including training, research and development, administration and welfare of personnel.

Since returning to MIT in 1997, Dr. Widnall has been active in the MIT Lean Aerospace Initiative with special emphasis on the space and policy focus teams. Her research activities in fluid dynamics have included the following: boundary layer stability, unsteady lifting-surface theory, unsteady leading-edge vortex separation from slender delta wings, tip-vortex aerodynamics, helicopter noise, vortex stability, aircraft-wake studies, turbulence and transition.

Dr. Widnall was appointed Abby Rockefeller Mauze Professor of Aeronautics and Astronautics in 1986 and Institute Professor in 1998. She served as MIT's Associate Provost from 1992-1993. In 2003, she served as a member of the Columbia space shuttle accident investigation board. Dr. Widnall is also a member and former Vice President of the National Academy of Engineering and an Honorary Fellow and former President of the American Institute of Aeronautics and Astronautics. She is a Fellow of the American Physical Society; a fellow and former President of the American Association for the Advancement of Science; a fellow of the American Academy of Arts and Sciences; an IEEE Honorary Member and a member of the American Philosophical Society. Dr. Widnall has received honorary degrees from Mount Holyoke College (1991); Smith College (1990); Princeton University (1994); Colorado School of Mines (2000); The Royal Institute of Technology of Sweden (2002); Oxford University (2008) and Northwestern University (2008).

Panel Staff

Jerry L. Malone, Panel Chief Operating Officer

Jerry L. Malone is an attorney in Washington, D.C. practicing in the areas of transportation and infrastructure, crisis management, and public policy/government relations. Mr. Malone served as General Counsel to the Chief Financial Officer of the Government of the District of Columbia from 2002 to 2007. Prior to that, he served as the Chief of Staff at the U.S. Department of Transportation for Transportation Secretary Rodney Slater and as Chief Counsel at the Federal Highway Administration when Mr. Slater was Administrator. Before serving as an appointee in the William J. Clinton U.S. Presidential Administration, Mr. Malone was a partner in the law firm Friday, Eldredge & Clark based in Little Rock, Arkansas. He received a B.S. in Public Administration from the University of Central Arkansas and a J.D. with high honors from the University of Arkansas at Little Rock School of Law. He is licensed to practice law in Arkansas and Washington, D.C.

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1) Meetings and briefings with Toyota executives and personnel.

a. *May 3, 2010* – The Panel visited the Toyota Motor Sales, U.S.A., Inc. (TMS) Service Development Center in Los Angeles, California, and met with a broad range of TMS employees and executives.
b. *May 8-10, 2010* – Chairman Slater visited TMC in Japan and met with Akio Toyoda, among others.
c. *May 22-27, 2010* – The Panel visited TMC in Japan and participated in a number of meetings and presentations with a broad range of Toyota employees from around the world, including high level TMC executives and engineers. Among other things, the Panel received tutorials on Toyota's research and development system and Toyota's ETCS-i. While in Japan, the Panel also toured the Higashi-Fuji Technical Center and the Tsutsumi Plant.
d. *June 18, 2010* – The Panel visited Toyota's Washington, D.C., office to understand how the company interacts with government agencies and regulators.
e. *August 17, 2010* – The Panel held its first meeting with the Toyota North American Quality Task Force.
f. *December 21, 2010* – The Panel attended a second joint meeting with the Toyota North American Quality Task Force in Washington, D.C.
g. *February 25, 2011* – The Panel held its third meeting with the Toyota North American Quality Task Force in Washington, D.C.
h. *March 22, 2011* – The Panel participated in a meeting via videoconference with Akio Toyoda and Senior Executives from TMC.

2) The Panel visits to Toyota Facilities in North America and Japan.

a. *April 20, 2010* – The Panel toured the Toyota Motor Manufacturing Plant Kentucky (TMMK) in Georgetown, Kentucky, and met with representatives from TMMK, TMA, TMC, and Toyota Motor Engineering & Manufacturing North America, Inc. (TEMA). During the visit, the Panel received a comprehensive overview of Toyota's quality assurance process for its manufacturing plants across North America.
b. *May 3, 2010* – The Panel visited Longo Toyota Dealership in El Monte, California, to discuss the dealership's consumer safety procedures and protocols.
c. *May 10-11, 2010* – The Panel visited the Toyota Technical Center (TTC) outside of Ann Arbor, Michigan, where they received a presentation from TTC engineers and held discussions with other representatives from TTC and TEMA.
d. *May 16-17, 2010* – The Panel toured the Toyota Arizona Proving Grounds and held additional discussions with TTC engineers.

3) Review of ETCS-i research and analysis.

a. *May 3, 2010* – Meeting with Exponent
b. *August 2010* – Meetings with Exponent
c. *December 17, 2010* – Panel members met with representatives from Exponent as well as Engineers from TMC most knowledgeable about electronics and other technical issues of interest to the Panel.

