The Future of Mobility and Shifting Risk

RISK + INNOVATION | PART 8 IN A SERIES

www.aig.com/innovativetech

Foreword by:
Professor Emeritus Robert W. Peterson, Former Director of the Center of Insurance Law and Regulation at Santa Clara University School of Law; Former Chair of the Standing Committee on Insurance Law of the State Bar of California
Professor Dorothy Glancy, Professor of Law at Santa Clara University School of Law; JD, CIPP/US (Certified Information Privacy Professional, United States)

Introduction by:
Lex Baugh, CEO, AIG North America General Insurance
Gaurav Garg, CEO, AIG Personal Insurance

FOREWORD

CONTENTS

By Professor Emeritus Robert Peterson and Professor Dorothy Glancy, Santa Clara University School of Law

Automobiles are already computers on wheels. A new car today may contain 100 million lines of code. Virtually all vehicle manufacturers and a number of high tech companies are working to move vehicle automation to the next levels — automated, self-driving and completely driverless. Inevitably, the role of the traditional human driver will decrease and the role of technologies will increase. These changes will also shift the allocation of risk in new and challenging ways among vehicle users, vehicle manufacturers, suppliers, and insurers. Some current risks may disappear while newer ones appear.

Autonomous vehicles (one of the many terms commonly used to describe these vehicles) promise the potential of greatly reducing the number of deaths attributed to automobiles (currently about 40,000 per year in the U.S.) and injuries from vehicle crashes. Over 90 percent of today's roadway deaths and injuries are due to human error.

Autonomous vehicles may also increase convenience, enhance productivity, and even change our landscape. The large portion of city space devoted to parking, for example, may be converted to better uses. Commuters may be willing to travel longer distances, since travel time could be devoted to multitasking.

Public attitudes towards autonomous vehicles will shape this future as regulators and legislatures respond to public concerns about risks and benefits from increased vehicle automation. Will the public accept giving up the steering wheel? What is the public view about who is responsible for vehicle crashes when they do occur? How will municipalities, which maintain infrastructure, be impacted? While some old risks (such as distracted driving) may fade, what are public attitudes towards new risks (such as software glitches)? Are risks of hacking or the risk of compromising private information of major concern to the public?

At this inflection point in the transformation of transportation technologies, information about public perceptions and attitudes is badly needed. Fortunately, AIG, one of the larger worldwide insurers with deep understanding of risk, has conducted surveys to explore these public attitudes. *The Future of Mobility and Shifting Risk* discusses the highly informative results of a survey of 1,000 driver-age people in the United States, as well as 400 Singaporeans and 400 residents of the United Kingdom.

Some of the results may be surprising. No fully autonomous vehicles are yet in the hands of the general public. Nevertheless, those surveyed expressed a wide range of attitudes and beliefs about the acceptability and safety of autonomous vehicles. Some of these views were not always congruent across the countries surveyed. Likewise, people surveyed entertained a wide range of views about who should be held legally responsible in the event of a car crash. Cybersecurity and privacy were also ranked high among respondents' concerns about automated driver assistance systems and driverless cars.
While many talented technologists are working on developing and improving autonomous vehicles, and developers are investing billions of dollars to make them

a reality, it is likely that automated and autonomous vehicles still exist only in the margins of the general public's imagination. Indeed, public experience may be limited to occasional news stories. It is human nature to find comfort in the familiar and to fear the unfamiliar. As autonomous vehicles emerge onto public roadways around the world so that more people can see them and ride in them, it is reasonable to anticipate that attitudes will change. How fast and in what ways these changes will occur remains to be seen.

The Future of Mobility and Shifting Risk and the data collected in the AIG surveys provide a storehouse of valuable information and a particularly useful starting place for moving into the future. The survey results counsel more education for the public and policy makers (some developers have already begun campaigns to do this), thoughtful evaluation of risk by people and enterprises up and down the supply chain, and imaginative approaches by insurers to enable these new transformations in personal mobility to come of age.

INTRODUCTION

By:
Lex Baugh, CEO, AIG North America General Insurance
Gaurav Garg, CEO, AIG Personal Insurance

The way we travel today is changing. We share rides. Cars park themselves. Driverless cars are being tested on public roads. When artificial intelligence and automation take more control over the operation of vehicles, they upend conventional wisdom about liability. As our mobility behavior changes, so too will the way we think about risk and exposure.

Road users deserve a voice in the conversation many in industry and academia are having about the future of mobility and how safe this new world will be. As the end users of driverless cars, and the people most directly affected by the risks associated with them, individual consumers must be part of the debate. They are the voters who decide whether to support autonomous vehicle testing grounds and regulatory pilot programs that allow for experimentation. They will sit on juries to decide how to allocate liability when accidents inevitably happen. And they will evaluate government and industry responses should a cyber breach occur.

The constant in this change is that risk will not simply disappear. It will shift, largely from human to machine, blurring the lines between personal and commercial risks. What is not clear is where the exposure will lodge itself or how quickly it will move. Is it between auto manufacturers, software developers, and parts manufacturers? Perhaps the road construction companies and local governments responsible for infrastructure that "speaks to" vehicles? The communications providers, or a new enabling technology not yet invented? Answers to these questions will be debated for quite some time. Responses will vary by experience and may be informed by age and colored by geography and cultural disposition. No doubt perceptions will evolve over time. This paper begins to plot that journey. Included where relevant is an analysis of perceptions of 1,000 road users in the United States, 400 in Singapore, and 400 in the United Kingdom.

The overall idea of risk shifting with the future of mobility, poll questions, and analysis were carefully vetted by experts at Santa Clara University School of Law, Professor Emeritus Robert Peterson and Professor Dorothy Glancy. We are grateful to their years of studying this topic, and for their feedback that has enriched this analysis.

> The constant in this change is that risk will not simply disappear. It will shift, largely from human to machine.

HISTORY OF AUTONOMY

Where it Began

Vehicles with minds of their own began as science fiction only a short time ago. The 1911 short film "The Automatic Motorist" warned of potential peril in trusting robot drivers.[i] In the 1953 short story "Sally," the author and technology visionary Isaac Asimov imagined a future where autonomous vehicles — those equipped with what he called "positronic" brains — would be the only vehicles on the road.

Five years later that vision started to become real. In 1958, autonomous features were first made available to consumers when Chrysler introduced "auto-pilot" — now called cruise control. Anti-lock brakes began appearing in automobiles in the 1960s. It wasn't until 1985 that the Defense Advanced Research Project Agency (DARPA) and Martin Marietta (now Lockheed Martin) introduced the first truly self-driving vehicle. Named the Autonomous Land Vehicle, the tank-like vehicle used an early version of Light Detection and Ranging (LIDAR) to map its surroundings and drive itself. This first test required six racks of computers to process its driving algorithms, and the vehicle could only travel short distances at extremely low speeds.[ii] Commercialization remained in the distant future.

In 1995, researchers in Germany and the United States raced to develop vehicles that steered themselves using images of the surrounding road. A human driver controlled the brakes and acceleration in the U.S. car, which steered itself on a trip from Pittsburgh to San Diego. Meanwhile, the Germans conducted a drive from Germany to Denmark with computers controlling steering, acceleration and brakes.[iii]

Another decade after the U.S./German feats, DARPA challenged inventors to develop autonomous vehicles capable of traveling a 150-mile rural route from California to Nevada. The best-performing car, from Carnegie Mellon University, made it less than 8 miles. But five vehicles completed the course the following year. In 2007, six vehicles completed a 60-mile urban course that required them to navigate more complicated roads shared with other vehicles.[iv] The Stanford University car won this Urban Challenge. The DARPA challenges spurred aggressive development and provided a proof of concept for autonomous vehicles that would launch another 10 years of rapid transformation, ensuring that the future is autonomous.

A Period of Rapid Change

In the 10 years since DARPA's transformative challenges, autonomous technology has grown by leaps and bounds. Today, autonomous features — called automated driver assistance systems (ADAS) — are standard features in many new cars. Along with the well-established cruise control, anti-lock brakes and electronic stability control, newer technology such as emergency braking and self-parking are among the most common autonomous features.

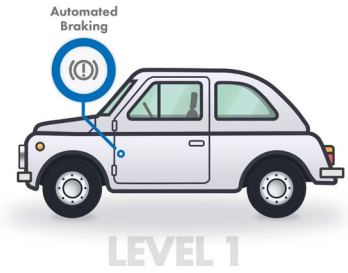
While consumers have yet to personally experience fully driverless vehicles, testing and development are underway around the globe, with major car manufacturers, technology companies and academic institutions all investing in innovation. The underlying concept is now a reality. And the pace of development is occurring quickly, bringing along new and complicated questions about technological development, modernization of infrastructure, security, safety, and insurance.

The incremental introduction of various automated features, some of which require more driver input than others, is happening today. The constant toggle between who or what is in control of the vehicle complicates the understanding of who or what is liable. An understanding of the various degrees of automation is critical to understanding the evolving risk landscape.

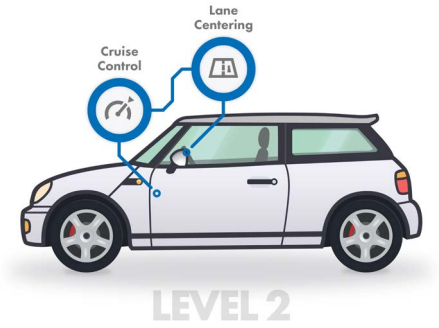
6 Levels of Autonomy

The industry generally recognizes six levels of autonomy, as outlined by SAE International, a global association of more than 128,000 engineers and related technical experts in the industry:[v]

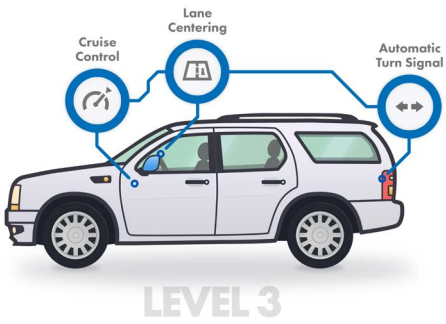
Level 0 (No Automation): The human driver is in complete control of the vehicle at all times.



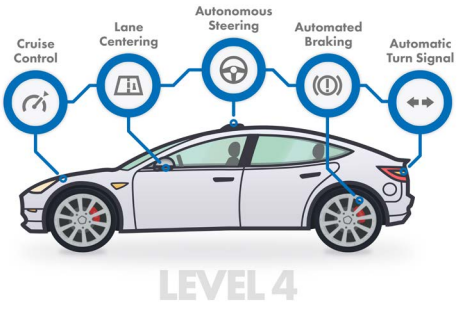
Level 1 (Driver Assistance): The human driver remains in active control, but one or more specific functions is automated. This could include features such as automated braking/acceleration, lane centering, etc. In Level 1 automation, risk begins to shift to the mobility innovators when an automated function does not work as intended.



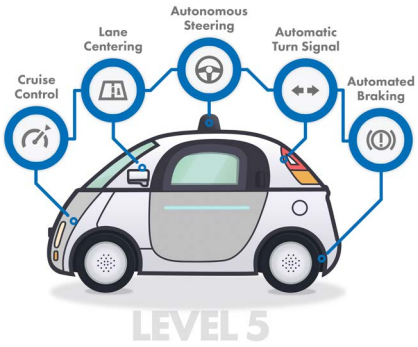
Level 2 (Partial Automation): The human driver remains in control, but the vehicle is capable of combining autonomous features such as steering and acceleration/deceleration. As with Level 1, at Level 2 risks will continue to shift to the mobility innovators when automated functions do not work as intended.



Level 3 (Conditional Automation): The driver is available and expected to take control of the vehicle under some conditions, but all critical functions are automated under other conditions. At Level 3 automation, more risks shift to the mobility innovators. New risks, such as responsibility for ensuring reasonable use by drivers, also begin to emerge for mobility innovators.



Level 4 (High Automation): The vehicle can operate itself in all situations within its operational design domain without requiring a human driver to intervene or take control, but retains optional human controls. At Level 4, virtually all risk rests with mobility innovators.



Level 5 (Full Automation): The vehicle can operate itself without a human driver under all roadway and environmental conditions, and has no means for control by human occupants.

