National Aeronautics and Space Administration

Hidden Hazards

Understanding the Social and Technical Issues Behind Faulty GM Ignition Switch

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website

Key Conclusions

- "The Valukas Report" uncovered issues involving communication, understanding the technical problem, urgency, oversight and company culture.
- A significant communication breakdown allowed the core technical issue involving the ignition switch and airbags to be concealed from anyone with technical oversight until 2013. Poor communication partially blocked how information flowed throughout GM, affecting management's interpretation of the information.

Summary

- **Date:** 2002 to 2014 (and beyond)
- **Company:** General Motors (GM)
- **Details:** Jenner & Block LLP investigated over a decade of operational issues with an ignition switch used in several GM vehicles, including the Chevy Cobalt. Drivers had problems with the ignition switch slipping out of position, stalling engines and cutting power to vehicle systems. In many cases, the stalling would disable the vehicle's airbags just as the car was about to crash.
- **Results:**
  - 124 deaths and 275 injuries
  - GM has recalled 30 million vehicles and paid over $2 billion in fines, penalties and settlements (since February 2014)

Communication and Management Issues

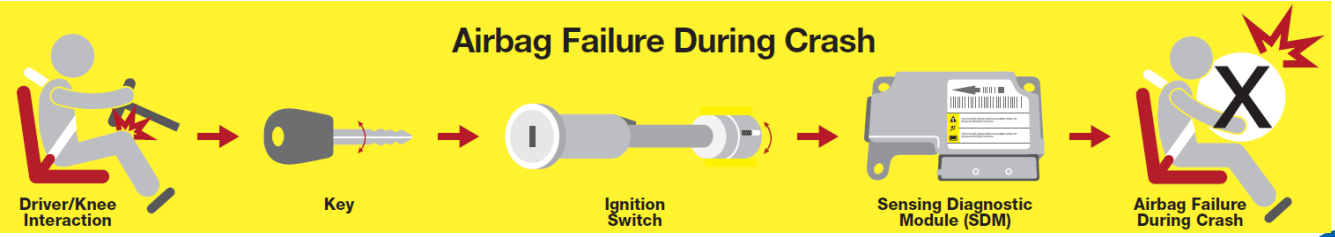
Any large, complex organization—including NASA—is vulnerable to poor communication and oversight. Consider these similar underlying issues identified by experts who investigated the flawed Hubble Space Telescope (HST):

- **Communication issues:** A significant communication breakdown occurred when a technician (employed by contractor Perkin-Elmer) rigged the equipment used to test the mirror's surface to provide a desired result, hiding its actual flaws from discovery until the telescope was in orbit. The technician failed to notify others of the modification. The contractor allowed critical components of the telescope to be fabricated in a closed-door environment, which restricted communication and prevented problems from being reviewed by third-party inspectors.

- **Management problems:** Financial problems as well as political and schedule pressures distracted managers at NASA and at Perkin-Elmer. Supervisors neglected to oversee the work on the primary HST mirror. Distractions overwhelmed managers to the point that they failed to identify and mitigate risk, enforce quality assurance and maintain good communication.

Background

- In the early 2000s, GM developed the Delta Vehicle Platform, a vehicle architecture that was used in the Chevy Cobalt and HHR, Saturn Ion and Pontiac G5.
- **GM FINANCIAL ISSUES AND COST-CUTTING STRATEGIES:** GM's financial problems in the early 2000s led the company to adjust its production, parts procurement and personnel. GM streamlined its U.S. engineering organization from 11 engineering centers to just one.
- **COBALT SAFETY CONCERNS:** In 2011, the Cobalt's driver death rate was higher than any other four-door vehicle in its class. Multiple witnesses characterized the Cobalt as a "cost-conscious vehicle" made on "slim margins."
- **IGNITION SWITCH POSITIONS AND COMPONENTS:** The switch operates in the following positions: START, RUN, ACCESSORY and OFF. Two components inside the switch assembly control the amount of effort needed to change the position of the switch. The plunger cap and coiled spring sit in a small groove (detent). While turning the key, the driver applies torque to the key to overcome the detent and rotate the switch to the desired position.
- **SENSING DIAGNOSTIC MODULE (SDM) AND AIRBAG SYSTEM:** When the switch is turned to Run after being in Accessory or Off (e.g., when the driver's knee bumps the key fob or keychain), the SDM (onboard electric module) "reboots," turning itself Off and then On. During the reboot process, the vehicle's airbags will not deploy. In the event of a crash and vehicle power loss, the SDM crash sensing will continue for about 150 milliseconds after the power loss. *If power was lost before the SDM started to sense the crash, the airbags wouldn't deploy.*



What Happened

2002 — Ion production begins; ignition switch issues also begin.

2003–2004 — Customers complain to GM about no crank/no start issues during cold weather. Large volume of starter issue complaints caused GM to focus on fixing the switch's starting issues instead of addressing the stalling issues. GM engineers considered the stalling problem to be a version of the starting problem.

2004 — The Cobalt goes into production with the same ignition switch used in the Ion; GM classifies the moving stall as a nonsafety issue.