4) Meetings with other industry leaders and experts.

a. *June 11, 2010* – The Panel hosted the Little Rock Science and Technology Roundtable at the University of Arkansas, Little Rock. The Panel heard presentations from a number of esteemed engineering professors and former NHTSA administrators, namely:
   1. **Dr. Jeffrey Luftig, Ph.D.**, Professor of Engineering Management, and **Dr. Barbara Lawton**, Lockheed Martin Professor of Management and Program Chair for the Engineering Management Program, both at the University of Colorado, Boulder
   2. **Dr. Elizabeth Pierce**, Chair of the Information Science program at the University of Arkansas at Little Rock
   3. **Dr. Daniel Roos**, Founding Director of the Massachusetts Institute of Technology (MIT) Center for Transportation Studies and the Japan Steel Industry Professor of Engineering Systems and Civil and Engineering Director of the MIT Portugal Program, and **Dr. Peter Sweatman**, Director of University of Michigan Transportation Research Institute
   4. **Dr. John Morrell**, former Director of Systems Engineering at Segway and current Associate Professor of Mechanical Engineering at Yale University
   5. **Nancy Leveson**, Professor of Aeronautics and Astronautics at the Engineering Systems Division at MIT
   6. **Hon. Jeffrey Runge, MD**, Assistant Secretary of Health Affairs and Chief Medical Officer of the Department of Homeland Security and Former Administrator at NHTSA, and **Dr. Sue Bailey**, Director at Emergent Biosolutions and Former Administrator at NHTSA.

b. *June 17, 2010* – The Panel travelled to Charlottesville, Virginia, to meet with executives from the Insurance Institute for Highway Safety.

c. *June 18, 2010* – The Panel met with **NHTSA Administrator David Strickland** and key members of his team.

d. *September 30, 2010* – The Panel held a roundtable discussion at the Massachusetts Institute of Technology. The Panel heard presentations from a number of experts in the fields of industrial organization, production, product testing, supplier relations, electronics and software, and human performance and safety. The presentations were given by:
   1. **Dr. James Womack**, Founder and Senior Advisor to the Lean Enterprise Institute, Inc., a nonprofit training, publishing, conference, and management research company chartered in August 1997 to advance a set of ideas known as lean production and lean thinking, based initially on Toyota's business system and now being extended to an entire lean management system
   2. **Tom Young**, Member of the National Academy of Engineering and retired Executive Vice President of Lockheed Martin
   3. **David Champion**, Senior Director of Consumer Reports Auto Test Center
   4. **Michael Cusamano**, the Sloan Management Review Distinguished Professor of Management at MIT's Sloan School of Management, with a joint appointment in the MIT Engineering Systems Division
   5. **Eugene "Don" D. Sussman**, Chief of the Operator Performance & Safety Analysis Division of the Department of Transportation Volpe National Transportation Systems Center
   6. **Missy Cummings**, Associate Professor of Aeronautics and Astronautics and Director of Humans and Automation Lab in the MIT Department of Aeronautics and Astronautics
   7. **Seth Teller**, Professor of Computer Science and Engineering, and Head of Robotics, Vision, and Sensor Networks Group (CSAIL) at MIT
   8. **Joseph Coughlin**, founder and Director of MIT's AgeLab – the first multi-disciplinary research program created to understand the behavior of the 45+ population
   9. **Timothy Sturgeon**, Senior Research Affiliate at MIT's Industrial Performance Center, co-organizer of the Global Value Chains Initiative and a Research Fellow at the Institute for Technology, Enterprise, and Competitiveness at the Doshisha Management School in Kyoto, Japan

   Various engineers from TMS, TTC, TMMK, and TMA participated in the roundtable discussions as well.

e. *November 16, 2010* – The Panel met with representatives of Ford Motor Company, including safety and engineering executives.

f. *December 20, 2010* – meeting with Joan Claybrook, President Emeritus, Public Safety, and former NHTSA Administrator and Clarence M. Ditlow, Executive Director, Center for Auto Safety.

g. *January 11, 2011* – The Panel participated in a teleconference with executives from J.D. Power and Associates.

