QUARTERLY OF THE INDUSTRIAL DESIGNERS SOCIETY OF AMERICA **WINTER 2013**

# INNOVATION

## Design Beliefs

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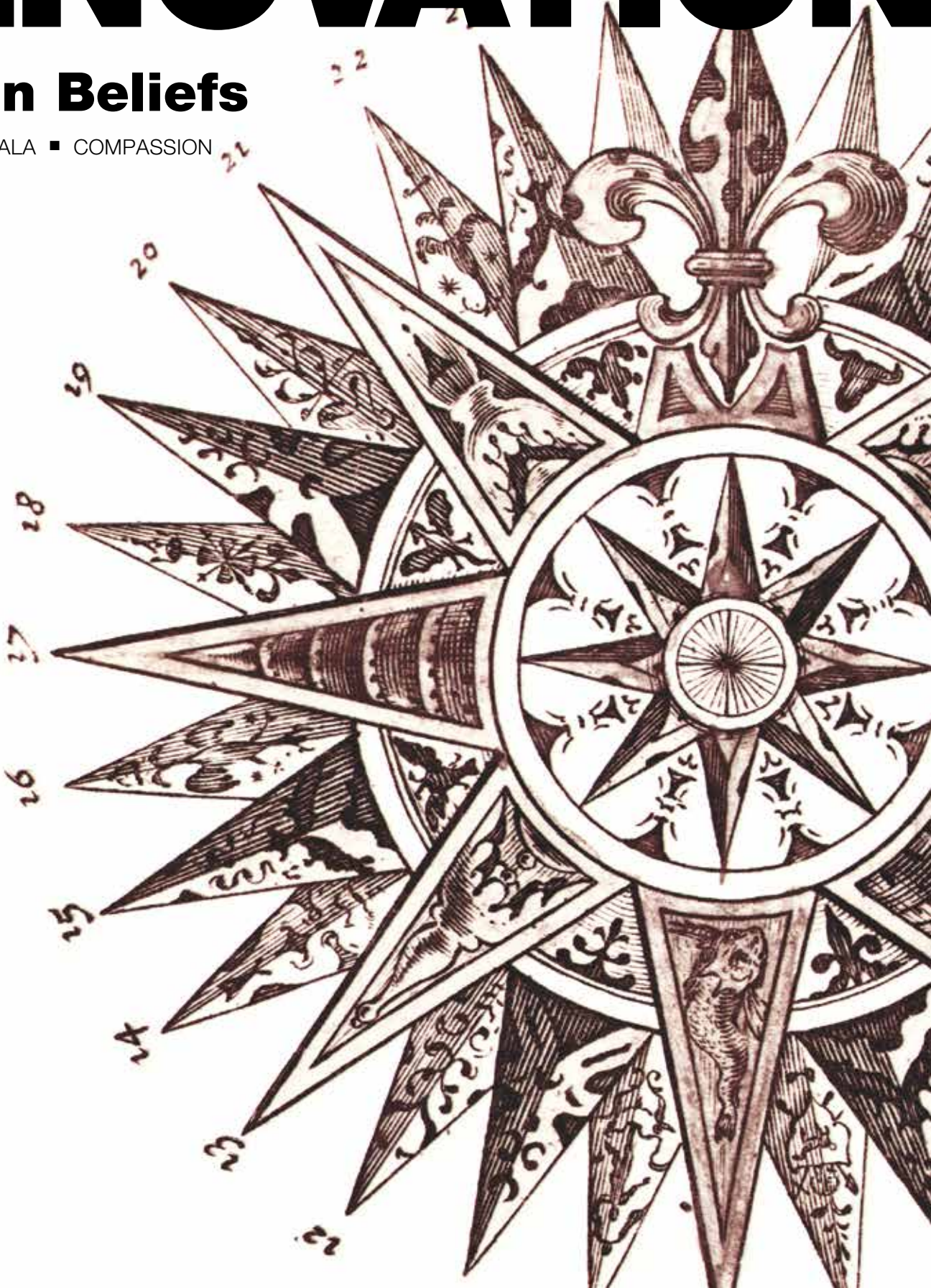