AUTONOMOUS TECHNOLOGY AND ADOPTION

The rate of progress in ADAS and driverless car technology is nothing short of astounding. It's estimated that by 2025, 40 percent of cars on the road globally will have ADAS systems, up from 10 percent in 2015.[vi] Others predict "fully automated chauffeuring, driverless operation on highways, platooning, and highly automated driving in urban areas are expected to be available by 2025."[vii]

By 2030, ADAS will be present in 50 percent of cars on the road, and up to one-third of vehicles are likely not to have a driver at all by 2035.[viii]

A wide range of manufacturers are promising major ADAS and driverless developments in the coming years. In October, Cadillac allowed a reporter to test its "Super Cruise" feature, which takes full control during highway driving, on a trip from New York City to Washington, D.C.[ix] Waymo, the self-driving company owned by Google's parent company Alphabet, announced in November that it is taking the human "safety drivers" out of its self-driving cars.[x]

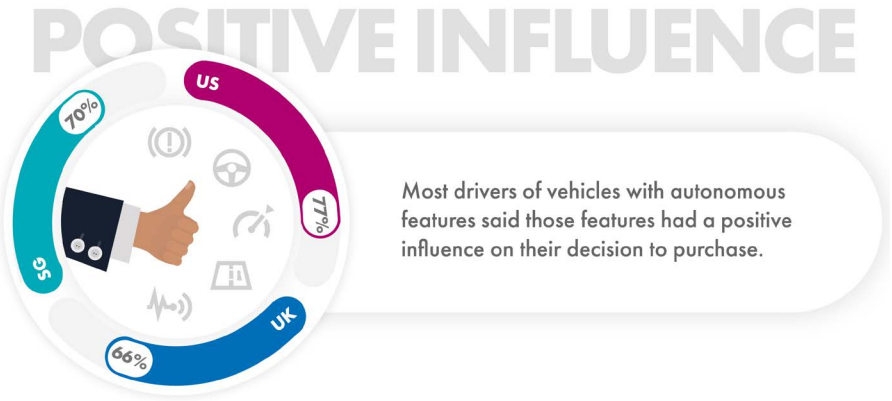
Tesla had promised a coast-to-coast autopilot demo by the end of 2017. General Motors and Lyft are partnering to test fleets of electric self-driving cars in 2018. By 2020, Renault-Nissan promises a highly autonomous vehicle capable of navigating complicated city traffic. Toyota, Volvo, BMW (with partners Intel and Mobileye), Daimler and Ford are all eyeing fully autonomous vehicles by the early 2020s. Honda and Hyundai are reportedly only a few years behind, with expectations of realizing Level 4 or 5 vehicles by 2025 and 2030, respectively.[xi]

Available technology does not mean adopted or on-the-road technology, however, and aggressive predictions may not come to fruition without significant regulatory action to drive adoption. As Santa Clara University professors Dorothy Glancy and Robert Peterson noted in their 2016 report, "A Look at the Legal Environment for Driverless Vehicles," "Electronic Stability Control (ESC) has been required on all light vehicles since 2011, yet the Insurance Institute for Highway Safety (IIHS) and Highway Loss Data Institute (HLDI) estimate that there will not be 95 percent penetration of ESC until 2030. Since self-driving cars are not mandated and will not be available for several years, one might expect the penetration of self-driving cars to take even longer than ESC."[xii]

How and when the public expects to use driverless vehicles

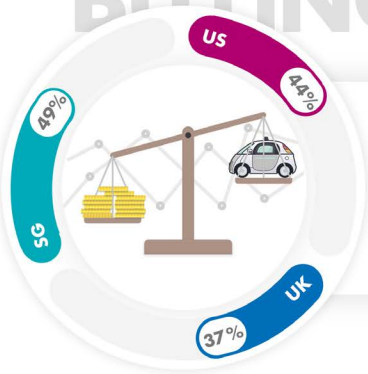
In our survey of the general public, 1 in 5 adults in the United States and Singapore, and 1 in 4 adults in the United Kingdom, self-identify as a current driver of a vehicle with automated assistance systems such as emergency braking, lane departure avoidance, or features that make the vehicle capable of self-driving part of the time. Three-quarters of those U.S. drivers (77 percent) and two-thirds of those UK and Singapore drivers (66 percent and 70 percent, respectively) said autonomous features had a positive influence on their decision to purchase their current vehicle.

> A wide range of manufacturers are promising major ADAS and driverless developments in the coming years.



Among the 4 in 5 U.S. adults who don't currently drive a vehicle with autonomous features, 44 percent said they would buy, rent, share or travel in a vehicle with those features. Thirty-seven percent of UK drivers and 49 percent of Singapore adults who don't currently drive a vehicle with autonomous features said they think they would buy, rent, share or travel in a vehicle with those features.

BUYING INTEREST

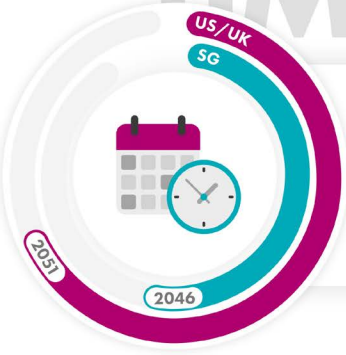


Among adults who don't currently drive a vehicle with autonomous features, many said they would buy, rent, share or travel in a vehicle with those features.

One-quarter of Singapore adults, 28 percent of U.S. adults and 33 percent of UK adults said they would not buy, rent, share or travel in a vehicle with autonomous features.

Though interest in autonomous features is strong, the public in the U.S. and UK are less welcoming than experts when it comes to the wide deployment of driverless vehicles. While experts predict that up to one-third of vehicles are likely not to have a driver at all by 2035,[xiii] on average adults in the U.S. think it will be 2039 before driverless cars represents more than 20 percent of vehicles on U.S. roads. Adults in the UK believe it will be 2040 before driverless cars represent more than 20 percent of vehicles on UK roads. Both groups expect it will be 2051 before driverless vehicles represent the majority of vehicles on road in their respective countries.

TIMETABLE

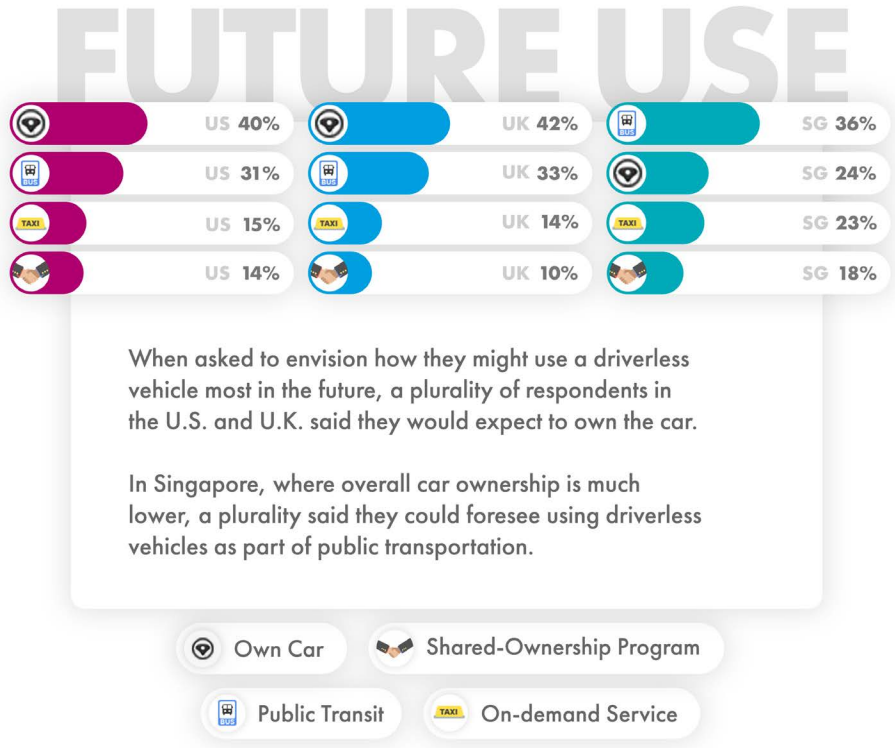


On average, adults in both the U.S. and U.K. expect it will be 2051 before driverless vehicles represent the majority of vehicles on road in their respective countries. Drivers in Singapore expect to hit the same milestone by 2046.

Singapore drivers foresee driverless cars being common more quickly than their counterparts in the U.S. and UK

Singapore drivers foresee driverless cars being common more quickly than their counterparts in the U.S. and UK On average, adults in Singapore expect driverless cars to represent 20 percent of cars on the road by 2035, four to five years earlier than drivers in the U.S. and UK Singapore drivers anticipate driverless cars representing the majority of vehicles on the road by 2046.

The U.S. and UK general publics also tend to disagree with experts on how they will utilize driverless vehicles. When asked to envision how they might use a driverless vehicle most in the future, 40 percent of U.S. respondents and 42 percent of UK respondents said they would expect to own the car, compared to 31 and 33 percent who envision using driverless public transit, 15 and 14 percent who expect to use a subscription or on-demand service, and 14 and 10 percent who expect to participate in a shared-ownership program.



In Singapore, where overall car ownership is much lower, 36 percent of adults said they could foresee using driverless vehicles as part of public transportation, with 24 percent expecting to own a driverless car, 23 percent expecting to use a subscription or on-demand service, and 18 percent expecting to participate in a shared-ownership program.

Consumers' expectation that they will largely own the driverless cars in which they travel stands in contrast to expert analysis that autonomous fleets are "potentially transformative" for manufacturers. One study predicted on-demand ride services could grow by eight-fold — to $285 billion — by 2030, and that autonomous fleet management "has the potential to be the biggest revenue pool in urban mobility."[xiv]

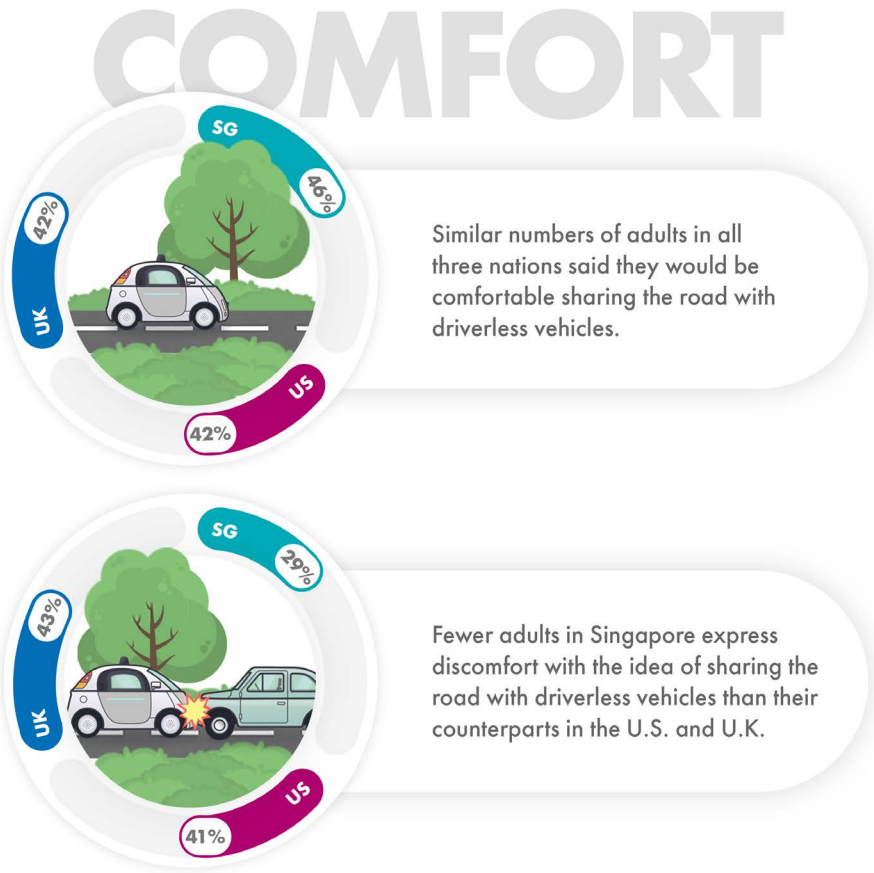
Another predicted, "urban consumers will use on-demand and car-sharing platforms to meet the majority of mobility needs. Car stock will shift from self-owned vehicles towards mobility fleets."[xv] Yet another estimated that by 2030, up to one in ten cars sold will be a shared vehicle, and up to 15 percent of new cars sold could be fully autonomous.[xvi]

Factors driving and delaying adoption

As adoption occurs, these technological advancements are expected to bring increased safety, fewer accidents, and a decline in the cost of automobile accidents. Some researchers predict vehicle autonomy will create a 90-percent reduction in accidents by 2050. While consumers see the potential for autonomous features and fully driverless vehicles to make roadways safer, they are not fully convinced.

Respondents in the U.S. and UK cited the possibility of safer roads as the most appealing benefit for cars with autonomous features, and the second-most appealing benefit for driverless cars behind easier, less stressful travel. Respondents in Singapore cited safer roads as the second-most appealing benefit for both autonomous vehicles and driverless cars. Yet when asked about how comfortable they would be sharing the road with driverless vehicles, respondents were split.

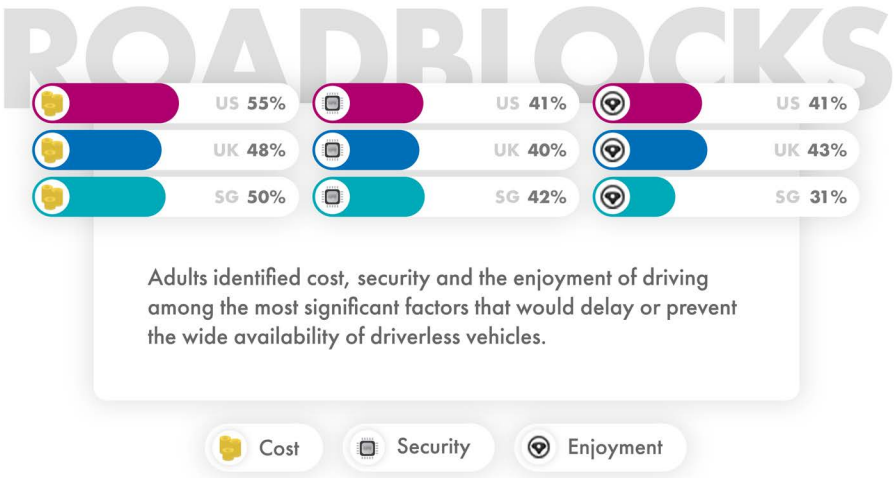
Forty-two percent of adults in the U.S. and UK said they would be comfortable sharing the road with driverless vehicles, but 41 and 43 percent said they're not comfortable in the U.S. and UK, respectively. Singapore adults expressed significantly less discomfort with sharing the road, at just 29 percent uncomfortable, although only 46 percent said they would be comfortable. One in four Singapore respondents weren't sure whether they would be comfortable or uncomfortable.