AAM	Alliance of Automobile Manufacturers
CSTO	Chief Safety Technology Officer
EDR	Electronic data recorders
ESC	Electronic stability control
ETCS-i	Electronic throttle control system with intelligence
IIHS	Insurance Institute for Highway Safety
IQS	Initial Quality Survey (J.D. Power and Associates' survey analyzing mechanical and design quality of new vehicles based on new owner surveys taken approximately 90 days after purchase).
NCAP	NHTSA's New Car Assessment Program
NHTSA	U.S. National Highway Traffic Safety Administration
NRC	National Research Counsel of the National Academies
SMART Teams	Swift Market Analysis Response Teams
TCI	Toyota Canada Inc.
TEMA	Toyota Motor Engineering & Manufacturing, North America
TFS	Toyota Financial Services
THUMS	Total HUman Model for Safety (A new generation of virtual test dummies developed by Toyota to assess internal organ injury risks)
TMA	Toyota Motor North America, Inc.
TMC	Toyota Motor Corporation, Japan
TMS	To yota Motor Sales U.S.A., Inc.
TPS	Toyota Production System
UA	Unintended Acceleration
VDS	Vehicle Dependability Survey (J.D. Power and Associates' survey analyzing vehicle reliability and durability from owner surveys taken after approximately three years after purchase)
VOQ	NHTSA vehicle owner questionnaire
VRTC	NHTSA's Vehicle Research and Test Center

Toyota North American Quality Advisory Panel Charter

For over 50 years, Toyota has built its reputation in North America on its commitment to quality, safety, and reliability. On March 2, 2010, Toyota Motor North America ("TMA") announced the creation of an independent North American Quality Advisory Panel ("Panel") to reaffirm this commitment. The creation of the Panel is consistent with Toyota's long-standing Toyota Way principles of continuous improvement and respect for people, helping Toyota ensure that the voice of the customer is an integral part of quality and safety improvements.

Background

Toyota's North American affiliate companies are wholly-owned subsidiaries of Toyota Motor Corporation of Japan, and, thus, do not have a traditional American board of directors structure, which typically includes outside directors. In an action believed to be unprecedented for a multi-national company, Toyota seeks to approximate the benefits of outside directors by the appointment of the Panel, consisting of prominent individuals ("Advisors") widely respected for their experience in quality, business, and government and for their demonstrated understanding of the importance of quality and safety as critical business objectives.

Purpose and Role

The North American Quality Advisory Panel will bring outside perspective and provide objective advice to the highest levels of Toyota's North American management with respect to content, implementation, and further development of our quality and safety processes. It will also have access to the President of Toyota Motor Corporation as needed.

Membership, Appointment and Term of Office

The North American Quality Advisory Panel will consist of several Advisors, chosen to reflect an independent and objective body with rich experience, and will be presided over by a Chair.

Advisors shall be selected and approved by the appointed Chair and Toyota's North American senior management. Each Advisor shall serve an initial term of two years. At the end of two years, each member's appointment shall, at the discretion of Toyota management, be extended for one year terms. Upon acceptance of membership, each Advisor shall sign a confidentiality agreement agreeing to maintain in the strictest confidence all information that is obtained during, and by virtue of, the Advisor's service on the North American Quality Advisory Panel that is not public, that is confidential or sensitive, or that could constitute proprietary or trade secret information.

Duties and Responsibilities

The North American Quality Advisory Panel will be given full access to information concerning Toyota's quality and safety procedures. After an Independent review, the Panel will advise senior management of its assessment of the soundness of the procedures and the company's implementation progress. The Panel will also evaluate all testing completed on the electronic throttle control system ("ETCS-i") installed in Toyota and Lexus vehicles, and release its findings to the public. The Panel may elect to commission an independent study of the ETCS-i. The North American Quality Advisory Panel will also make recommendations to Toyota's senior management concerning additional approaches and best practices that should, in the Panel's judgment, be considered in the company's quality and safety efforts.

Budget and Administrative Support

To enable it to function effectively, the Panel shall have an annual budget and sufficient administrative support. Each Advisor will receive an agreed-upon fee for services and will be reimbursed for all Panel-related expenses, including reasonable travel expenses.

Meetings

The Panel shall meet at least 3 times per year with Toyota's North American Quality Task Force. Ad hoc meetings of the Panel shall be determined by the Panel Chair. A schedule of meeting dates and locations will be determined by the Panel Chair and Toyota senior management. Meeting locations will be arranged in a manner intended to orient the Panel to the company's quality and safety procedures, and its North American business operations.

Conclusion

Working together, the North American Quality Advisory Panel and Toyota's senior management will reinforce Toyota's commitment to quality and safety, and strengthen the company's ability to continue to build the safest and most reliable vehicles in the world.

1 Toyota North American Quality Advisory Panel Charter (Panel Charter), at 1 (attached as Appendix D).

2 *Id.* at 3.

3 *Id.*

4 NASA Engineering and Safety Center, Technical Support to the National Highway Traffic Safety Administration on the Toyota Unintended Acceleration Investigation, at 170–72 (Apr. 15, 2011), *available at* www.nhtsa.gov/staticfiles/nvs/pdf/NHTSA-UA_report.pdf (hereinafter "NASA UA Report").

5 *See* Jeffrey K. Liker and Timothy N. Ogden, Toyota Under Fire 163 (2011).

6 Michael A. Cusumano, Staying Power 2 (2010).

7 *See Consumer Reports 2007 Annual Car Reliability Survey Highlights*, ConsumerReports.org, Oct. 16, 2007, http://news.consumerreports.org/cars/2007/10/car-reliability.html.

