



cutting through complexity

# Marketplace of change: Automobile insurance in the era of autonomous vehicles

White Paper | October 2015

[kpmg.com/insurance](http://kpmg.com/insurance)

## A message from the insurance task force

The conversion to autonomous vehicles could bring about the most significant change to the automobile insurance industry since its inception. Convergence of consumer and automotive technologies along with the rise of mobility services could transform the way we drive and commute – and in turn could change the amount, type, and purchase of automobile insurance. The disruption to insurers could be profound, with a select set of winners and a broader swath of potential losers. Now is the time to rethink the future and start taking action.

The advent of the autonomous vehicle era is upon us. Change is coming—faster than most expect. Yet, we know there is strong skepticism across the automobile insurance marketplace about this potential transformation. Our recent survey of insurance executives confirmed that few carriers have taken action—not due to doubts about the possible ramifications but rather because most believe the change will happen far into the future if at all.<sup>1</sup> We respect this conservatism. In fact, we carried a similar viewpoint as we started our task force on this topic. The more we learned, however, the more we became convinced that the transformation is real and it is happening now. And we are not alone—several automotive industry leaders and analysts now predict fully autonomous vehicles within five years.

KPMG has been at the forefront of the autonomous vehicle conversation. Our Automotive Team did a deep dive into the underlying technologies in 2012, and issued a seminal white paper, *Self Driving Cars: The Next Revolution*. Subsequently, that Team issued follow-on papers focused on the ultra-connected age and on consumer adoption—yes, the marketplace will buy safe and affordable self-driving vehicles.<sup>2</sup> Our research was convincingly clear that the automobile landscape was poised for disruptive change.

Now the dialogue must expand to include insurance. Leveraging KPMG’s automotive research, our task force developed actuarial models that considered the implications on a carrier’s core metrics: accident frequency, claim severity, and loss costs. The results were stark. We also conducted a survey of insurance executives to gauge industry readiness.

This white paper synthesizes our work to date, and provides an integrated view along three key themes:

### 1. Alignment for mass change within a decade

Together, the core ingredients—including technology, consumer adoption, and regulatory permission—are presently aligning to enable mass change. We envision four incremental phases of the transformation, moving from the current “training wheels” phase of curiosity and introduction into “full speed” as the vehicle stock starts to widely convert in 2025.

### 2. Radical shifts for the auto insurance marketplace

A continual decline in the frequency of accidents should drive a drop in industry loss costs, with a precipitous fall starting in a decade as the vehicle stock converts. The mix of insurance will also change, as commercial and products liability lines expand. Within 25 years, our models suggest a scenario where the personal auto insurance sector could shrink to 40 percent of current size.<sup>3</sup> The elimination of excess capacity could bring severe market issues, with changing business models and new competitors only adding to the turbulence and speed of change.

### 3. The need to start preparing now

No one has a crystal ball to predict with certainty the future. The shift, however, is clear to us. We encourage insurance companies to consider the implications on their organizations and take precautionary action now, with deeper changes taken later based on movement in lead indicators. The tactical responses will take considerable time and resources—strategic moves will require significantly more. Now is the time for a rethink.



**Jerry Albright**

Principal

617-777-4623

jjalbright@kpmg.com



**Alex Bell**

Managing Director

312-665-5539

alexabell@kpmg.com



**Joe Schneider**

Managing Director

312-665-1006

jeschneider@kpmg.com



**Chris Nyce**

Principal

610-341-4803

gnyce@kpmg.com



We hope that you will find this report full of insight and provocative thought. Now is the time for robust discussion about the potential implications of autonomous vehicles on your organization. We look forward to the opportunity to having that conversation with you soon.