AIG's survey also revealed areas where uncertainty reigns supreme for consumers considering the future of mobility. The general public is especially concerned with safety, a major factor in liability. In order to alleviate consumers' concerns and to drive adoption, stakeholders across the autonomous spectrum will have to address the issue head-on. In a separate survey, 68 percent of Americans said they would change their opinion with a proven track record of safety.[xvii]

Thirty-nine percent (U.S.), 37 percent (UK) and 32 percent (Singapore) think driverless cars will be safer than the average driver. When asked if driverless cars will be safer than the respondent's own driving, just 29 percent, 27 percent and 22 percent respectively say yes.

Respondents in all three countries believe cost will be the biggest factor in delaying or preventing the wide availability of driverless vehicles, with 55 percent of U.S. adults, 50 percent of Singapore adults and 48 percent of UK adults identifying it as one of the top three factors. Forty-one, 42 and 40 percent, respectively, identified the security of computer systems to be a top-three factor in delaying availability of driverless vehicles.

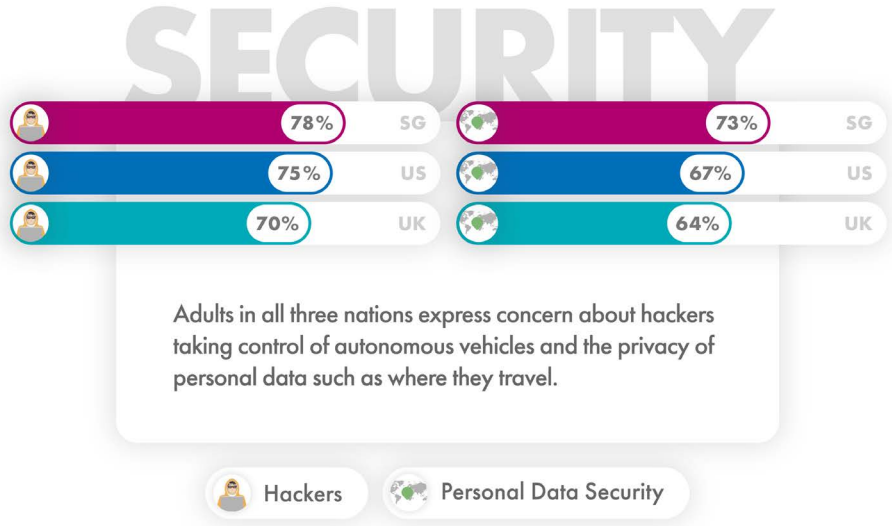


Forty-one percent of U.S. adults and 43 percent of UK adults cited people's enjoyment of driving as a major factor in delaying adoption, while only 31 percent of Singapore adults did. The difference may be a result of a less robust driving culture in Singapore. Just 53 percent of respondents in Singapore reported currently owning a car, compared to 85 percent in the U.S. and 79 percent in the UK

Respondents in all three countries believe cost will be the biggest factor in delaying or preventing the wide availability of driverless vehicles.

Security and reliability of driverless cars and data a major fear

Adults in all three nations see security as a significant barrier to adoption. Seventy-eight percent of respondents in Singapore, 75 percent of respondents in the U.S. and 70 percent of respondents in the UK expressed concern about hackers taking control of autonomous vehicles, while 73 percent, 67 percent and 64 percent respectively expressed concern about the privacy of personal data such as where they travel and when.



Forty-eight (U.S.) , 47 (Singapore) and 46 percent (UK) of respondents said their biggest concern about privacy would be a breach of personal information — such as credit card numbers to make gasoline purchases or address books to make phone calls — stored in the car. Twenty percent (U.S.) and 22 percent (UK and Singapore) cited the security of internet connections with the car as their biggest privacy concern, following by the car knowing where they travel (18 percent, 16 percent and 12 percent) and the car overhearing private conversations (9 percent, 8 percent and 10 percent).

The general public finds agreement with experts on the challenges related to the security and reliability of data transmission within and among autonomous vehicles, though the general public tends to overlook one key challenge: whether and how vehicles will communicate with one another.

One approach, initially proposed by the U.S. Department of Transportation, would require all vehicles to contain the same kind of vehicle-to-vehicle radio communication device that would standardize direct communication among vehicles of different makes running different software on different parts.

An alternative to this approach is for wireless companies to provide the networks on which cars and infrastructure will communicate. Such an approach could make those networks liable for the successful transmission of information among devices.

> The general public finds agreement with experts on the challenges related to the security and reliability of data transmission.

Beyond vehicle-to-vehicle and vehicle-to-infrastructure communications, questions loom regarding the vulnerability of driverless vehicle software systems. Even modern driver-operated vehicles are susceptible to "cracking" by outsiders who have demonstrated an ability to take control of vehicles through, for example, onboard entertainment systems. In one highly publicized demonstration, white-hat hackers took control of a vehicle on the road and brought it to a stop.

Sophisticated malware could take over control of a driverless car, or it could cause a driverless car to sense that the car is located in a place where it isn't. Spoofing can cause a vehicle to see things on the road ahead that aren't there. This kind of cyber vulnerability presents obvious and immediate safety risks to vehicle occupants.

A less immediate but equally real risk involves less invasive hacking. Where cracking a driverless system would give criminals control over the car, hacking a system would give them access to information stored in its systems, including potentially sensitive personally identifiable information about owners or occupants, such as their location or places they have visited.

Without the appropriate insurance coverage, parties will bear the cost of harm caused by cyber attacks. Depending on circumstances, there may be a claim against responsible parties for intrusion into the system - perhaps the software programmer or network provider. Of course the perpetrator/hacker would likely be long-gone and out of reach. Some communications networks may be subject to the FCC's mobile communications rules, some of which limit the carriers' liability.[xviii] However, the FCC has not yet spoken specifically about vehicle-based mobile communications.

To the extent that municipalities install or operate the communications systems that tell a car whether the light is green or red, for example, questions remain as to whether the municipality may be liable if the communications systems malfunction. Under current laws most municipalities are immune from liability unless they've waived immunity in some way.[xix]

Without the appropriate insurance coverage, parties will bear the cost of harm caused by cyber attacks.

ON PUBLIC PERCEPTIONS OF HACKING AND PRIVACY

By Dorothy Glancy

It is not surprising that consumers are uneasy about, even afraid of, driverless vehicles. Hacking of automated systems and mishandling of personal information are indeed among the important concerns reflected in the surveys. Media accounts of personal information exposure and stories about hacking exploits get a lot of press. Most late-model vehicles are indeed "hackable." Skilled computer engineers have, in fact, taken over control of automated vehicles from remote locations. In short, such concerns appear to be well-founded. However, some consumer uncertainties about ADAS and driverless vehicles are not uniquely about driverless vehicles.

Researchers, such as me, who have studied human reactions to driverless and automated vehicles over a long time have also noted what appears to be the influence of a psychological phenomenon known as neophobia — literally, aversion to the new. New ways of doing things, especially new technologies, seem inherently suspicious. (By the way, neophobia is not limited to adult human beings. The behavior of human infants, as well as of primates and other animals, seem to indicate innate neophobia.) So far, studies have not separated out this innate human aversion to the new (neophobia) from other reasons, such as safety, privacy, or cybersecurity concerns, for survey respondents in the U.S. and around the world to express reluctance about accepting driverless vehicles on their roads.

It is likely that human aversive reactions to increasingly comprehensive automated driver assistance or complete elimination of the human driver, are at least partially driven by neophobia. For example, it appears that human reactions to driver assistance automation (Level 2, where we are now) are less intense (as well as less negative) than reactions to Level 5 vehicles that will have no equipment which a human occupant could use to control the vehicle. Indeed, the main difference between SAE Level 4 and Level 5 automation is that familiar human controls are entirely eliminated from the vehicle in Level 5. Level 4 vehicles are defined by retaining optional controls (such as a steering wheel, accelerator and brakes) just in case the human occupants need or want to take over control of the Level 4 vehicle that is fully capable of driving itself in all circumstances.

Automobile manufacturers are acting on the premise that gradual "conditioning" of driver-age cohorts to ever greater degrees of automation will eventually lead to abeyance of neophobia and to widespread acceptance of driverless vehicles. So far this and other surveys seem to validate their premise.

An interesting feature of the results of the AIG survey is the suggestion that there is greater caution about advanced technology among younger people in the age-cohort 18-24. Surveys have shown caution among younger people in reaction to other new technologies. These survey results are especially interesting because caution about ADAS and driverless vehicles among older age cohorts may simply result from unfamiliarity with advanced technology in general and artificial intelligence in particular. But the younger age cohort has grown up with a broad range of technology. Young people are very familiar with both the helpful and dangerous sides of advanced technology.

Higher levels of concern related to hackers taking control of driverless vehicles seem to reflect extensive media reports about taking over control of vehicles. In contrast, there have been almost no media reports about vehicles exposing personal information. (In September, researchers at the Kromtech Security Center discovered that SVR Tracking, a company that uses GPS to locate cars for auto dealerships, had left more than a half a million ID records exposed on a publicly accessible web server. The records contained emails and login information, along with vehicle identification numbers, license plate numbers and data associated with the GPS devices installed on specific cars, but the exposure received little coverage outside the tech media.)[xx]

Over time, resistance to advanced vehicle automation attributable to innate neophobia and sensational media coverage are likely to abate. Increased experience with ADAS and driverless technologies should increase what the AIG survey reveals to be relatively low levels of understanding of ADAS and driverless vehicle technologies.

Still, significant cyber risks will remain associated with ADAS and driverless cars, including well-founded concerns both about hacking and about privacy threats. As I have written previously,

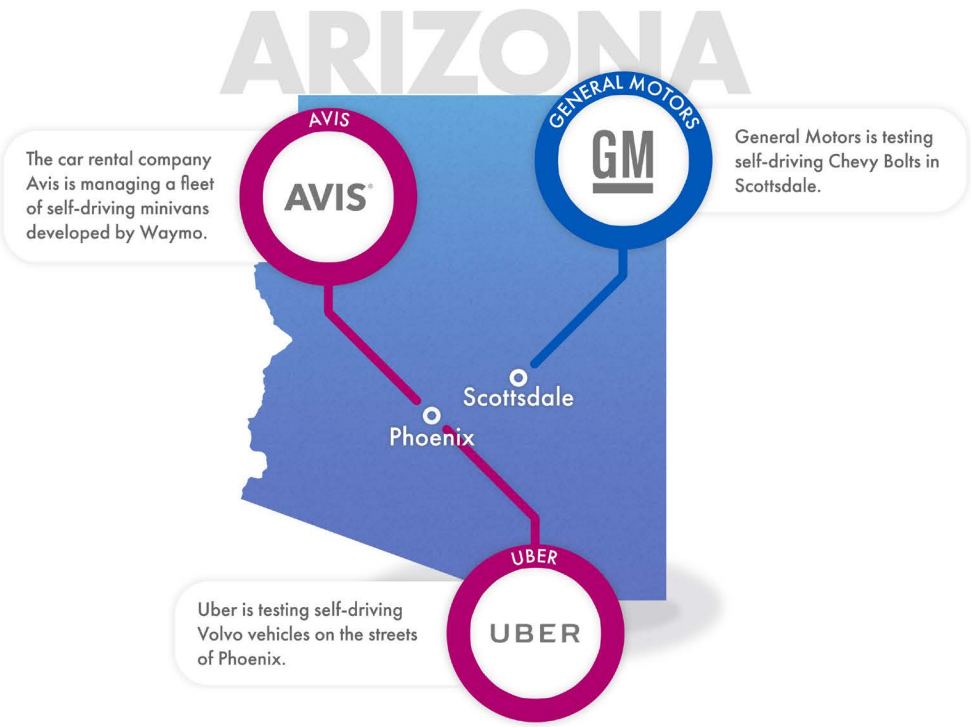
" Driverless cars on the road are likely to raise the importance of cybersecurity. Unlike most hacking today, malicious cyber interference with a driverless automobile could result in serious personal injury and property damage. At present, there is little financial motive to hack into cars; but this may change with the advent of ransomware and more widespread deployment of automated and driverless vehicles. State-sponsored cyberattacks causing mass disruption to critical transportation infrastructure, as well as potentially mass casualties, are also a matter that transportation officials rightfully take very seriously. For example, NHTSA is engaged in research on hacking and cybersecurity at its Transportation Research Center.