8 In 2009, Toyota issued nine recalls affecting approximately 4.9 million vehicles. *See Toyota Tops Number of Recalled Vehicles in 2009*, U.S. News & World Rep., Dec. 31, 2009, *available at* http://usnews.rankingsandreviews.com/cars-trucks/daily-news/091231-Toyota-Tops-Number-of-Recalled-Vehicles-in-2009/.

In 2010, Toyota recalled its vehicles approximately 17 times, affecting 6.7 million vehicles. Industry-wide, there were approximately 20.3 million vehicles recalled in 2010. *See* Christopher Jensen, *2010 a Record Year for 'Voluntary' Recalls*, N.Y. Times, Jan. 20, 2011, http://wheels.blogs.nytimes.com/2011/01/20/2010-a-record-year-for-voluntary-recalls (citing recently released NHTSA data).

9 Panel Charter at 1.

10 *Id.*

11 *Id.*

12 NHTSA, Technical Assessment of Toyota Electronic Throttle Control (ETC) Systems, at vi, n.1 (Apr. 15, 2011), *available at* www.nhtsa.gov/staticfiles/nvs/pdf/NHTSA-UA_report.pdf (updating the initial version of the report originally released to the public on Feb. 8, 2011) (hereinafter "NHTSA ETCS Report").

13 *Id.*

14 John Holusha, *A Hard Sell for Audi*, N.Y. Times, July 24, 1988, *available at* http://www.nytimes.com/1988/07/24/business/a-hard-sell-for-audi.html?scp=14&sq=audi%20sudden%20acceleration&st=cse

15 Wolfgang Reinhart, Paper, *The Effect of Countermeasures to Reduce the Incidence of Unintended Acceleration Accidents*, 14th Int'l Conf. on Enhanced Safety of Vehicles (1994).

16 *Id.*

17 Those investigations included: DP03003 (closed without recall); DP04003/PE04021 (closed without recall); DP05002 (closed without recall); DP06003 (closed without recall); PE07016/EA07010 (all-weather floor mat recall 07E-082); DP08001 (closed without recall); PE08025 (recall 09V-023 to fix possible missing trim clip in Sienna); DP09001 (denied as covered by recall 09V-388 (floor mat entrapment)). *See* NHTSA, Timeline of Major Events Involving Allegations of Sudden Acceleration in Toyota Vehicles, *available at* http://democrats.energycommerce.house.gov/Press_111/20100222/Timeline.of.Major.Events.Involving.Allegations.of.Sudden.Acceleration.in.Toyota.Vehicles.pdf; NHTSA, Detailed Timeline and Background of NHTSA Actions Regarding Toyota Sudden Acceleration, *available at* http://democrats.energycommerce.house.gov/Press_111/20100222/Detailed.Timeline.and.Background.of.NHTSA.Actions.Regarding.Toyota.Sudden.Acceleration.pdf.

18 *See* NHTSA, Detailed Timeline and Background of NHTSA Actions Regarding Toyota Sudden Acceleration, *available at* http://democrats.energycommerce.house.gov/Press_111/20100222/Detailed.Timeline.and.Background.of.NHTSA.Actions.Regarding.Toyota.Sudden.Acceleration.pdf.

19 *See* Consumer Letter to NHTSA, Apr. 25, 2003, NHTSA Defect Petition DP03-003, *available at* http://www-odi.nhtsa.dot.gov/acms/documentList.do?docId=DP03003&docType=INV&fromPublic=true.

20 *See* NHTSA Closing Resume, DP03-003, Sept. 23, 2003, *available at* http://www-odi.nhtsa.dot.gov/acms/docservlet/Artemis/Public/Pursuits/2003/DP/INCLA-DP03003-16128P.pdf.

21 *See* NHTSA Opening Resume, PE04-021, Mar. 3, 2004, *available at* http://www-odi.nhtsa.dot.gov/acms/docservlet/Artemis/Public/Pursuits/2004/PE/INOA-PE04021-17295P.pdf.

22 *See* NHTSA Memo to File, PE04-021, July 7, 2004, *available at* http://www-odi.nhtsa.dot.gov/acms/docservlet/Artemis/Public/Pursuits/2004/PE/INME-PE04021-18263P.pdf; *see also* NHTSA, Detailed Timeline and Background of NHTSA Actions Regarding Toyota Sudden Acceleration, *available at* http://democrats.energycommerce.house.gov/Press_111/20100222/Detailed.Timeline.and.Background.of.NHTSA.Actions.Regarding.Toyota.Sudden.Acceleration.pdf.

23 NHTSA Closing Resume, PE04-021, July 22, 2004, *available at* http://www-odi.nhtsa.dot.gov/acms/docservlet/Artemis/Public/Pursuits/2004/PE/INCR-PE04021-21969P.PDF.