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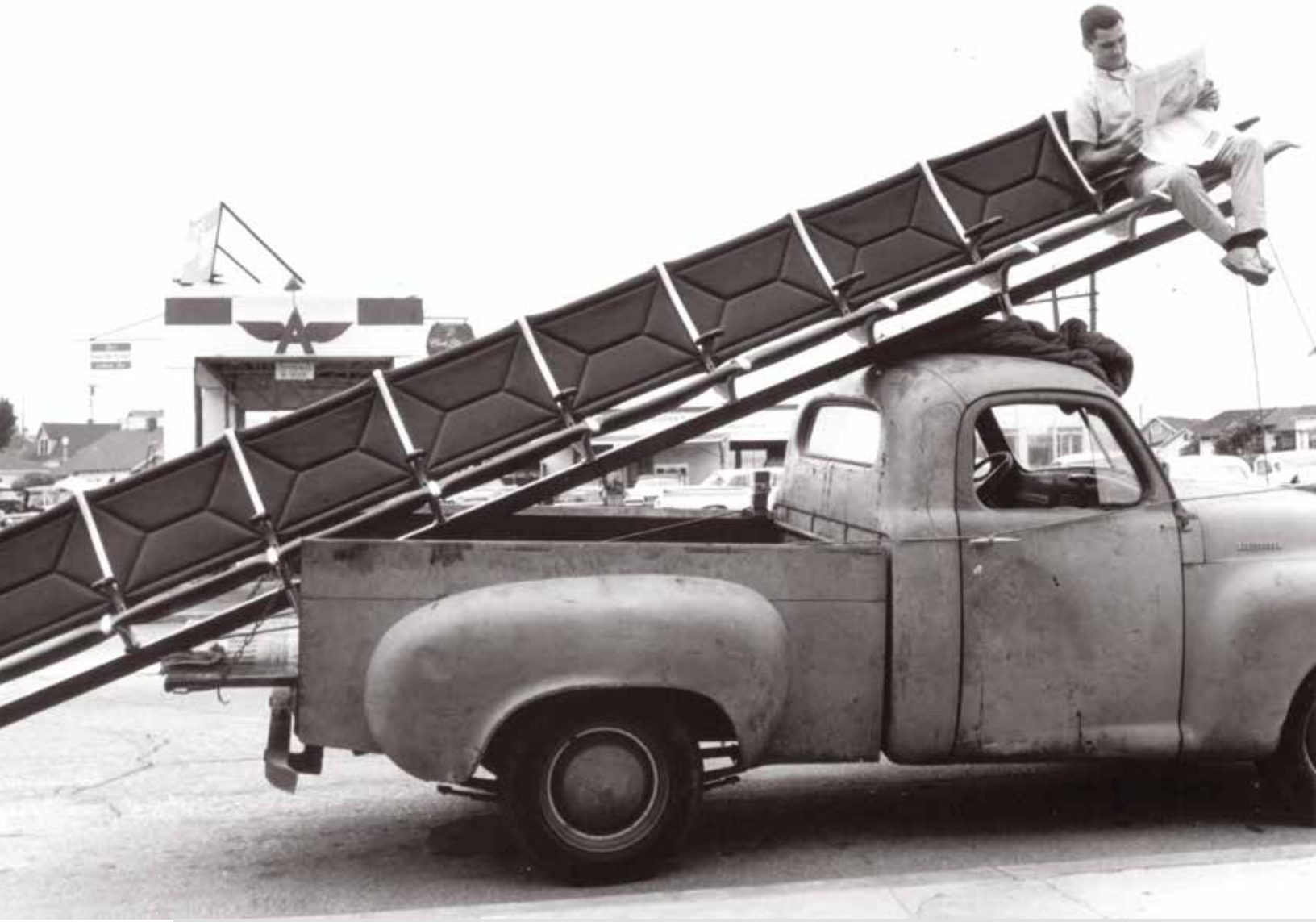

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The quarterly publication of the Industrial Designers Society of America (IDSA), *Innovation* provides in-depth coverage of design issues and long-term trends while communicating the value of design to business and society at large.