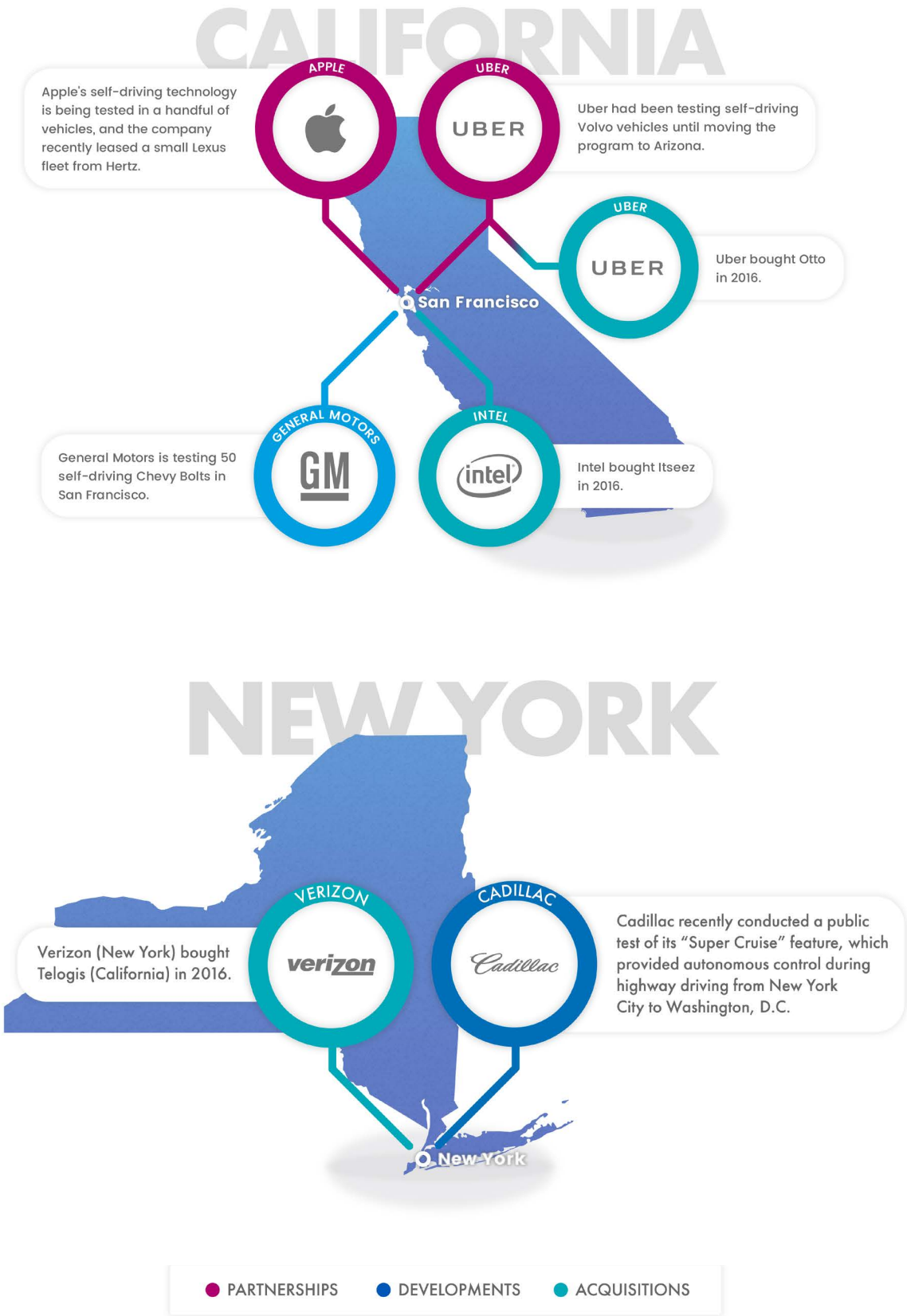
In addition, a driverless vehicle, or its manufacturer, may acquire data of a personal nature, such as a person's real-time location or places the person has visited over time. The potential for potential misuse of such personal information suggests that there may be an developing market, at least at the commercial level, for cyber insurance to cover these enhanced risks. Existing standard Commercial General Liability policies do not generally cover cyber risks such as harm caused by being hacked or by misusing personal information. Often coverage depends on whether there was 'property damage' or merely damage to electronic media and records. As liability insurers begin to add cyber exclusions to their policies to avoid coverage, wise consumers, as well as wise manufacturers and smart service providers, are beginning to pay attention to insuring against these new risks of harm that can result in potential liability."

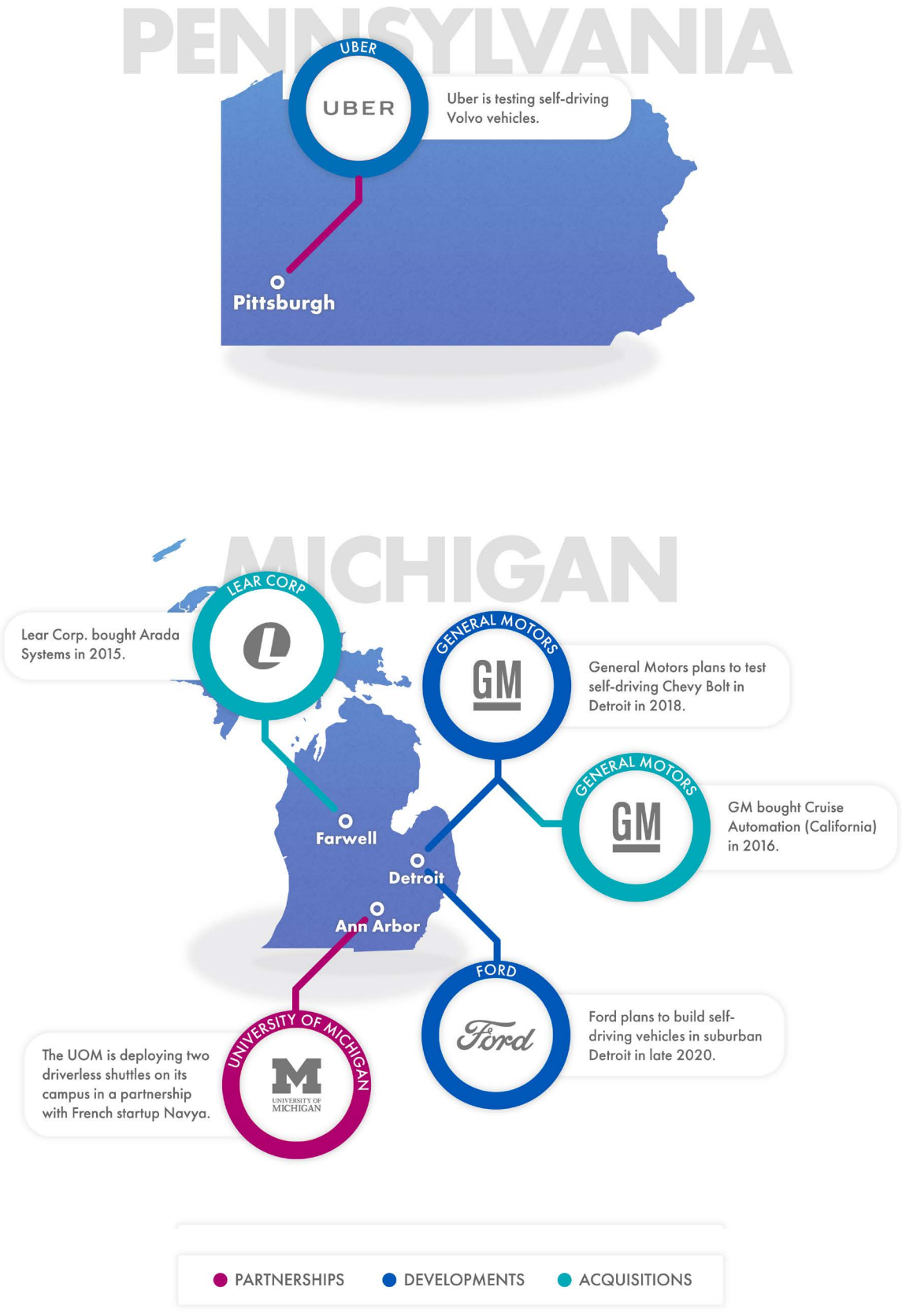
Still, significant cyber risks will remain associated with ADAS and driverless cars, including well-founded concerns both about hacking and about privacy threats.

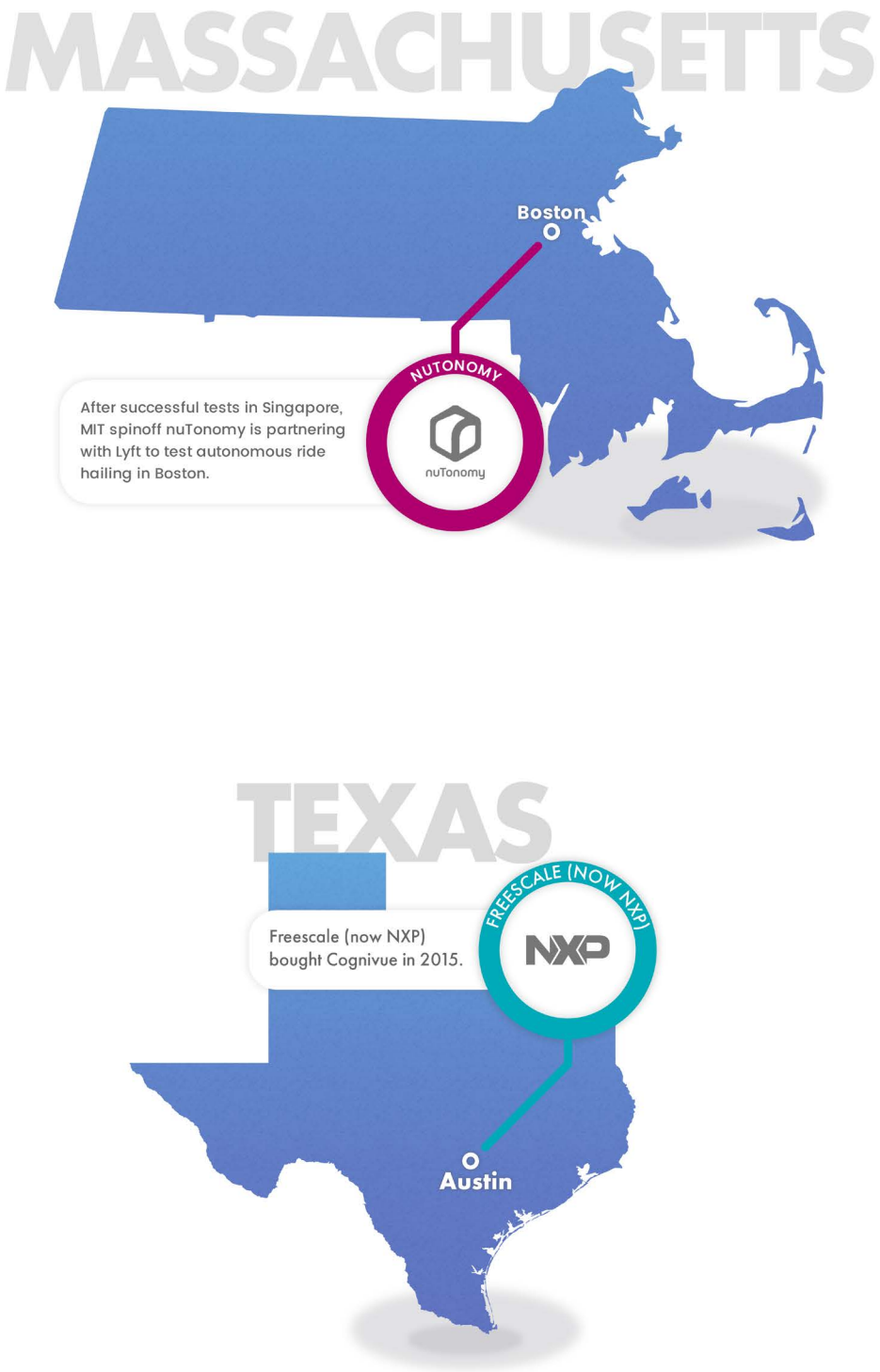
PARTNERSHIPS AND MOBILITY STRATEGIES

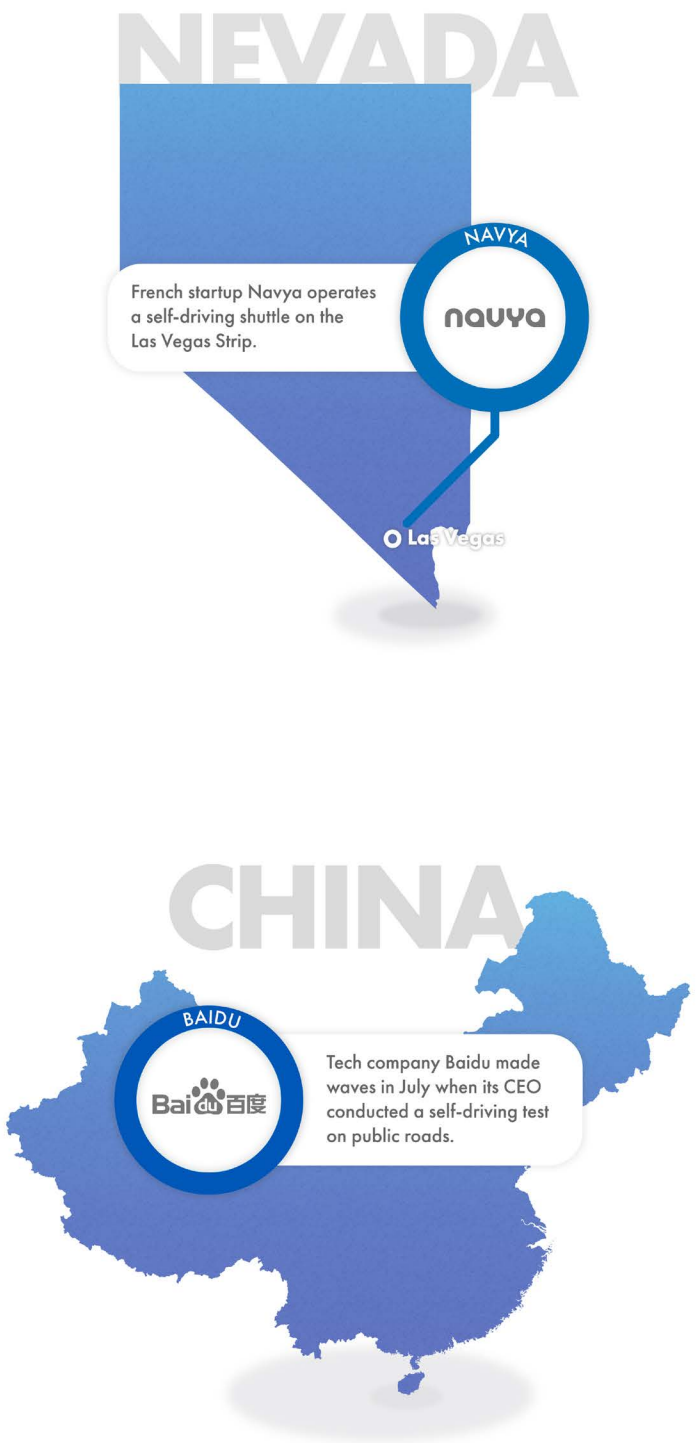
The rapid growth of partnerships among established auto manufacturers, traditional transportation companies and technology companies demonstrates the increasing interconnectedness of the vehicle industry. Development and testing of driverless vehicles are happening all around the world, from longtime technology-leading centers like Silicon Valley and Singapore, to new entrants like Pittsburgh, Pennsylvania, and Gothenburg, Sweden. Here are just a few:

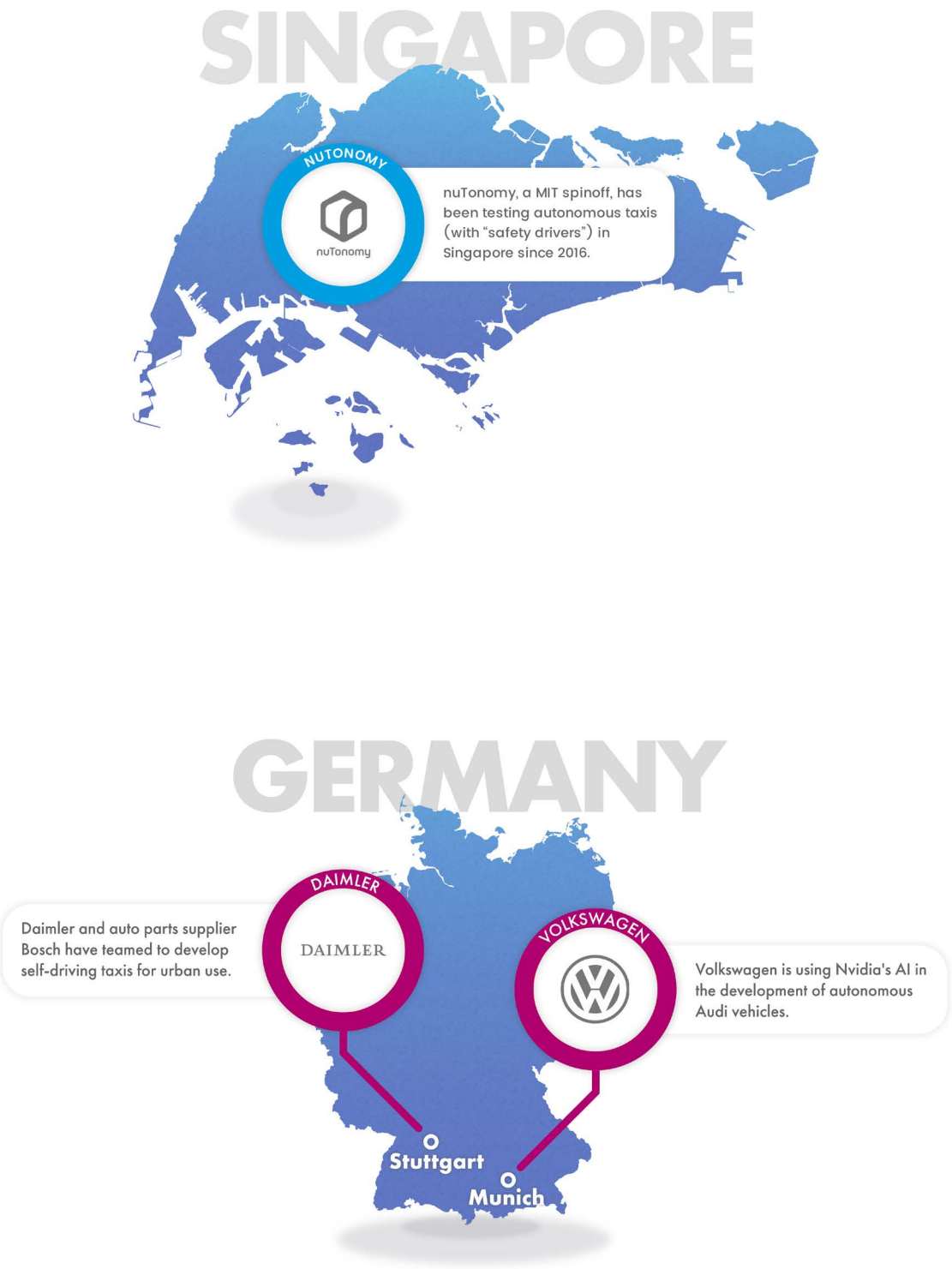



CALIFORNIA
APPLE
Apple's self-driving technology is being tested in a handful of vehicles, and the company recently leased a small Lexus fleet from Hertz.
UBER
UBER
Uber had been testing self-driving Volvo vehicles until moving the program to Arizona.
UBER
UBER
Uber bought Otto in 2016.
San Francisco
GENERAL MOTORS
GM
General Motors is testing 50 self-driving Chevy Bolts in San Francisco.
INTEL
intel
Intel bought Itseez in 2016.
NEW YORK
VERIZON
verizon
Verizon (New York) bought Telogis (California) in 2016.
CADILLAC
Cadillac
Cadillac recently conducted a public test of its "Super Cruise" feature, which provided autonomous control during highway driving from New York City to Washington, D.C.
New York
PARTNERSHIPS
DEVELOPMENTS
ACQUISITIONS

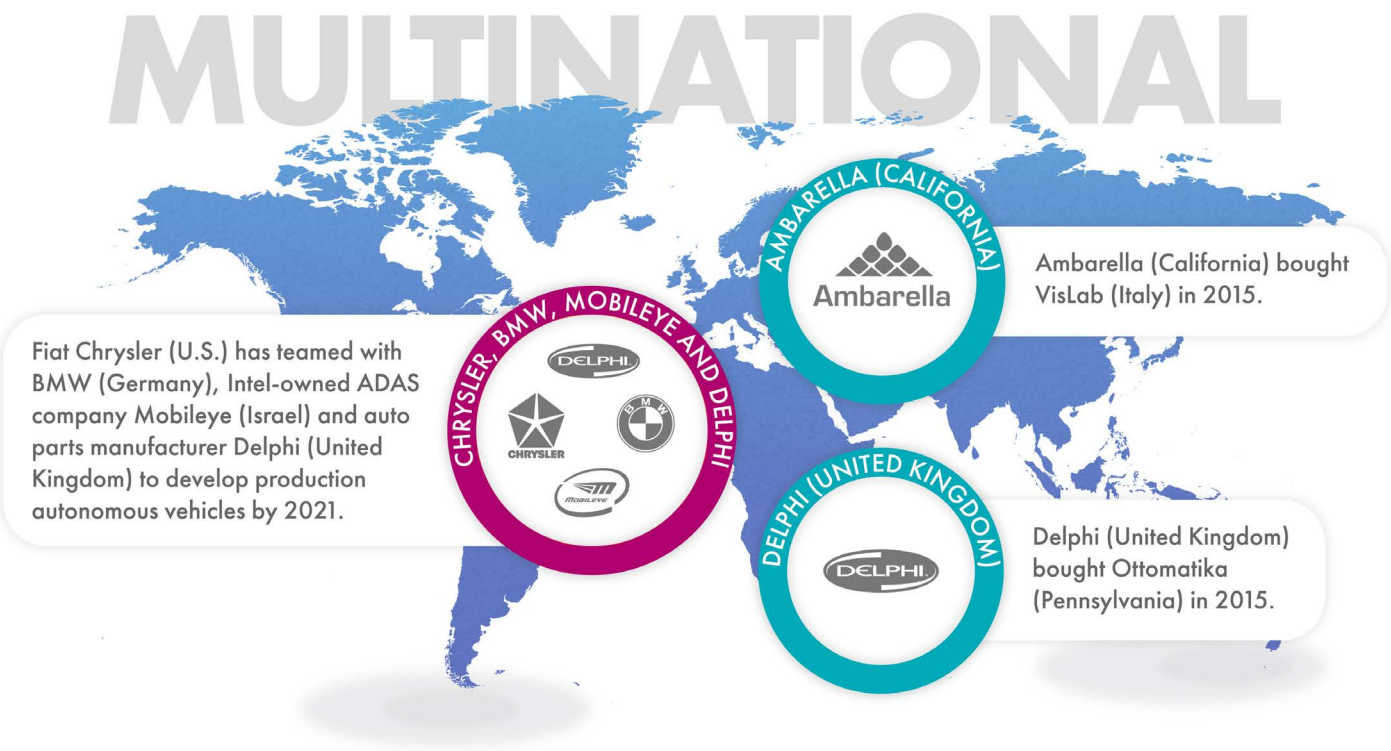

PENNSYLVANIA
UBER
UBER
Uber is testing self-driving Volvo vehicles.
Pittsburgh
MICHIGAN
LEAR CORP
Lear Corp. bought Arada Systems in 2015.
GENERAL MOTORS
GM
General Motors plans to test self-driving Chevy Bolt in Detroit in 2018.
GENERAL MOTORS
GM
GM bought Cruise Automation (California) in 2016.
Farwell
Detroit
Ann Arbor
FORD
Ford
Ford plans to build self-driving vehicles in suburban Detroit in late 2020.
UNIVERSITY OF MICHIGAN
UNIVERSITY OF MICHIGAN
The UOM is deploying two driverless shuttles on its campus in a partnership with French startup Navya.
PARTNERSHIPS
DEVELOPMENTS
ACQUISITIONS


MASSACHUSETTS
Boston
NUTONOMY
nuTonomy
After successful tests in Singapore, MIT spinoff nuTonomy is partnering with Lyft to test autonomous ride hailing in Boston.
TEXAS
FREESCALE (NOW NXP)
NXP
Freescale (now NXP) bought Cognivue in 2015.
Austin
PARTNERSHIPS
DEVELOPMENTS
ACQUISITIONS

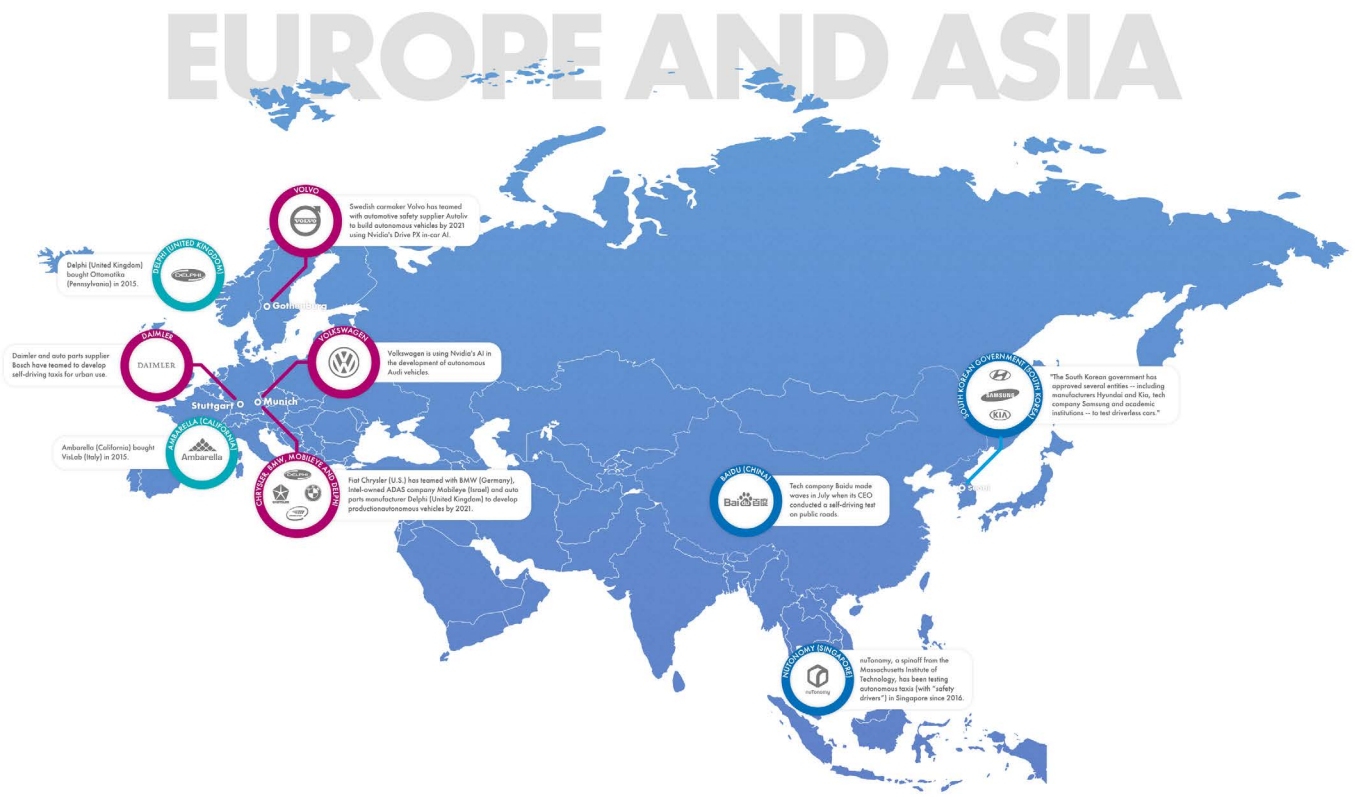

NEVADA
NAVYA
navya
French startup Navya operates a self-driving shuttle on the Las Vegas Strip.
Las Vegas
CHINA
BAIDU
Bai du 百度
Tech company Baidu made waves in July when its CEO conducted a self-driving test on public roads.
PARTNERSHIPS
DEVELOPMENTS
ACQUISITIONS