24 NHTSA PE07-016 (NHTSA "preliminary evaluation") and EA07-010 (NHTSA "engineering analysis") resulted in the NHTSA Recall Campaign 07E-082. *See* NHTSA, Timeline of Major Events Involving Allegations of Sudden Acceleration in Toyota Vehicles, *available at* http://democrats.energycommerce.house.gov/Press_111/20100222/Timeline.of.Major.Events.Involving.Allegations.of.Sudden.Acceleration.in.Toyota.Vehicles.pdf; NHTSA, Detailed Timeline and Background of NHTSA Actions Regarding Toyota Sudden Acceleration, *available at* http://democrats.energycommerce.house.gov/Press_111/20100222/Detailed.Timeline.and.Background.of.NHTSA.Actions.Regarding.Toyota.Sudden.Acceleration.pdf; *see also* Toyota Defect Information Report to NHTSA, NHSTA Recall Campaign 07E-082, Sept. 26, 2007, *available at* http://www-odi.nhtsa.dot.gov/acms/docservlet/Artemis/Public/Recalls/2007/E/RCDNN-07E082-7736.pdf. These investigations were initiated to examine reports that optional all-weather floor mats installed in certain Lexus ES 350 vehicles could interfere with the accelerator pedal. *See* NHTSA Opening Resume, PE07-016, Mar. 29, 2007, *available at* http://www-odi.nhtsa.dot.gov/acms/docservlet/Artemis/Public/Pursuits/2007/PE/INOA-PE07016-61690.pdf. NHTSA PE08-025 and EA08-014 resulted in the other recall, NHTSA Recall Campaign 09V-023. *See* NHTSA, Timeline of Major Events Involving Allegations of Sudden Acceleration in Toyota Vehicles, *available at* http://democrats.energycommerce.house.gov/Press_111/20100222/Timeline.of.Major.Events.Involving.Allegations.of.Sudden.Acceleration.in.Toyota.Vehicles.pdf; NHTSA, Detailed Timeline and Background of NHTSA Actions Regarding Toyota Sudden Acceleration, *available at* http://democrats.energycommerce.house.gov/Press_111/20100222/Detailed.Timeline.and.Background.of.NHTSA.Actions.Regarding.Toyota.Sudden.Acceleration.pdf; *see also* Toyota Letter to NHTSA, NHSTA Recall Campaign 09V-023, Jan. 14, 2009, *available at* http://www-odi.nhtsa.dot.gov/. These investigations were initiated to examine reports that an interior trim panel in certain 2004 Toyota Siennas could interfere with the movement of the accelerator pedal. *See* NHTSA Opening Resume, PE08-025, Apr. 10, 2008, *available at* http://www-odi.nhtsa.dot.gov/acms/docservlet/Artemis/Public/Pursuits/2008/PE/INOA-PE08025-61690.pdf.

25 Toyota Defect Information Report to NHTSA, NHSTA Recall Campaign 07E-082, Sept. 26, 2007, *available at* http://www-odi.nhtsa.dot.gov/acms/docservlet/Artemis/Public/Recalls/2007/E/RCDNN-07E082-7736.pdf.

26 *Id.*

27 *Id.*; *see, e.g.*, Lexus ES 350 Owner Notification Letter for NHTSA Recall Campaign ID 07E-082, *available at* http://www-odi.nhtsa.dot.gov/acms/docservlet/Artemis/Public/Recalls/2007/E/RCONL-07E082-8177.pdf; Camry Owner Notification Letter for NHSTA Recall Campaign ID 07E-082, *available at* http://www-odi.nhtsa.dot.gov/acms/docservlet/Artemis/Public/Recalls/2007/E/RCONL-07E082-2445.pdf.

28 *Id.*

29 NHTSA Opening Resume, PE08-025, Apr. 10, 2008, *available at* http://www-odi.nhtsa.dot.gov/acms/docservlet/Artemis/Public/Pursuits/2008/PE/INOA-PE08025-61690.pdf. NHTSA also opened a related Engineering Analysis, EA08-014. *See* NHTSA Opening Resume, EA08-014, Aug. 8, 2008, *available at* http://www-odi.nhtsa.dot.gov/acms/docservlet/Artemis/Public/Pursuits/2008/EA/INOA-EA08014-29885.pdf.

30 NHTSA Defect Investigation Results Summary, PE08-025, Aug. 8, 2008, *available at* http://www-odi.nhtsa.dot.gov/cars/problems/defect/results.cfm?action_number=PE08025&SearchType=QuickSearch&summary=true.

31 NHTSA Closing Resume, EA08-014, Jan. 26, 2009, *available at* http://www-odi.nhtsa.dot.gov/acms/docservlet/Artemis/Public/Pursuits/2008/EA/INCLA-EA08014-33406.pdf.