## DESIGN BELIEFS



## FEATURES



## IN EVERY ISSUE



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**Left:** This is one of Steve Frykholm's favorite photos from the Herman Miller archive. In 1962 Charles and Ray Eames won the competition to design the seating for Chicago's new O'Hare Airport. As well as pictures of the product in use, they also took this spontaneous and whimsical photo. See p. 46.


**Cover photo:** 17th-Century Drawing of a Compass Rose by Blaue/Corbis Images


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**By Byron Bloch, IDSA**
www.AutoSafetyExpert.com

Byron Bloch has been an auto safety expert in design and crashworthiness for over 40 years, advocating for the adoption of airbags, forward-of-axle fuel tanks, stronger roofs for roll-over protection, truck underride guards and other technologies. He inspects accident vehicles, lectures, writes, appears on TV, testifies in court on behalf of crash victims, demonstrates designs that are safer and produces documentaries analyzing car crash accidents. He's a graduate of UCLA's industrial design program.

# THIS WILL REALLY BURN YOU UP!

Ask yourself, what are the vital qualities that must be taken into account for every product you design? Is safety one of them? From my own perspective of over 40 years immersed in industrial design and human factors engineering, it has been clear that safety *must* be included as a key requirement in the design and performance of every product. This is imperative whether the product is intended for households, factories, offices, outdoor workplaces, sports applications or transportation on roads, on the sea, in the air or in outer space, or anywhere else. For every product, whatever its uses and purposes, *it is critical to include safety*.

The importance of a product being designed with optimum safety might seem self-evident. Of course, everyone wants their products to be safe. Well, maybe not always. What if a slightly safer design adds a few extra dollars to the cost of making the product? How important is it to be *slightly safer*? And what if the product is a motor vehicle that will foreseeably be involved in collision accidents; what then should be done to make it safer and more crashworthy? When I was studying industrial design at UCLA under the direction of renowned Henry Dreyfuss, author of *Designing for People*, he instilled his basic principles of industrial design, beginning with utility and safety, a focus that helped guide my passion for safer design in vehicles.

## A Long, Fiery Road

Let's use the Ford Mustang as a case in point. When the Ford Mustang was introduced back in 1964, the awards poured in, mostly for the Mustang's great overall design: its styling, its excitement, its performance and the package concept of an affordable, attractive, sporty car that was fun to drive. The Mustang is still a beloved classic car with many fan clubs, devoted magazines and sources for replacement parts to keep them running forever.

When the Ford Mustang was first launched as a 1965 model, the fuel tank was located behind the rear axle and very close to the rear bumper. The design was known as a drop-in flange-mounted fuel tank; the sheet metal fuel tank

Classic Ford Mustang: The fuel tank and filler tube are dangerously located near the rear bumper and the top of the fuel tank is also the floor of the trunk (above).

This 1966 Ford Mustang was rear-impacted and burst into flames.