SINGAPORE
NUTONOMY
nuTonomy
nuTonomy, a MIT spinoff, has been testing autonomous taxis (with "safety drivers") in Singapore since 2016.
GERMANY
DAIMLER
DAIMLER
Daimler and auto parts supplier Bosch have teamed to develop self-driving taxis for urban use.
VOLKSWAGEN
Volkswagen is using Nvidia's AI in the development of autonomous Audi vehicles.
Stuttgart
Munich
PARTNERSHIPS
DEVELOPMENTS
ACQUISITIONS

PARTNERSHIPS DEVELOPMENTS ACQUISITIONS


MULTINATIONAL
AMBARELLA (CALIFORNIA)
Ambarella
Ambarella (California) bought VisLab (Italy) in 2015.
CHRYSLER, BMW, MOBILEYE AND DELPHI
DELPHI
CHRYSLER
BMW
MOBILEYE
Fiat Chrysler (U.S.) has teamed with BMW (Germany), Intel-owned ADAS company Mobileye (Israel) and auto parts manufacturer Delphi (United Kingdom) to develop production autonomous vehicles by 2021.
DELPHI (UNITED KINGDOM)
DELPHI
Delphi (United Kingdom) bought Ottomatika (Pennsylvania) in 2015.
PARTNERSHIPS
DEVELOPMENTS
ACQUISITIONS


UNITED STATES
General Motors plans to test self-driving Chevy Bolt in Detroit in 2018.
GM bought Cruise Automation (California) in 2016.
After successful tests in Singapore, MIT spinoff nuTonomy is partnering with Lyft test autonomous ride hailing in Boston.
Ford plans to build self driving vehicles in suburban Detroit in late 2020.
Lear Corp. bought Arada Systems in 2015.
Farwell
Detroit
Ann Arbor
Uber bought Otto in 2016.
Uber is testing self-driving Volvo vehicles.
Boston
New York
Uber had been testing self-driving Volvo vehicles until moving the program to Arizona.
Apple's self-driving technology is being tested in a handful of vehicles, and the company recently leased a small Lexus fleet from Hertz.
NEVADA
French startup Navya operates a self-driving shuttle on the Las Vegas Strip.
San Francisco
Las Vegas
The UOM is deploying two driverless shuttles on its campus in a partnership with French startup Navya.
Pittsburgh
Verizon (New York) bought Telogis (California) in 2016.
Cadillac recently conducted a public test of its "Super Cruise" feature, which provided autonomous control during highway driving from New York City to Washington, D.C.
General Motors is testing 50 self-driving Chevy Bolts in San Francisco.
Intel bought Itseez in 2016.
General Motors is testing self-driving Chevy Bolts in Scottsdale.
ARIZONA
Scottsdale
Phoenix
Freescale (now NXP) bought Cognivue in 2015.
TEXAS
The car rental company Avis is managing a fleet of self-driving minivans developed by Waymo.
Uber is testing self-driving Volvo vehicles on the streets of Phoenix.
Austin
PARTNERSHIPS
DEVELOPMENTS
ACQUISITIONS

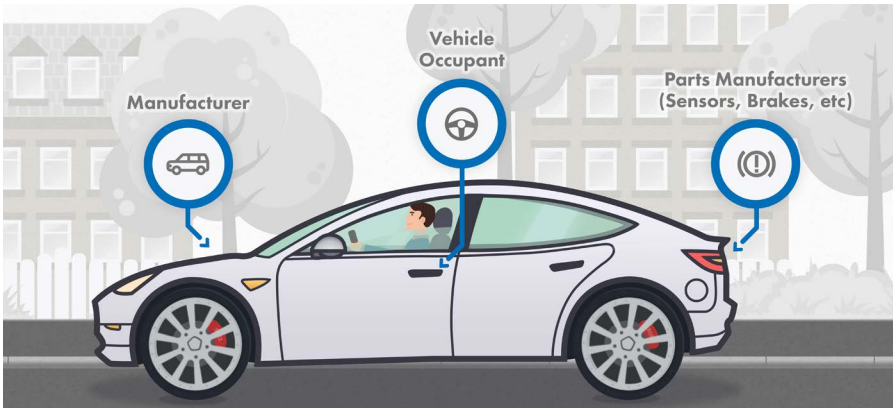

EUROPE AND ASIA
VOLVO
Swedish carmaker Volvo has teamed with automotive safety supplier Autoliv to build autonomous vehicles by 2021 using Nvidia's Drive PX in-car AI.
DELPHI (UNITED KINGDOM)
Delphi (United Kingdom) bought Ottomatika (Pennsylvania) in 2015.
Gothenburg
DAIMLER
Daimler and auto parts supplier Bosch have teamed to develop self-driving taxis for urban use.
VOLKSWAGEN
Volkswagen is using Nvidia's AI in the development of autonomous Audi vehicles.
Stuttgart
Munich
AMBARELLA (CALIFORNIA)
Ambarella (California) bought VisLab (Italy) in 2015.
CHRYSLER, BMW, MOBILEYE AND DELPHI
Fiat Chrysler (U.S.) has teamed with BMW (Germany), Intel-owned ADAS company Mobileye (Israel) and auto parts manufacturer Delphi (United Kingdom) to develop productionautonomous vehicles by 2021.
SOUTH KOREAN GOVERNMENT (SOUTH KOREA)
"The South Korean government has approved several entities -- including manufacturers Hyundai and Kia, tech company Samsung and academic institutions -- to test driverless cars."
BAIDU (CHINA)
Tech company Baidu made waves in July when its CEO conducted a self-driving test on public roads.
AUTONOMY (SINGAPORE)
nuTonomy, a spinoff from the Massachusetts Institute of Technology, has been testing autonomous taxis (with "safety drivers") in Singapore since 2016.
PARTNERSHIPS
DEVELOPMENTS
ACQUISITIONS

MOVEMENT OF RISK WITHIN AUTONOMOUS CARS

The vast majority of vehicles on the road today are considered Level 0, where human drivers are in complete control of the vehicle at all times. Risk and liability for Level 0 cars is relatively straightforward. Regulation and decades of case law support the assumption that at least one of the drivers involved in a collision is at fault, unless a manufacturing flaw or bad part or defective infrastructure caused the crash.[xxi]

While many questions remain about liability for fully driverless vehicles — those that never turn control over to a human operator — the biggest and most complex questions are around what some analysts are calling "the chaotic middle."[xxii] The chaotic middle is the time between now and fully driverless functionality, as Level 2 and Level 3 vehicles penetrate the market and the vehicles and humans share control over and responsibility for operating the vehicle.

As automation in vehicles increases incrementally, risks and liability for damages will evolve and shift from the driver and toward one or more of the entities involved in producing the cars, the car's parts (such as sensors), or the data used by the artificial intelligence to make operational decisions. In situations where the car rather than the human driver is in control, risk begins to shift to somewhere within the vehicle's systems, generating complexity for all parties including the insurers. Risk will also grow for the entities responsible for building and maintaining the roads and networks on which autonomous vehicles operate. The new community of mobility innovators includes:



- **auto manufacturers**
- **the companies that develop the algorithms and software that comprise an autonomous vehicle's artificially intelligent "brain"**
- **manufacturers of various parts and systems (from traditional parts such as brakes, belts, and fluid lines to new devices such as cameras, sensors, and communication tools)**
- **the entities that develop, maintain, and own infrastructure such as roadways and traffic lights**
- **the companies that build and maintain communications networks autonomous vehicles use to communicate with their networks and the cars around them**
- **suppliers of data such as mapping information**
- **and many more**

Regulators sense this shift coming. In guidance issued in September 2017, the United States Department of Transportation encouraged states to "begin to consider how to allocate liability among ADS owners, operators, passengers, manufacturers, and other entities when a crash occurs," adding, "For insurance purposes, determine who (owner, operator, passenger,

manufacturer, other entity, etc.) must carry motor vehicle insurance" and "begin to consider rules and laws allocating tort liability."[xxiii]

The UK government has begun soliciting views on how to develop insurance policies that cover product liability as it relates to automated vehicles. According to one study the current system, based on compulsory coverage for drivers, will require reshaping as the lines between human and artificial intelligence drivers continue to blur.[xxiv] Leaders in Singapore, too, have issued calls to review the insurance landscape and update it for "new and emerging" risks related to autonomous vehicles.[xxv]

Because human drivers are generally assumed to be responsible for accidents when they are operating a vehicle, all U.S. states require vehicle owners either to carry car insurance or to be personally financially responsible for damages. England leaves the liability on the vehicle "operator" regardless of fault and gives the insurer a subrogation claim, meaning the insurer can transfer responsibility to the manufacturer if the injury is caused by a defect. But that, too, raises new questions in an ADAS-equipped and driverless paradigm: What makes an occupant an "operator"? If a consumer orders a car with an app and pushes a "go" button, does that make her the operator?

Public perceptions of shifting risk

Consumers, too, sense the coming shift in liability. The general public expects autonomous features and driverless cars to continue presenting risk, and they see liability shifting as autonomous features take more control of the vehicle. Respondents were presented with several accident scenarios and asked to choose which entities they would consider most liable in each.

In cases where the respondent took on the role of the operator of a vehicle with autonomous features that struck a pedestrian in a crosswalk, they viewed themselves as most liable. In the United States, 54 percent cited "the driver" as most liable, compared to 33 percent selecting the manufacturer and 27 percent selecting the software programmer. In the UK, 57 cited "the driver" as most liable, compared to 30 percent selecting the software programmer and 25 percent selecting the manufacturer. In Singapore, 44 percent cited "the driver" as most liable, compared to 37 percent citing the manufacturer and 37 percent citing the software programmer.

In scenarios involving fully driverless vehicles, consumers do see risk shifting to other parties. When U.S. respondents were asked to assume that they were the occupant of a driverless vehicle that strikes a child, 50 percent named the manufacturer as most liable, followed by 37 percent naming the software programmer, 23 percent naming the vehicle occupant and 19 percent naming the vehicle owner who, in the case of driverless vehicles, may be another individual or a corporation.

In the same scenario, UK drivers cited the manufacturer and software programmer as equally liable, with 40 percent of respondents citing each as the most liable. Twenty-eight percent named the vehicle occupant and 19 percent named the vehicle owner as among the most liable.

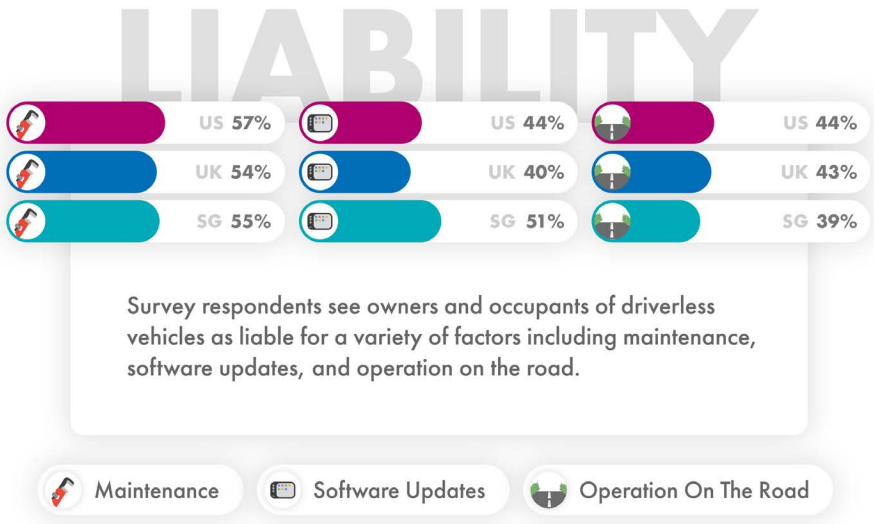
Singapore drivers also cited the manufacturer and software programmer equally, with 45 percent and 46 percent naming them most liable, respectively. Just 16 percent of Singapore adults cited the occupant and just 18 percent cited the owner of a driverless vehicle as among the most liable.