32 *Id.*

33 Toyota Letter to NHTSA, NHSTA Recall Campaign 09V-023, Jan. 14, 2009, *available at* http://www-odi.nhtsa.dot.gov/acms/docservlet/Artemis/Public/Recalls/2009/V/RCDNN-09V023-8407.pdf.

34 NHTSA Vehicle Research and Test Center (VRTC) Memorandum: Vehicle and Crash Site Inspection of 2009 Lexus ES-350, VIN JTHBJ46G792282025, Sept. 30, 2009, *available at* http://www-odi.nhtsa.dot.gov/acms/docservlet/Artemis/Public/Pursuits/2009/DP/INME-DP09001-37211P.pdf.

35 *Id.*

36 *Id.*

37 *Id.*

38 *Id.*

39 Press Release, Toyota, Toyota Consumer Safety Advisory: Potential Floor Mat Interference with Accelerator Pedal (Sept. 29, 2009), *available at* http://pressroom.toyota.com/article_display.cfm?article_id=1764.

40 *Id.*

41 *Id.*

42 *See* Toyota Defect Information Report to NHTSA, NHSTA Recall Campaign 09V-388, Oct. 5, 2009, *available at* http://www-odi.nhtsa.dot.gov/acms/docservlet/Artemis/Public/Recalls/2009/V/RCDNN-09V388-8067.pdf.

43 *Id.*

44 *Id.*

45 Press Release, Toyota, Toyota Begins Interim Notification to Owners Regarding Future Voluntary Safety Recall Related to Floor Mats (Nov. 2, 2009), *available at* http://pressroom.toyota.com/article_display.cfm?article_id=1802 (announcing recall); Toyota Defect Information Report to NHTSA, NHTSA Recall Campaign 09V-388, Oct. 5, 2009, http://www-odi.nhtsa.dot.gov/acms/docservlet/Artemis/Public/Recalls/2009/V/RCDNN-09V388-8067.pdf (estimating the total number of vehicles affected to be 3.8 million).

46 Press Release, Toyota, Toyota Begins Interim Notification to Owners Regarding Future Voluntary Safety Recall Related to Floor Mats (Nov. 2, 2009), *available at* http://pressroom.toyota.com/article_display.cfm?article_id=1802. The letter to customers states that:

> The defect is the potential for an unsecured or incompatible driver's floor mat to interfere with the accelerator pedal and cause it to get stuck in the wide open position. Toyota has determined that this defect does not exist in vehicles in which the driver side floor mat is compatible with the vehicle and properly secured.
>
> Toyota is currently developing a campaign remedy and will notify you when it is ready. In the meantime we are providing important information regarding the issue and steps you may take in the interim.

Toyota Owner Interim Notification Letter, Nov. 2, 2009, *available at* http://pressroom.toyota.com/images/document/Floor_mat_Owner_Letter_sample.pdf.

47 Press Release, Toyota, Toyota Begins Interim Notification to Owners Regarding Future Voluntary Safety Recall Related to Floor Mats (Nov. 2, 2009), *available at* http://pressroom.toyota.com/article_display.cfm?article_id=1802.

48 Press Release, NHTSA, NHTSA Statement Concerning the Safety Recall of 3.8 million Toyota Vehicles (Nov. 4, 2009), *available at* http://www.nhtsa.gov/About+NHTSA/Press+Releases/2009/NHTSA+Statement+Concerning+The+Safety+Recall+of+3.8+million+Toyota+Vehicles.

49 Press Release, Toyota, Toyota's Statement Regarding NHTSA News Release (Nov. 4, 2009), *available at* http://pressroom.toyota.com/article_display.cfm?article_id=2736.

50 Toyota Amended Defect and Noncompliance Notice, NHSTA Recall Campaign 09V-388, Nov. 25, 2009, *available at* http://www-odi.nhtsa.dot.gov/acms/docservlet/Artemis/Public/Recalls/2009/V/RCDNN-09V388-5101.pdf.

While Toyota intended to replace the accelerator pedals and install brake override systems in all of the models listed in the recall, Toyota only intended to reshape the floor surface for the Lexus ES, Camry, and Avalon models, not all of the vehicles subject to the recall. "In the Lexus ES, Camry, and Avalon models additional modifications to the floor surface are included in the remedy plan to improve the pedal clearance" and only intended "to add a supplemental function to the software for owners of ES, Camry, Avalon, and IS models that will ensure that the brake overrides the accelerator in the event that both pedals are being applied at the same time." *Id.*