## Contents

A potential view from the insurance marketplace – 2030	1
Alignment for mass change: Eight key elements for transformation	3
A new normal within a decade: Four potential phases of incremental change	17
Survival of the fittest: A new insurance landscape	25
Key considerations	36
Next steps – Call to action	39



## A potential view from the insurance marketplace – 2030

### A case study

Mary Elleston, president of GoGo Auto Insurance, sighs as she finishes reading the latest market analysis from her research team compiled for this week's board meeting. The turmoil in the auto insurance marketplace only continues to deepen. Another two regional auto insurance carriers—peers of GoGo—have closed this quarter, with most of their books of business absorbed again by the big five insurance companies that have come to dominate the industry with niche players picking up a portion. The number of auto insurance companies has decreased by nearly half since 2015, and the consolidation trend is only accelerating. Not a surprise as she thinks about all that's happened over the past 15 years. The adoption of autonomous vehicles has driven the change. And the implications, in Mary's view, have been decidedly mixed.

The use of these vehicles has no doubt improved quality of life—reducing commute times and allowing for multitasking while en route. Through sensors and vehicle-to-vehicle (V2V) communications, the frequency of accidents has fallen significantly, which in turn has sliced away billions in claim damage, reduced the number of personal injuries, and saved hundreds, perhaps thousands, of lives, too.

---

Auto manufacturers—both traditional players and a wave of new technology entrants—have released a series of new models, each with increasingly more sophisticated levels of self-driving capabilities. The year 2025 was a milestone—the National Highway Traffic Safety Administration (NHTSA) mandated that all new vehicles sold have self-driving capabilities, which built upon a vehicle-to-vehicle communication mandate implemented a few years earlier. The trend was in retrospect clear, when you considered all of the societal benefits.

By 2025, the consumer had fully embraced self-driving vehicles, too. People quickly moved from seeing the vehicles as a novelty to becoming accustomed to the benefits—checking the Internet, video chatting with friends, watching TV, and doing office work on their commutes. In fact, the auto dashboard has become an integral part of their lives. The adoption cut across all demographics, not just tech savvy Millennials. A surge by Baby Boomers—eager to maintain their personal independence—has proven to be an unexpected, but major catalyst.

On the other hand, the fallout for the insurance industry has been devastating. Frequency of accidents has fallen over 50 percent during the past 15 years, and will continue to drop. As premiums follow loss costs, the size of the auto insurance marketplace has also dropped significantly, with some offset due to severity increases related to more expensive vehicles. In addition, the overall vehicle stock has plateaued and actually begun to fall due to more efficient sharing of vehicles. While these factors were shrinking the size of the auto premium pie, the allocation of the slices of risk among carriers was dramatically changing as well.

A large movement to self-driving vehicles on demand—basically fleets of transportation pods summoned by text, call, or calendar entry—has pumped up the commercial auto share of the market. With all of the new technology being used, products liability took share to cover the new risks. The remaining portion of the market available to personal auto writers has shrunk to about two-thirds of the 2015 size. And the competition for this smaller slice has become even fiercer.

Auto manufacturers began to sell insurance as part of the sticker price of the vehicle. Technology companies—which owned the data coming from the dashboard—started their own insurance groups, leveraging the competitive (and proprietary) insights gained about driving performance.

The brunt of the transformation has fallen on legacy automobile insurance carriers. Mary remembers many a tense conversation with her executive team—and then increasingly with the board—about what to do. At first, GoGo—like most other insurance carriers—got distracted playing catch-up with the side effects of the new technologies through a continual series of tactical actions around policy forms, pricing schedules and underwriting guidelines. The financial implications caught her by surprise.

Customers began to demand more premium discounts to reflect safer driving, and then the number of policies in force fell for the first time. The shift to mobility on demand—especially in urban locations—accelerated the decline. As GoGo's gross premiums slipped, the expense ratio got distorted. She quickly implemented teams to evaluate expense structure, and determine where to cut costs and by how much. It was ugly. GoGo wasn't alone. Other carriers—particularly monoline companies focused solely on auto—faced similar challenges. Rates began to fall as stressed companies attempted to grab cash flow to cover costs, which caused a further downward spiral. This period of irrational pricing, which has only now started to abate, drove several carriers into bankruptcy and hurt the capital positions for those that survived. The financial markets also turned away, limiting the ability to raise additional funds. GoGo survived, but has been deeply shaken.