Software programmers are viewed as most liable (61 percent in Singapore, 56 percent in the U.S. and 50 percent in the UK) in cases where driverless vehicles crashed as a result of incorrect or misleading data, followed by manufacturers (40 percent, 42 percent and 36 percent), internet connectivity providers (26 percent, 26 percent and 24 percent) and the vehicle owner (18 percent, 18 percent and 21 percent).

Consumers expect that a variety of entities — including internet service providers, parts manufacturers, road construction companies, and local governments responsible for infrastructure — will shoulder varying degrees of liability for accidents involving cars with autonomous features and fully driverless cars.

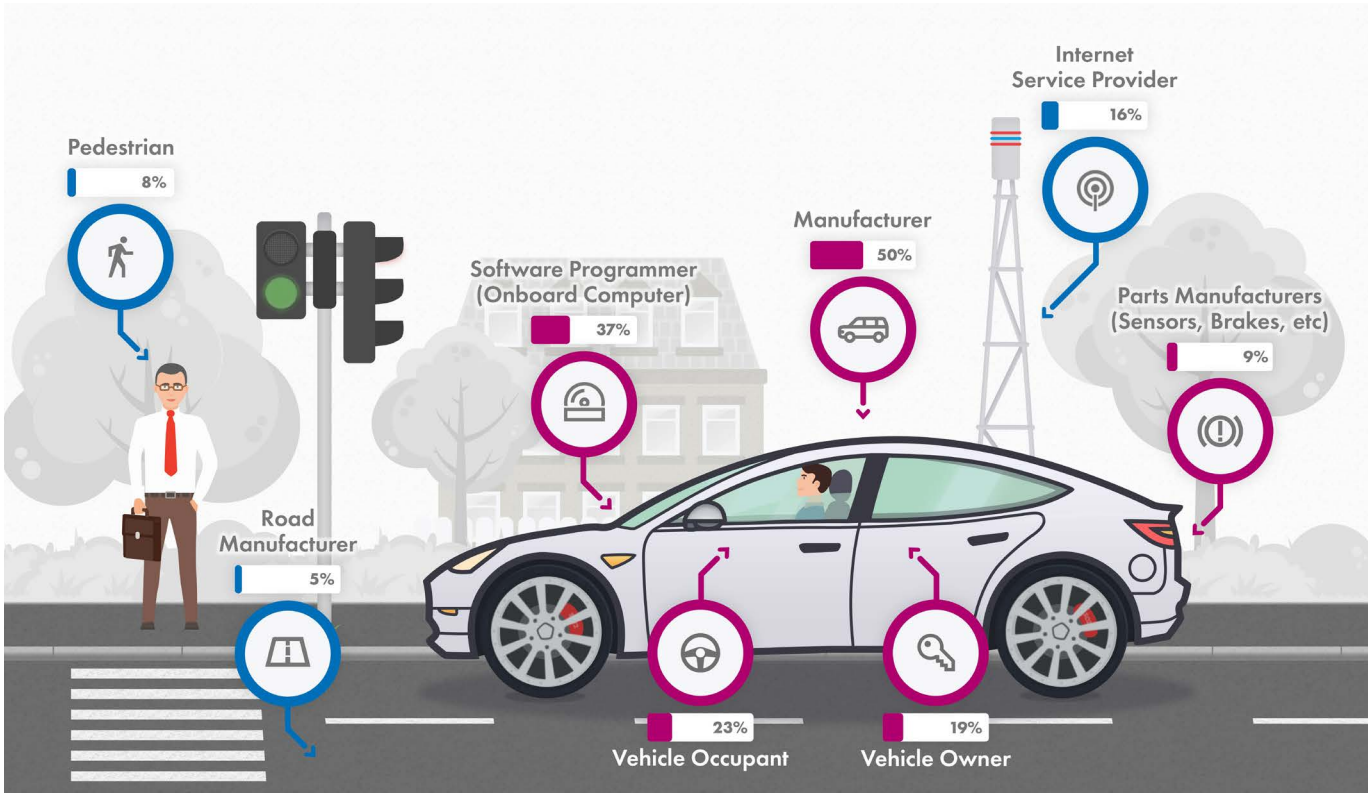
Fifty-seven percent of U.S. adults, 55 percent of Singapore adults and 54 percent of UK adults cited vehicle maintenance as holding the greatest potential for liability for the owner or occupant of a driverless vehicle. Forty-four percent (U.S.), 51 percent (Singapore) and 40 percent (UK) said owners and occupants face the most liability with regard to software updates, and 44 percent (U.S.), 39 percent (Singapore) and 43 percent (UK) said owners' and occupants' greatest risk exposure was related to operation on the road.

As these liabilities shift, the entities that take on risk will need to evaluate their exposure and take steps to protect themselves and their customers from financial harm.



WHO IS LIABLE IN A FULLY DRIVERLESS WORLD?

RISK SHIFTING FROM DRIVER TO A VARIETY OF ENTITIES INSIDE AND OUTSIDE THE CAR



Respondents to AIG's survey identified parties including the car manufacturer, software programmer, vehicle occupant, vehicle owner, parts manufacturer, internet service provider, pedestrian and road manufacturer as "most liable" in crash scenarios involving driverless cars.

COMPANY STATEMENTS ON LIABILITY

Some companies are making "bet the firm" decisions today on the basis of this shifting liability landscape. Knowing the mindset of the leadership at some companies shaping our future mobility landscape is an important stop along the way to understanding the whole picture. Some automakers are taking it upon themselves to address liability head on.

Swedish carmaker Volvo has announced it will accept liability whenever one of its vehicles is operating in autonomous mode.[xxvi] "We are the suppliers of this technology and we are liable for everything the car is doing in autonomous mode," Volvo Car Group President and CEO Håkan Samuelsson said in 2015. "If you are not ready to make such a statement, you shouldn't try to develop an autonomous system."[xxvii]

Mercedes and Google told CBS's "60 Minutes" that "if their technology is at fault once it becomes commercially available, they'll accept responsibility and liability."[xxviii]

"Any corporation putting its name on something that will be driven without a driver is going to [accept liability]," said Ron Medford, director of safety for Google's Waymo. "Regulation is fine, and we support efforts being made to make sure the vehicle is safe. But the primary responsibility will be with the manufacturer, because it has to be."[xxix]

Carmakers' willingness to publicly accept liability has been perceived as a signal that they are serious about driverless vehicles and want regulators to take them seriously too. "The U.S. risks losing its leading position due to the lack of federal guidelines for the testing and certification of autonomous vehicles," Samuelsson said in his 2015 remarks. "It would be a shame if the U.S. took a similar path to Europe in this crucial area."[xxx]

However, it remains to be seen how these public pledges will play out in practice. According to one report, Volvo's pledge, for example, would not cover "instances when a car operated in autonomous mode could not avoid the reckless actions of another vehicle."[xxxi] A General Motors spokesperson told CarAdvice in September that "it is too early … to say what liability will look like in the future."[xxx]

The fact is that under current law, carmakers may be liable for crashes caused by defects. If a carmaker's human safety driver causes a crash, they may be liable under vicarious liability. Exactly what these public statements accepting liability add to the equation is unclear, according to Peterson.[xxxiii] Absent a regulatory framework and legal precedent, numerous questions remain regarding who will ultimately be held responsible for accidents that may have a number of contributing factors.

Absent a regulatory framework and legal precedent, numerous questions remain regarding who will ultimately be held responsible for accidents that may have a number of contributing factors.

PUBLIC EXPECTATIONS FOR THE FUTURE OF INSURANCE

Respondents in all three countries demonstrated an understanding that the risk landscape is changing, and all expressed a sense that insurance and insurers have a significant role to play in the future of mobility.

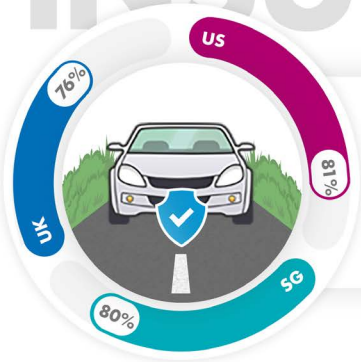
Though consumer perceptions about the overall safety and security associated with autonomous vehicle operation are mixed, more than a third of respondents in the U.S. and the UK, and 20 percent of respondents in Singapore, identified "lower insurance costs" as a most-appealing benefit for cars with autonomous features and driverless cars.

An overwhelming majority in all three nations — 81 percent in the U.S., 80 percent in Singapore and 76 percent in the UK — said owners or riders of driverless vehicles in the future should have car insurance. Nearly two-thirds — 64 percent in the U.S., 69 percent in Singapore and 65 percent in the UK — said people who use subscription or on-demand driverless services should have their own auto insurance.

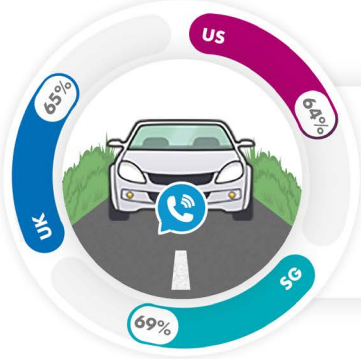
BENEFITS

"Lower insurance costs" is among the three most appealing benefits for cars with autonomous features and driverless cars in all three nations.

INSURANCE



An overwhelming majority in all three nations said owners or riders of driverless vehicles should have car insurance.



Nearly two-thirds said people who use subscription or on-demand driverless services should have their own insurance.

CONCLUSION

Rapid technology developments are creating new and evolving challenges in mobility. Risk is not going away. Rather, it is changing and shifting — in some cases dramatically. Reducing risk and covering losses effectively will require new ways of thinking on the parts of all stakeholders.

All stakeholders in the future of mobility — auto manufacturers, software developers, parts manufactures, internet service providers, road construction companies, local governments responsible for infrastructure, and others — must recognize that things are changing as liability shifts.

Insurers must recognize the seismic shifts that are already occurring, embrace our role as an enabler of innovation, and adapt. The lines between personal risk and commercial risk are blurring. Addressing the complex challenges of insuring the autonomous vehicle market requires a collaborative, nimble approach.

Consumers also must have a voice at the table. AIG's survey demonstrates that the public is open to change, but their expectations differ from analyst's on a number of key issues. Rather than writing the differences off as the result of low information, industry should address them head-on — educating the public where necessary and adapting their own approach where appropriate.

The age of autonomous vehicles is upon us. Driverless cars are no longer the stuff of science fiction. They are on the road today, and will continue to grow in influence as technology matures and regulatory frameworks take shape. Working together across industries and borders will ensure a smooth — and, importantly, safe — transition.

APPENDIX: MAP INFOGRAPHIC DATA

This text represents the data for the infographic on Partnerships and Mobility Strategies

- **Arizona, U.S.**
  - Phoenix: The car rental company Avis is managing a fleet of self-driving minivans development by Waymo, a self-driving company owned by Google's parent company Alphabet.[xxxiv]
  - Phoenix: Uber is testing self-driving Volvo vehicles on the streets of Phoenix, having moved the program from San Francisco.[xxxv]
  - Scottsdale: General Motors is testing self-driving Chevy Bolts in Scottsdale.[xxxvi]
- **California, U.S.**
  - General Motors is testing 50 self-driving Chevy Bolts in San Francisco, with plans to add 130 more in the coming months.[xxxvii]
  - Uber had been testing self-driving Volvo vehicles on the streets of San Francisco until the program moved to Phoenix, Arizona.[xxxviii]
  - Apple's self-driving technology is being tested in a handful of vehicles in San Francisco, and the company recently leased a small fleet of Lexus SUVs from car-rental company Hertz's fleet management unit, Donlen.[xxxix]
  - Uber bought Otto in 2016.[xl]
  - Intel bought Itseez in 2016.[xli]
- **Massachusetts, U.S.**
  - After successful tests in Singapore, MIT spinoff nuTonomy is partnering with Lyft test autonomous ride-hailing in Boston.[xlii]
- **Michigan, U.S.**
  - Ann Arbor: The University of Michigan is deploying two driverless shuttles on its campus in a partnership with French startup Navya.[xliii]
  - Detroit: GM (which acquired Cruise Automation and invested $500 million in Lyft in 2016) plan to test self-driving Chevy Bolt in Detroit and "several states" in 2018.[xliv]
  - Detroit: Ford plans to build self-driving vehicles in suburban Detroit in late 2020,[xlv] and recently announced an interoperability partnership with Lyft.[xlvi]
  - GM bought Cruise Automation (California) in 2016.[xlvii]
  - Lear Corp bought Arada Systems in 2015.[xlviii]
- **New York, U.S.**
  - Verizon bought Telogis (California) in 2016.[xlix]
  - Cadillac recently conducted a public test of its "Super Cruise" feature, which provided autonomous control during highway driving from New York City to Washington, D.C.[l]
- **Nevada, U.S.**
  - French startup Navya operates a self-driving shuttle on the Las Vegas Strip.[li]
- **Pennsylvania, U.S.**
  - Uber is testing self-driving Volvo vehicles on the streets of Pittsburgh.[lii]
- **Texas, U.S.**
  - Freescale (now NXP) bought CogniVue in 2015.[liii]
- **China**
  - Tech company Baidu made waves in July when its CEO conducted a self-driving test on public roads.[liv] The company has open sourced its technology for carmakers to use in developing autonomous vehicles.[lv]
- **Germany**
  - Munich: Volkswagen is using Nvidia's artificial intelligence in development of autonomous Audi vehicles and other applications focused on the broader transportation eco-system.[lvi]
  - Stuttgart: Automaker Daimler and auto parts supplier Bosch have teamed to develop self-driving taxis for urban use,[lvii] and have opened a self-parking garage in Stuttgart for the vehicles.[lviii]
- **Singapore**
  - nuTonomy has been testing autonomous taxis (with "safety drivers") in Singapore since 2016.[lix] (Ackerman, E.)
- **South Korea**
  - The South Korean government has approved several entities – including manufacturers Hyundai and Kia, tech company Samsung and academic institutions – to test driverless cars on South Korean roads.[lx]
- **Sweden**
  - Swedish carmaker Volvo has teamed with Swedish automotive safety supply Autoliv to build autonomous vehicles by 2021 using California's technology company Nvidia's Drive PX in-car AI computing platform.[lxi]
- **Multinational**
  - Fiat Chrysler (U.S.) has teamed with BMW (Germany), Intel-owned ADAS company Mobileye (Israel) and auto parts manufacturer Delphi (United Kingdom) to develop production autonomous vehicles by 2021.[lxii]
  - Delphi (United Kingdom) bought Ottomatika (Pennsylvania) in 2015.[lxiii]
  - Amarella (California) bought VisLab (Italy) in 2015.[lxiv]