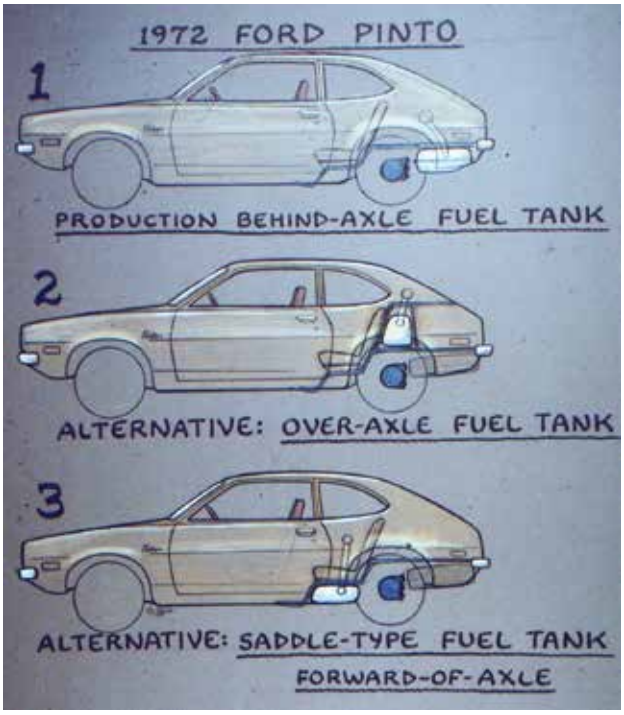
was simply placed in a large rectangular hole in the trunk, where it rested atop a peripheral flange to which it was bolted. This meant that the top of the fuel tank also served as the floor of the trunk; there was no separate trunk floor above the fuel tank. This terribly unsafe design was not generally recognized back then, there was no safety-standard crash-test requirement, and it was overlooked by the media, which failed to alert the public.

As an auto safety expert for more than 40 years, I have inspected accident vehicles coast to coast. Long ago, I saw that many vehicles, from virtually all automakers, had the fuel tank dangerously close to the rear bumper, and many rear-impact accidents had led to fuel-fed fires and severe burn injuries and deaths. I documented how the filler tube separated from the fuel tank, how the fuel tank had been crushed and punctured, and how the car had been consumed by the fuel-fed fire. I also noticed and documented that the exhaust system muffler was often located forward of the rear axle, and it had easily survived that same collision. So why not switch locations for the fuel tank and muffler?

Ford knew of the Mustang's problems from its own internal crash testing, all of which were kept confidential until Ford was forced to produce its reports in subsequent court cases. Ford typically conducted rear-impact crash tests at 21 and 31 miles per hour. The filler tube's rubber hose section came off the short metal filler neck of the tank, and the sheet metal fuel tank was crushed and punctured. Ford knew the Mustang's fuel tank was much too vulnerable and that leakage and fires would occur in real-world rear-impact accidents.

Along the way, Ford had become aware of the lethality of the vulnerable behind-axle fuel tank in the Mustang, Pinto, Maverick, Comet and many other models. The company explored ways to upgrade fuel-system integrity, such as by using a tough-skin bladder liner within the sheet metal fuel tank, a protective flak suit, a double-wall tank-in-tank safety fuel tank, and other measures that would have cost from $4 to $17 per car. But these fuel tank safety measures were never adopted for production.

As another case in point, Ford introduced the Pinto as an inexpensive compact car in 1971. The marketing goal was a 2,000-pound car that would sell for $2,000, but compromises would have to be made. The fuel tank was conventionally located behind the rear axle, but without substantial subframe members to help protect the tank within its short rear body (i.e., the rear crush zone). Ford's internal crash tests of prototypes and early production Pintos showed the leakage problem. In some tests, Ford used bladder liners as a potential upgrade and noted that although the fuel tank




Feasible location of the fuel tank for the Ford Pinto: #1 is lethal, #2 is less vulnerable, #3 is the safest location.

had been punctured in puncture-prone areas, thanks to the bladder liner no leakage occurred. But safety bladder liners were never adopted into production.

**Toward a Safer Design**

I decided to design and demonstrate what a safer fuel tank design would be like. While working on a product liability case in Georgia in late 1975, I redesigned the fuel tank system of a full-size Ford Galaxie sedan and replaced the deadly vertical behind-axle fuel tank with my own design for a fuel tank located in the safer forward-of-axle position. I then conducted an offset rear impact at 63 miles per hour, demonstrating in my "Phoenix Project" the feasibility and merits of this safer forward-of-axle design.