51 *Id.*

52 Press Release, NHTSA, U.S. Department of Transportation Releases Results from NHTSA-NASA Study of Unintended Acceleration in Toyota Vehicles (Feb. 8, 2011), *available at* http://www.nhtsa.gov/PR/DOT-16-11; *see also* Micheline Maynard, *Lawmakers Ask Toyota to Prove Fix Solves Problem*, N.Y. Times, Feb. 3, 2010, at B1, *available at* http://www.nytimes.com/2010/02/03/business/global/03toyota.html; Brian Todd, U.S. Official: Toyota Pressured Into Recall, CNN.com, Feb. 2, 2010, http://articles.cnn.com/2010-02-02/politics/lahood.toyota.recall_1_cts-pedals-toyota-accelerator?_s=PM:POLITICS. Secretary of Transportation Ray LaHood later explained that "[w]hile Toyota is taking responsible action now, it unfortunately took an enormous effort to get to this point." *Id.*

53 Press Release, NHTSA, U.S. Department of Transportation Releases Results from NHTSA-NASA Study of Unintended Acceleration in Toyota Vehicles (Feb. 8, 2011), *available at* http://www.nhtsa.gov/PR/DOT-16-11.

54 Press Release, Toyota, Toyota Files Voluntary Safety Recall on Select Toyota Division Vehicles for Sticking Accelerator Pedal (Jan. 21, 2010), *available at* http://pressroom.toyota.com/article_display.cfm?article_id=1844; *see also* Toyota Defect Information Report to NHTSA, NHTSA Recall Campaign 10V-017, Jan. 21, 2010, *available at* http://www-odi.nhtsa.dot.gov/acms/docservlet/Artemis/Public/Recalls/2010/V/RCDNN-10V017-1931.pdf.

55 Press Release, Toyota, Toyota Files Voluntary Safety Recall on Select Toyota Division Vehicles for Sticking Accelerator Pedal (Jan. 21, 2010), *available at* http://pressroom.toyota.com/article_display.cfm?article_id=1844.

56 Press Release, Toyota, Toyota Amends Recall on Potential Floor Mat Interference with Accelerator Pedal (Jan. 27, 2010), *available at* http://pressroom.toyota.com/article_display.cfm?article_id=1847.

57 *Response by Toyota and NHTSA to Incidents of Sudden Unintended Acceleration: Hearing Before the Subcomm. on Oversight and Investigations of the H. Comm. on Energy and Commerce*, 111th Cong. 3 (2010) (statement of Ray LaHood, Sec. of Transport. of the U.S.).

58 Presentation of David Champion, Senior Director of Consumer Reports Auto Test Division, Product Testing, Panel Roundtable, Massachusetts Institute of Technology, (Sept. 30, 2010).

59 *Id.*

60 *Id.*

61 *Id.*

62 *Id.*

63 *Id.*

64 Presentation of David Champion, Senior Director of Consumer Reports Auto Test Division, Product Testing, Panel Roundtable, Massachusetts Institute of Technology, (Sept. 30, 2010).

65 *See 2010 Initial Quality Study Results*, JDPower.com, *available at* http://www.jdpower.com/autos/articles/2010-Initial-Quality-Study-Results/.

66 *See 2010 Vehicle Dependability Study Results*, JDPower.com, *available at* http://www.jdpower.com/autos/articles/2010-Vehicle-Dependability-Study-Results/.

67 *See* Press Release, J.D. Power and Assocs., While Vehicle Dependability Continues to Improve, New Technologies and Features Pose Challenges for Automakers (Mar. 17, 2011), *available at* http://www.jdpower.com/news/pressrelease.aspx?ID=2011029 ("Toyota Motor Corporation continues to perform well in long-term dependability.").

68 *Id.*

69 Press Release, J.D. Power and Assocs., Domestic Brands Surpass Imports in Initial Quality for the First Time in IQS History (June 17, 2010), *available at* http://www.autoblog.com/2010/06/17/jd-power-2010-initial-quality-study-domestics-lead-imports/.

70 *See Fatality Facts 2009: Occupants*, Ins. Inst. for Highway Safety, *available at* http://www.iihs.org/research/fatality_facts_2009/occupants.html.

71 *See* NASA UA Report at 44, *supra* note 4.

72 *Id.*

73 *Cf.* Rosabeth Moss Kanter, SuperCorp: How Vanguard Companies Create Innovation, Profits, Growth, and Social Good (2009) (Citing examples of "'vanguard companies' that pursue their everyday business opportunities in a way that reflects humanistic values and promotes the highest standards in the countries where they operate.").

74 Jim Olson, The Little Red Box of Management Tools 37 (2010).

75 Jorn Madslien, *Toyota's Reputation Could be Tarnished for Years*, BBC News, Feb. 4, 2010, http://news.bbc.co.uk/2/hi/business/8498036.stm. In his testimony before the House Energy and Commerce Committee, James Lentz, President and Chief Executive Officer of TMS, acknowledged that Toyota "didn't do a very good job of sharing information across the globe." *Response by Toyota and NHTSA to Incidents of Sudden Unintended Acceleration: Hearing Before the Subcomm. on Oversight and Investigations of the H. Comm. on Energy and Commerce*, 111th Cong. 183 (2010) (testimony of James E. Lentz, President and Chief Executive Officer of TMS).