CITATIONS

i. Waters, Michael. "This Bizarre 1911 Film Warns of the Perils of Self-Driving Cars." Atlas Obscura. June 16, 2017. https://www.atlasobscura.com/articles/automatic-motorist-1911-film

ii. "Driving Forces: Autonomous Land Vehicles." Lockheed Martin. 100 Years of Accelerating Tomorrow. http://www.lockheedmartin.com/us/100years/stories/alv.html

iii. Kroger, Fabian. "Automated Driving in Its Social, Historical and Cultural Contexts." Autonomous Driving: Technical, Legal and Social Aspects." Springer Berlin Heidelberg. 2016. https://link.springer.com/chapter/10.1007/978-3-662-48847-8_3/fulltext.html

iv. "A Brief History of Autonomous Vehicle Technology" Wired. March 2016. https://www.wired.com/brandlab/2016/03/a-brief-history-of-autonomous-vehicle-technology/

v. SAE News. "U.S. Department of Transportation's New Policy on Automated Vehicles Adopts SAE International's Levels of Automation for Defining Driving Automation in On-Road Motor Vehicles." September 22, 2016. https://www.sae.org/news/3544/

vi. Khayatt, F; Boilard, M; and Pletziger, R. "Auto Insurance Faces Big Challenges: Even before driverless cars hit the road." Oliver Wyman. June 2017. http://www.oliverwyman.com/content/dam/oliver-wyman/v2/publications/2017/jun/Art11-Auto-insurance.pdf

vii. Reiner, Juergen., et al. "The True Value of Autonomous Driving." Oliver Wyman. July 29, 2015. http://www.brinknews.com/the-true-value-of-autonomous-driving/

viii. Khayatt, F.

ix. Nunez, Michael. "I drove a Cadillac from New York to D.C. without using my hands." Mashable. October 22, 2017. http://mashable.com/2017/10/22/2018-cadillac-ct6-super-cruise-test-drive/

x. Davies, Alex. "Waymo Has Taken The Human Out of Its Self-Driving Cars" Wired. Nov. 7, 2017. https://www.wired.com/story/waymo-google-arizona-phoenix-driverless-self-driving-cars/

xi. Britzky, J. "The race to the finish for self-driving cars." Axios July 15, 2017.

xii. Glancy, D., Peterson, R., et al. "A Look at the Legal Environment for Driverless Vehicles." The National Academies Press, February 2016. [HERE IS A LINK TO THE PIECE: http://www.trb.org/Publications/Blurbs/173557.aspx]

xiii. Khayatt, F.

xiv. Burgstaller, Stefan, et al. "Rethinking Mobility: The 'pay-as-you-go car:" Ride hailing just the start." Goldman Sachs. Equity Research. May 23, 2017. http://orfe.princeton.edu/%7Ealaink/SmartDrivingCars/PDFs/Rethinking%20Mobility_GoldmanSachsMay2017.pdf

xv. Albright, J., Schneider, J., Nyce, C. "The chaotic middle: The autonomous vehicle and disruption in automobile insurance." KPMG. June 2017.

xvi. "Automotive revolution – perspective towards 2030: How the convergence of disruptive technology-driven trends could transform the auto industry." McKinsey & Company. January 2016.

xvii. "Deloitte Study: Fact, Fiction and Fear Cloud Future of Autonomous Vehicles in the Minds of Consumers." Deloitte Press Release. January 17, 2017. https://www2.deloitte.com/us/en/pages/about-deloitte/articles/press-releases/deloitte-study-future-of-autonomous-vehicles-in-minds-of-consumers.html

xviii. Glancy, Dorothy. Interview conducted October 6, 2017.

xix. Peterson, Robert. Interview conducted October 6, 2017.

xx. Diachenko, Bob. "Auto Tracking Company Leaks Hundreds of Thousands of Records Online." MacKeeper. Sept. 21, 2017. https://mackeepersecurity.com/post/auto-tracking-company-leaks-hundreds-of-thousands-of-records-online

xxi. Blackmore, Nicholas. "Autonomous Vehicles, Liability and Insurance." Kennedys IT Seminar Series. August 17. 2017.)

xxii. Albright, J.

xxiii. NHTSA. "Automated Driving Systems 2.0: A Vision for Safety." U.S. Department of Transportation. September 6, 2017. https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/13069a-ads2.0_090617_v9a_tag.pdf

xxiv. "Development of self-driving vehicles in the United Kingdom: Where science fiction meets science fact." Deloitte University Press. April 6, 2017. https://dupress.deloitte.com/content/dam/dup-us-en/articles/3913_Driverless-cars-in-the-UK/DUP_Development-of-self-driving-vehicles-UK.pdf

xxv. Abdullah, Zhaki. "Insurance industry must adapt: Minster." Straits Times. October 27, 2016. http://www.straitstimes.com/singapore/insurance-industry-must-adapt-minister

xxvi. Albright, J.

xxvii. Bigelow, Pete. "Can't accept autonomous liability? Get out of the game, says Volvo." Autoblog. October 9, 2015. https://www.autoblog.com/2015/10/09/volvo-accept-autonomous-car-liability/

xxviii. Whitaker, Bill. "Hands off the wheel." 60 Minutes. October 4, 2015. https://www.cbsnews.com/news/self-driving-cars-google-mercedes-benz-60-minutes/

xxix. Bigelow, P.

xxx. Korosec, Kirsten. "Volvo CEO: We will accept all liability when our cars are in autonomous mode." Fortune.com. October 7, 2015. http://fortune.com/2015/10/07/volvo-liability-self-driving-cars/

xxxi. Bigelow, P.

xxxii. Marus, Michelle. "General Motors To Take Responsibility For Autonomous Car Crashes?" Art of Gears. Oct. 5, 2017. https://artofgears.com/2017/10/05/general-motors-autonomous-car-crashes/

xxxiii. Peterson, R.

xxxiv. O'Kane, Sean. "Avis will service Waymo's self-driving minivans." The Verge. June 26, 2017. https://www.theverge.com/2017/6/26/15873236/avis-waymo-google-self-driving-cars-vans

xxxv. Sisson, Patrick. "Driverless cars: Who's doing what, and how it impacts urban transportation." Curbed. July 7, 2017. https://www.curbed.com/2017/7/7/15935126/google-uber-driverless-car-waymo-autonomous

xxxvi. Lienert, Paul. "Exclusive: GM plans to build, test thousands of self-driving Bolts in 2018 – sources." Reuters. February 17, 2017. https://www.reuters.com/article/us-autoshow-frankfurt-electrics/carmakers-face-electric-reality-as-combustion-engine-outlook-dims-idUSKCN1BN00X

xxxvii. Hawkins, A.

xxxviii. Sisson, P.

xxxix. Webb, Alex and Welch, David. "Apple Is Working With Hertz to Manage Its Self-Driving Car Fleet." Bloomberg. June 26, 2017. https://www.bloomberg.com/news/articles/2017-06-26/apple-working-with-hertz-unit-to-manage-small-autonomous-fleet

xl. Albright, J.

xli. Albright, J.

xlii. Etherington, Darrell. "Lyft and Nutonomy partner to bring first self-driving Lyft service to Boston." TechCrunch. June 6, 2017. https://techcrunch.com/2017/06/06/lyft-and-nutonomy-partner-to-bring-first-self-driving-lyft-service-to-boston/

xliii. Hawkins, Andrew J. "This adorable driverless bus will soon be making stops at the University of Michigan." June 21, 2017. https://www.theverge.com/2017/6/21/15848098/michigan-driverless-shuttle-navya-mcity

xliv. Lienert, P.

xlv. Lienert, P.

xlvi. Hawkins, Andrew J. "Ford and Lyft will work together to deploy autonomous cars." The Verge. Sept. 27, 2017. https://www.theverge.com/2017/9/27/16373574/ford-lyft-self-driving-car-partnership-gm

xlvii. Albright, J.

xlviii. Albright, J.

xlix. Albright, J.

l. Nunez, Michael.

li. Hawkins, Andrew J. "Las Vegas is expanding its self-driving shuttle experiment." The Verge. November 6, 2017.

lii. Sisson, P.

liii. Albright, J.

liv. Pham, Sherisse and Dong, Serena. "Tech CEO's self-driving car ride upsets Chinese traffic cops." CNN Tech. July 6, 2017. http://money.cnn.com/2017/07/06/technology/baidu-robin-li-driverless-car-illegal/index.html

lv. Kharpal, Arjun. "Chinese tech titan Baidu is opening up its driverless car tech to challenge Google, Tesla." CNBC. April 19, 2017. http://money.cnn.com/2017/05/02/technology/samsung-driverless-car-test-drive/index.html?iid=EL

lvi. Russell, Jon. "Volkswagen partners with Nvidia to expand its use of AI beyond autonomous vehicles." Techcrunch. June 27, 2017. https://techcrunch.com/2017/06/27/volkswagen-partners-with-nvidia-to-expand-its-use-of-ai-beyond-autonomous-vehicles/

lvii. Korosec, Kirsten. "Daimler and Bosch Plan to Bring Self-Driving Taxis to Cities." Fortune. April 4, 2017. http://fortune.com/2017/04/04/daimler-bosch-self-driving-taxis/

lviii. Etherington, Darrell. "Daimler and Bosch create a driverless parking garage." Techcrunch. July 24, 2017. https://techcrunch.com/2017/07/24/daimler-and-bosch-create-a-driverless-parking-garage/

lix. Ackerman, Evan. "After Mastering Singapore's Streets, NuTonomy's Robo-Taxis Are Poised to Take on New Cities." IEEE Spectrum. Dec. 29, 2016. https://spectrum.ieee.org/transportation/self-driving/after-mastering-singapores-streets-nutonomys-robotaxis-are-poised-to-take-on-new-cities

lx. Pham, Sherisse. "Samsung just got approval to start testing a self-driving car." CNN Tech. May 2, 2017. http://money.cnn.com/2017/05/02/technology/samsung-driverless-car-test-drive/index.html?iid=EL

lxi. Etherington, Darrell. "Volvo and Autoliv aim to sell self-driving cars with Nvidia AI tech by 2021." Techcrunch. June 26, 2017. https://techcrunch.com/2017/06/26/volvo-and-autoliv-aim-to-sell-self-driving-cars-with-nvidia-ai-tech-by-2021/

lxii. Abuelsamid, Sam. "Fiat Chrysler Signs On To BMW/Intel/Mobileye Automated Driving Partnership." Forbes.com. https://www.forbes.com/sites/samabuelsamid/2017/08/16/fiat-chrysler-signs-on-to-bmwintelmobileye-automated-driving-partnership/#5fd2bb6663f4

lxiii. Albright, J.

lxiv. Albright, J.

American International Group, Inc. (AIG) is a leading global insurance organization. Founded in 1919, today AIG member companies provide a wide range of property casualty insurance, life insurance, retirement products, and other financial services to customers in more than 80 countries and jurisdictions. These diverse offerings include products and services that help businesses and individuals protect their assets, manage risks and provide for retirement security. AIG common stock is listed on the New York Stock Exchange and the Tokyo Stock Exchange.

Additional information about AIG can be found at www.aig.com | YouTube: www.youtube.com/aig | Twitter: @AIGinsurance www.twitter.com/AIGinsurance | LinkedIn: www.linkedin.com/company/aig. These references with additional information about AIG have been provided as a convenience, and the information contained on such websites is not incorporated by reference into this press release.

AIG is the marketing name for the worldwide property-casualty, life and retirement, and general insurance operations of American International Group, Inc. For additional information, please visit our website at www.aig.com. All products and services are written or provided by subsidiaries or affiliates of American International Group, Inc. Products or services may not be available in all countries, and coverage is subject to actual policy language. Non-insurance products and services may be provided by independent third parties. Certain property-casualty coverages may be provided by a surplus lines insurer. Surplus lines insurers do not generally participate in state guaranty funds, and insureds are therefore not protected by such funds.

12/17 6142T