The board is nervous. Mary is still finalizing the go-forward strategy to reposition GoGo in this evolving marketplace. The challenges have been great, but several opportunities remain, she is sure. Down the hall, her executive team has assembled in the conference room for another planning meeting. As she gathers the market report and her notes, she again considers the options.

## Alignment for mass change: Eight key elements for transformation

The advent of the autonomous vehicle era is upon us. Shifts of this scale won't happen through singular change, but will instead require foundational movements across the entire driving environment. We have identified eight core elements that will likely be needed to drive the transformation. Each element has been individually advancing—you are seeing evidence daily of the progress—and brings its own industry implications. The current alignment of these eight elements, however, can enable a new normal across the automobile sector.



**Integrity of technology** – Foundational technologies required for driver autonomy already exist, and should only continue to strengthen and integrate. Convergence of technologies will ultimately be needed for mass adoption.



**Capability accessibility** – Traditional manufacturers (OEMs) have committed pipelines of new vehicles, with each release making accessible more sophisticated autonomous capabilities. Watch for high-tech companies—like Google, Tesla, and Apple—to leapfrog to fully self-driving.



**Infrastructure availability** – With the initial technology embedded into the vehicles themselves, the new vehicles can use existing roads—no up-front investment in infrastructure is needed to get started. Over time, road infrastructure is expected to become increasingly “smart” and will communicate with vehicles to realize a more holistic array of information.



**Regulatory permission** – As of earlier this year, sixteen states (District of Columbia included in this number) have passed or introduced bills related to self-driving vehicles, with California, Michigan, and Nevada likely to set the standards to be adopted by the others.<sup>4</sup> In 2013, the NHTSA (the Administration) released a preliminary findings report that—from our perspective—stopped just short of a full endorsement.<sup>5</sup> The Administration is also gathering formal feedback on a potential mandate to require V2V communications in new vehicles.<sup>6</sup>





**Legal responsibility** – As the vehicle itself makes more driving decisions, determining who is responsible when an accident occurs will need to be clarified. These legal issues should resolve in parallel with advances in autonomous technology—likely without hindering market advances. Insurance companies have an opportunity to develop policy covers to provide protection to both individuals and corporations—manufacturers of the vehicles and technology—in this new environment.



**Consumer adoption** – Our research showed that once consumers understood the potential benefits, they were significantly more willing to use autonomous vehicles.<sup>7</sup> Each driver has a unique value proposition, and autonomous vehicles offer broad appeal: the ability to multitask, faster commutes, safer travel, and more independence to name a few. Consumer education and awareness will be important—and a key area of manufacturer focus—to promote adoption. As consumers begin to adopt the autonomous technology, a tipping point—like that exhibited for cellular technology—may be reached that will further accelerate the movement. Potential government mandates could push the rate of adoption, too.

## Eight key elements for transformation

The interaction between these eight elements will be an important dynamic, as we anticipate that advances in one area will likely act as a catalyst for more rapid progress in the others. The following section will delve further into each.



**Mobility services** – Ride-hailing is now a standard option for urban drivers. This new model of vehicle usage has thrived due to convenience and cost advantages for the user. Those two core benefits have been further magnified through the emergence of mobility on demand—with Uber as a good example. Downward pressure on the overall size of vehicle stock—due to efficiency of usage—is another potential ramification.



**Data management** – Autonomous driving requires and generates a substantial amount of data, which will likely grow exponentially as the web of information becomes denser between vehicles, infrastructure, and other sources.<sup>8</sup> Driving records along with dashboard activity (captured in a “black box” equivalent) only add to the volume and mix. In this environment, data management—integrity, storage, analytics, and security—becomes critical.



## Element 1 – Integrity of technology

Building on existing foundational capabilities

Technological innovation will need to lay the foundation for a potential self-driving revolution, so this is where we need to start our conversation. It is critical to first establish a basic understanding of the underlying technology components, as this lens helps us better see how the future may change. KPMG's Automotive Team has already done a deep dive into the underlying technologies, and issued a seminal white paper, *Self-Driving Cars: The Next Revolution*. Our insurance task force worked closely with the Automotive Team to identify the following key points to highlight in this report.