In 1980, I testified in the precedent-setting "reckless homicide" trial in Winamac, IN. This case arose out of a rear-impact accident in which a 1973 Ford Pinto burst into flames, tragically killing three teenage girls. Because of massive media coverage, I felt this was an opportunity to teach the industry that the safest place for a fuel tank was in the protected area forward of the rear axle. Though Ford was acquitted, the compassionate message had gone out loud and clear: To prevent the fiery crashes, move the fuel tank.

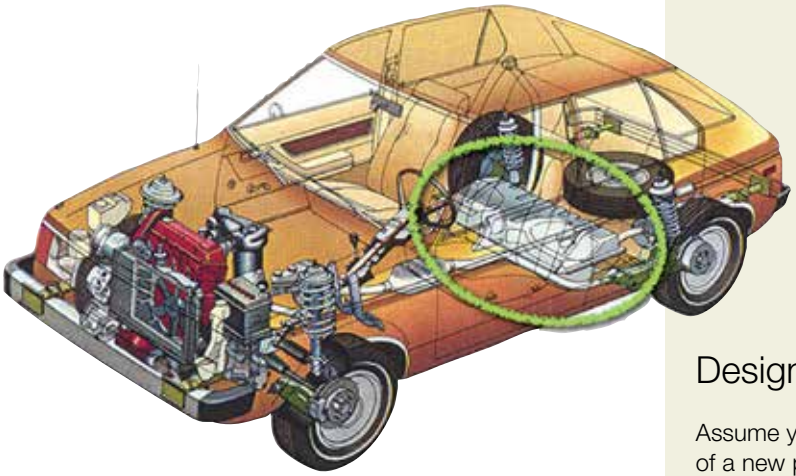
In the 1970s and '80s, I had become strongly outspoken in urging the industry to adopt the forward-of-axle location, as some automakers (such as NSU Motorenwerke and BMW) had already done or were beginning to do. I criticized unsafe fuel tanks in my own auto safety reports on KABC TV news in Los Angeles and in the *20/20* newsmagazine report "Beyond the Pinto." When Ford in 1985 introduced its all-new Taurus, I was invited to the premiere in Los Angeles and met with Ford President Donald Petersen, who was aware of my safety criticisms. He proudly showed me that the new Taurus had its fuel tank forward of the rear axle. Ford was indeed moving forward.

Automakers knew that many of their cars had unsafe fuel tank designs. As just some examples, Ford had the Mustang, Pinto, Maverick, Comet, Montego and Galaxie. GM had the Chevette, Vega, Camaro, Firebird, Chevelle and Omega. Chrysler had the Challenger, Barracuda, Dart, Duster and Volare. AMC had the Gremlin, Javelin and Jeep Cherokee. Toyota and Nissan and other automakers also had vulnerable fuel tanks. Automakers knew from their own internal crash tests, that when these cars would be rear-impacted in common accidents, there was too often a lethal fuel-fed fire in which people would suffer severe or fatal burns. Automakers also knew from the lawsuits filed by the burn victims.

Through the 1960's, '70s and '80s, the fuel tank in most cars was located within the rear crush zone, exposing the fuel tank to being crushed punctured and ruptured in common rear-impact accidents.

Some cases settled prior to trial, while others were decided by a jury verdict. In the 1978 California trial of *Grimshaw v. Ford*, involving the Pinto, the jury awarded $3 million in compensatory damages and $125 million in punitive damages (later reduced by the judge) for Ford's corporate behavior of malice. In 1981 the California Appellate Court affirmed that judgment: "There was evidence that Ford could have corrected the hazardous design defects at minimal cost but decided to defer correction of the shortcomings by engaging in a cost-benefit analysis balancing human lives and limbs against corporate profits." Hopefully, Ford has since mended its ways.

What about measures to upgrade the crash survivability of the fuel tank? Why did most automakers (including GM, Ford, Chrysler, American Motors, Toyota and Nissan) settle for too low a performance requirement for fuel tank safety? It appears that they only designed the fuel tank to comply with the Federal Motor Vehicle Safety Standards, which are by law only *minimum* requirements. A recent US Supreme Court opinion in *Williamson v. Mazda* further affirmed that complying with Federal Safety Standards is not enough. And why did Ford wait 40 long years until 2005 before finally moving the Mustang's fuel tank from its dangerous behind-axle location to the safer forward-of-axle location?