2005

- **March** — Various GM committees considered possible fixes to the ignition switch problem. However, they rejected them as "too costly," since the switch issue was not deemed a safety concern. GM closes the initial safety investigation regarding the stalling issue without taking action.
- **July** — The first fatality involving the stalling issue occurs when Amber Marie Rose crashes her 2005 Cobalt into a tree.
- **December** — GM sent out a dealer notice about possible customer complaints of ignition cut-offs, instructing dealers to tell customers to remove heavy items from keychains and offering an insert to the key that would reduce the likelihood of the switch rotating unintentionally. Only customers who complained to the dealers received these instructions.

2006

- Ray DeGiorgio, the engineer who approved the ignition switch to enter production, authorized a change in the ignition switch to increase the amount of torque needed to turn the key. While GM had a policy in place to require a part number update for a significant change, DeGiorgio did not change the part number to reflect the design update. No one at GM verified his decision to change the part.
- Litigation into fatalities from ignition switch-related accidents begin.

What Happened

2007

- Outside individuals/organizations correctly diagnose the problem with the ignition switch design flaw.
- A Field Performance Assessment (FPA) engineer is tasked with tracking incidents of Cobalt airbag failures in a spreadsheet. (given no deliverable or timeframe, the engineer is unaware of the prior problems with the ignition switch, including 2005 dealer bulletin) Engineer eventually recognizes a pattern connecting the airbags with the ignition switch.

2009 — When questioned by John Sprague (an FPA airbag engineer at GM), DeGiorgio said that "there had been no change to the switch that would have affected the power mode shutting off." DeGiorgio did not discuss any changes to the detent plunger "that would have affected the torque required to turn the key."

2011

- Outside legal counsel warns GM's in-house counsel that it could be accused of "egregious conduct" for failure to address the airbag problem.
- GM's lawyers request that the investigation be reassigned to GM's Product Investigations unit (assigned to investigator Brian Stouffer).

2012

- While Stouffer gains access to Indiana University's report and the plaintiff's expert report, he discounts their findings, concluding that they were inaccurate.

2013

- **April** — GM engineers finally understand that Cobalt ignition switches had changed and realize that earlier models had the torque problem.
- **December** — A proposed recall reaches the Executive Field Action Decision Committee (EFADC), which includes three GM vice presidents and its chief engineer. Chief engineer questions the data. EFADC lacks the accident fatality information, so they don't act with a sense of urgency.

2014

- **February** — GM issues the first recall. The initial recall is deemed incomplete because EFADC decision-makers lack all pertinent information needed.

Proximate Cause

- The ignition switch did not meet the mechanical specifications for torque and required less force to turn the key than its designers originally ordered.
- If the driver's knee hit the key fob, the car would often turn off, causing stalling at highway speeds and disabling the airbags.

Underlying Issues

- Inadequate communication
- Lack of understanding of the technical problem
- Lack of urgency
- Inadequate oversight
- Company culture characterized by low accountability

Aftermath

- GM's top leaders have been proactive in handling safety-related social issues, focusing on honesty and transparency.
- The company reorganized and restructured its engineering operations to improve quality and safety.
- While GM has been working to recover financially, its appeal to block several lawsuits related to faulty ignition switches was rejected by the Supreme Court in April 2017.

Applying Lessons Learned to Current and Future NASA Missions

- Unintended barriers to effective communication have contributed to several major NASA mishaps, including the following:
  - **Apollo 1**
  - **Hubble Space Telescope**
  - **Challenger**
  - **Columbia**

- Lack of effective communication contributed to other well-known mishaps, including **SpaceShipTwo** and **Three Mile Island (TMI).**
- Conditions exist today where the potential for unintentional barriers to communication to block the timely exchange of safety-critical information is *very real*. Examples:
  - Competing providers of commercial launch services are given federal regulatory and contractual latitude to substitute corporate efficiencies in place of formal SE&I principles. Yet, NASA looks for evidence of engineering discipline and control via requirements verification and the examination of deliverable documents.

Applying Lessons Learned to Current and Future NASA Missions

- NASA milestones and schedules in some programs are complex and spread out geographically and chronologically in such a way that successful integration requires the unprecedented use of tools and constancy of purpose over decades. Even if the organization is configured to effectively communicate in real time, decisions and systems knowledge that exist now may not transfer effectively—or at all—to new deciders and actors in the future.
- The incremental budgeting of facilities and projects can limit planning and the communication about planning to near-term activities that are capable of fiscal control. Communication about long-term strategies can be limited or even ignored because the strategies are considered unrealistic or premature.

- To ensure effective risk communication, answer the following:
  - **What do risk owners need to know to mitigate unacceptable risk?**
  - **When do they need to know it?**
- Exercising a formal dissent process in the open will help generate trust and confidence across peer groups and throughout the management chain. Maintaining a confidential communication path for those who have never raised a safety concern before is also necessary.

Questions for Discussion

- Are there any projects or processes within your organization where only one person is in charge of testing and approving a final component/design?
- Are you encouraged to notify upper management about potential safety issues? If not, are there other channels for you to use to report safety concerns?
- In general, how quickly are potential safety issues handled within your organization? How are safety issues prioritized?
- When human life is at stake, are cost or schedule placed ahead of safety?