### Key point 1 – Not light year components

The foundational capabilities needed for autonomous driving already exist. These aren't some light year components found under the hood of George Jetson's space car, but rather technologies that have become commonplace in today's world: sensors, cameras, satellite positioning (GPS), and short-range radio communications. These technologies will continue to advance, but the core capabilities are available today.

### Key point 2 – Pervasive sensors

Sensor-based solutions are expected to be the first thrust of the transition. The automotive industry has a robust pipeline of Advanced Driver Assistance Systems (ADAS) that are positioned to become broader and more sophisticated with each subsequent release. The public is getting introduced to this technology through lane-keeping alarms to parallel parking assistance, and we believe that sensors will become ubiquitous to driving.

### Key point 3 – Technology convergence required

Ultimately, the convergence of sensor-based solutions with dedicated short-range radio communications (DSRC) will be needed to "see" and understand the world as the human driver can. In time, we believe the initial V2V communications will be complemented with vehicle-to-infrastructure (V2I) communications, where a vehicle is gathering and interpreting information from the external environment like road signage, guard rails, and even the pavement itself. There will be a further tightening of the web of information.

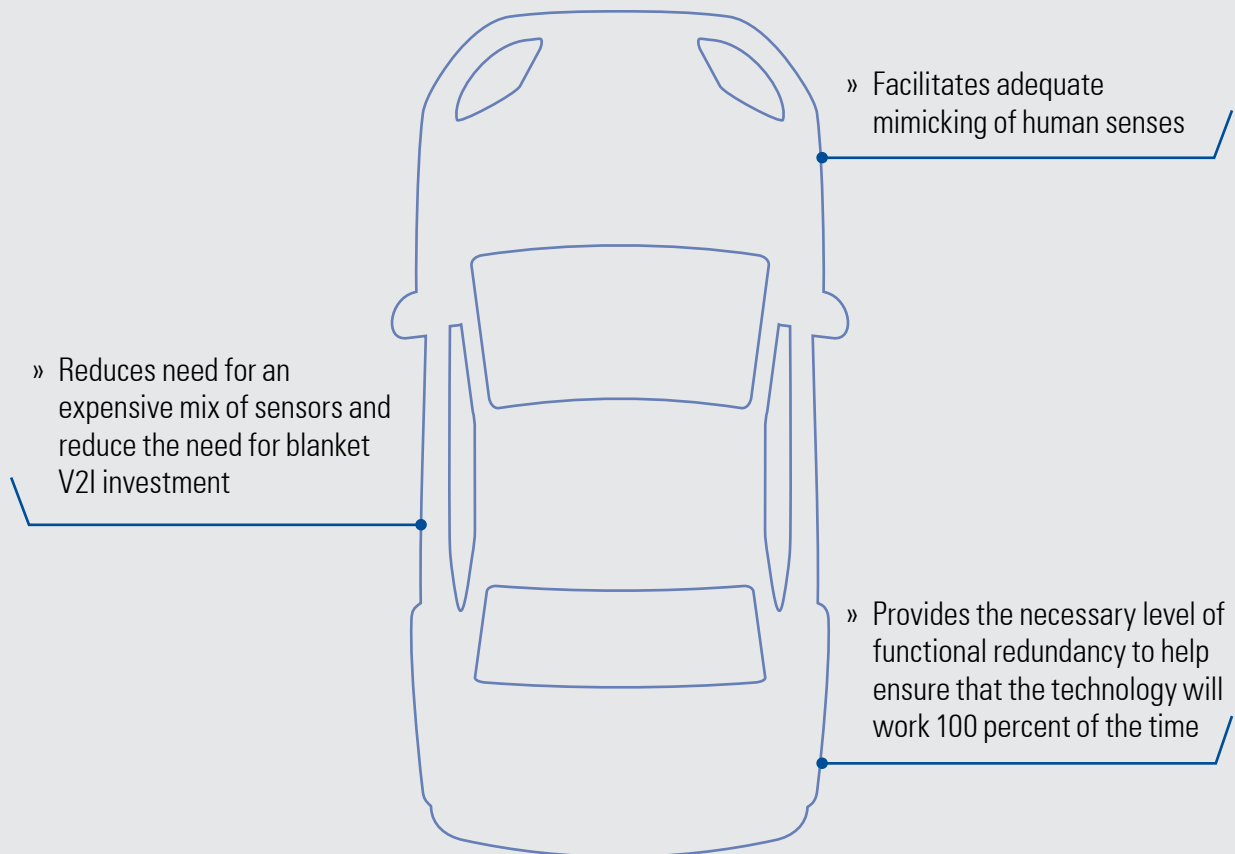
KPMG's *Self-Driving Cars: The Next Revolution* was a seminal piece of research. In the three years since that paper was issued, the technology predictions have proven to be right on target, making it a must-read. Please click here to get to the full report for more details.