After a needless delay of 20 to 30 or more years, most vehicles are finally designed with the fuel tank in the safety zone forward of the rear axle.

**What Would You Do?**

Back in the 1970s and '80s, when the vast majority of fuel tanks were behind the rear axle, there were about 700 burn deaths annually in rear-impact accidents. Now that virtually all vehicles have the fuel tank forward of the rear axle, there are about 100 burn deaths per year. A simple design change brought greater safety, yes, but there's still more to do to get the fiery death toll down to zero. And with about 35,000 fatalities in all US vehicle accidents per year, and 1.3 million worldwide, there's clearly a compelling need to design more crashworthy vehicles for all collision situations.

As you read through this summary of Ford and fuel tank safety issues of the Mustang and Pinto, what would your recommendations have been? Would you have gone along with keeping the fuel tank near the rear bumper? Would you have been outspoken in urging design changes so that the fuel tank would be in a safer location forward of the rear axle? Does your own expertise and focus and compassion as an industrial designer include always making safety a high priority in the products you design?

When you consider safety, you should realize this is not just a technical issue. The quality of *compassion* must be inherent, since the consequences of compromising safety in product design may lead to or cause severe injury or death to other human beings. When vehicle manufacturers design needlessly unsafe fuel tanks or weak roofs that buckle and crush down in rollover accidents or fail to provide side guards on large trailers, that lack of compassion leads to many thousands of individuals needlessly suffering severe to fatal burn injuries, quadriplegia and other disabling conditions. Safety and compassion are intrinsically tied together, and lives are at stake in however you design a product. ■

## Design for Safety from the Beginning

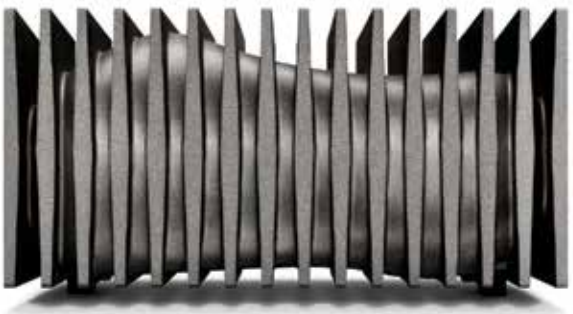
Assume you're an industrial designer working on the design of a new product. Individually, and possibly as a member of a multidisciplinary team, you should identify the foreseeable and potential inadvertent uses of the product to ensure that the design of the product is safe and will not cause or contribute to any harm to the user or others who may become affected by the product's performance, whether intended or adverse or inadvertent.

You should also analyze the experiences of prior similar products, including competitive products, to learn the reasons that they failed and caused harm, and then correct the flaws in your own design. You should conduct a failure modes and effects analysis (FMEA) to analyze any potential product failures and the adverse effects therefrom, and then correct the deficiencies.

Your team should conduct risk assessments that can describe how accidents may occur and the consequences and costs that may ensue. Be aware that the company (your client) may have to defend any product liability legal cases alleging that the product was defectively designed and unreasonably dangerous. That defense will involve significant legal costs for defense attorneys and defense experts and will have an adverse effect on insurance costs.

By taking leadership in designing a safer product in the first place, accidents and injuries will be prevented, the costs of defense will decrease, and the payouts in settlements and verdicts will be reduced. You will have compassionately helped to prevent accidents and injuries, and thereby also prevented risks and costs for your client. A win-win for all.

**For More Information:** The compromise of fuel tank safety, roof crush in rollover accidents and the truck underride hazard were part of Bloch's presentation at the 2013 IDSA International Conference. To see the presentation, please go to: www.idsa.org/byron-bloch-fighting-ensure-safer-vehicles. To see the Smithsonian website story of Bloch and the Indiana Pinto trial, please go to http://amhistory.si.edu/onthemove/themes/pdf/autosafety_byron_bloch.pdf.