76 Alex Taylor III, *How Toyota Lost Its Way*, Fortune, July 12, 2010, *available at* http://money.cnn.com/2010/07/12/news/international/toyota_recall_crisis_full_version.fortune/index.htm.

77 Jeffery K. Liker, The Toyota Way 40 (2004).

78 *See* Jeffrey K. Liker & Michael Hoseus, Toyota Culture: The Heart and Soul of the Toyota Way 164–65 (2008).

79 Akio Toyoda, President and Chief and Executive Officer of TMC, Op-Ed., Toyota's Plan to Repair its Public Image, Wash. Post, Feb. 9, 2010, *available at* http://www.washingtonpost.com/wp-dyn/content/article/2010/02/08/AR2010020803078.html.

80 *Id.*

81 *See* Recall Details for Toyota – Lexus IS200, United Kingdom Vehicle & Operator Services Agency, Sept. 12, 2000, *available at* http://www.dft.gov.uk/vosa/apps/recalls/searches/expand.asp?uniqueID=4A22F46D6AEEDE4480256BB9002689AF&freeText=Blank&tx=VOSA.

82 *Response by Toyota and NHTSA to Incidents of Sudden Unintended Acceleration: Hearing Before the Subcomm. on Oversight and Investigations of the H. Comm. on Energy and Commerce*, 111th Cong. 182–83 (2010) (testimony of James E. Lentz, President and Chief Executive Officer of TMS).

83 Associated Press, *Transport Secretary Calls Toyota 'Safety Deaf'*, MSNBC.com, Feb. 2, 2010, http://www.msnbc.msn.com/id/35201553/ns/business-autos/ ("LaHood told The Associated Press that federal safety officials had to 'wake them up' to the seriousness of the safety issues that eventually led Toyota to recall millions of popular brands like Camry and Corolla. That included a visit to Toyota's offices in Japan to convince them to take action."); *see also* Micheline Maynard, *Lawmakers Ask Toyota to Prove Fix Solves Problem*, N.Y. Times, Feb. 3, 2010, at B1, *available at* http://www.nytimes.com/2010/02/03/business/global/03toyota.html.

84 On April 19, 2010, Toyota agreed to pay a fine of $16.375 million to settle allegations it did not report safely issue related to sticky accelerator pedals to NHTSA on a timely basis. *See* Press Release, NHTSA, Statement form U.S. Transportation Secretary Ray LaHood on Toyota's Agreement to Pay Maximum Civil Penalty (Apr. 19, 2010), *available at* http://www.nhtsa.gov/PR/DOT-71-10.

On December 20, 2010, Toyota agreed to pay two separate fines totaling $32.425 million to address the timeliness of recalls in 2005 to address potential concerns with steering relay rods and from 2007 to early 2010 to address the potential for pedal entrapment by unsecured, incompatible or improperly installed floor mats. Press Release, Toyota, Toyota Issues Statement Regarding NHTSA Settlement (Dec. 20, 2010), *available at* http://pressroom.toyota.com/article_display.cfm?article_id=2824.

85 Press Release, Toyota, Toyota Motor Corporation Agrees to Settle NHTSA Civil Penalty (Apr. 19, 2010), *available at* http://pressroom.toyota.com/article_display.cfm?article_id=1958; Press Release, Toyota, Toyota Issues Statement Regarding NHTSA Settlement (Dec. 20, 2010), *available at* http://pressroom.toyota.com/article_display.cfm?article_id=2824.

86 *See also* Hans Greimel, *Toyota to Unlock Secrets of Black-Box Recorders*, Automotive News, Feb. 25, 2010, http://www.autonews.com/apps/pbcs.dll/article?AID=/20100225/RETAIL05/100229914; *see also* Congressional Research Service, Unintended Acceleration in Passenger Vehicles, at 12 (Apr. 26, 2010), *available at* www.fas.org/sgp/crs/misc/R41205.pdf.

87 Press Release, Toyota, Toyota Clarifies the Facts about Event Data Recorders (May 12, 2010), *available at* http://pressroom.toyota.com/article_display.cfm?article_id=1926.

88 *Id.*

89 *Id.*

90 Congressional Research Service, Unintended Acceleration in Passenger Vehicles, at 12 (Apr. 26, 2010), *available at* www.fas.org/sgp/crs/misc/R41205.pdf.

91 Dionne Searcey & Kate Linebaugh, *Toyota Woes Put Focus on Black Box*, Wall St. J., Feb. 16, 2010, at B1, *available at* http://online.wsj.com/article/SB10001424052748703562404575067680423734178.html.

92 Press Release, Toyota, Toyota Unveils Global Vision (Mar. 9, 2011), *available at* http://pressroom.toyota.com/releases/toyota+global+vision.download.

93 *Id.*

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