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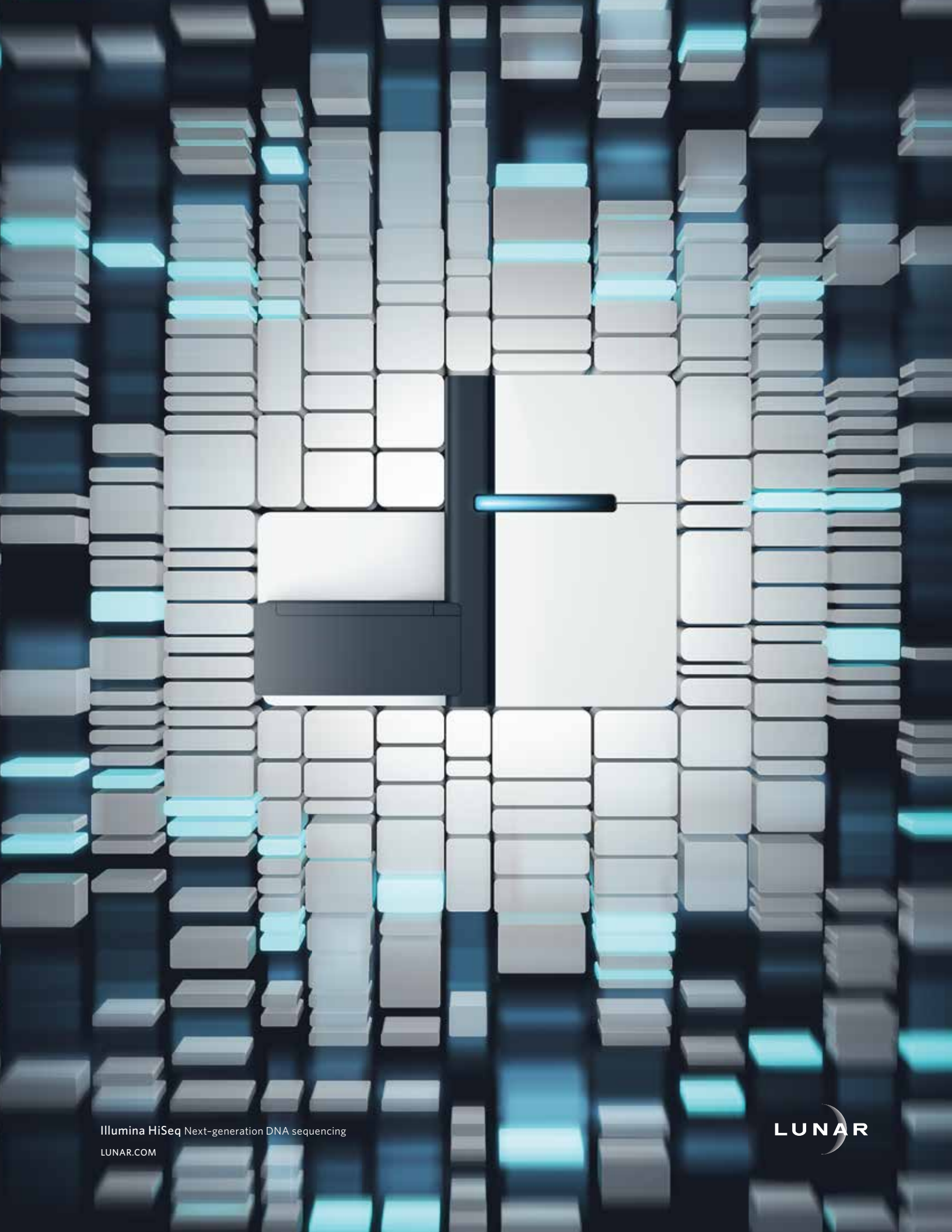
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