### Key point 4 – Smart money following opportunity

Sensing opportunity, a flush of new investment in this space will fuel even more break-through innovations. Traditional companies within the automotive industry—such as General Motors—have created venture capital (VC) arms to channel significant amounts of capital into autonomous technology and connected transportation.<sup>9</sup> In addition to funding from core manufacturing firms, "smart money" is also starting to flow from VC firms. For example, Mobileye—a technology company that aims to reduce collisions through vision-based assistance systems—went public in 2014, and is now valued at \$12 billion.<sup>10</sup> Intel has created a \$100 million "Intel Capital Connected Car Fund" to accelerate technology innovation in the automotive industry.<sup>11</sup> This flow of money should provide a broader platform to develop autonomous technologies, and at a more rapid pace. Money begets money. As these new technologies enter the limelight, VC and other companies will continue to invest in developing and bringing them to market.

KPMG's Automotive Team has already done a deep dive into the underlying technologies, and issued a seminal white paper, *Self-Driving Cars: The Next Revolution*. Our insurance task force worked closely with the Automotive Team to identify key points to highlight in this report.

## Technology convergence



## Technological innovation

will need to lay the foundation for a potential self-driving revolution, so this is where we need to start the conversation.



## Element 2 – Capability accessibility

Committing to a pipeline of affordable products

Traditional market participants, as well as new entrants, are developing self-driving vehicles or the technology that underpins them. These capabilities have generally focused on two speed zones:

- Low speeds where the driver tends to get distracted—park assist, back-up alerts, traffic jam piloting, etc.
- High speeds where split second errors translate into serious risk—blind spot detection, lane departure warnings, etc.

Each consecutive release of capabilities from traditional manufacturers provides more driver substitution, with an evolutionary advance from braking assistance into full steering control.

Google and Tesla are leap-frogging past these incremental changes with a fully autonomous vehicle, and their aggressive time lines may act as a catalyst pushing the industry towards more and faster action. Apple has also disclosed an intent to enter the automotive space.<sup>25</sup> Change will happen fast. In fact, the chief executive officer of Ford Motor Company predicted fully autonomous vehicles will likely be market available within five years.<sup>26</sup>

Company	Capability	Extent of automation	Implementation/ Expected introduction
Volvo <sup>12</sup>	Traffic jam assist	Stop-and-go up to 31 mph	2014
Mercedes-Benz <sup>13</sup>	Traffic jam assist	Stop-and-go up to 37 mph	2014
BMW <sup>14</sup>	Traffic jam assist	Stop-and-go up to 25 mph	2014
Nissan <sup>15</sup>	Self-parking	Vehicle that parks itself	2016
Audi <sup>16</sup>	Traffic jam assist	Stop-and-go up to 37 mph	2016
Tesla <sup>17</sup>	Autonomous driving	Auto pilot functionality	2016
Mobileye <sup>18</sup>	Autonomous driving	Fully autonomous technology (excluding country roads and city traffic)	2016
Cadillac <sup>19</sup>	Super cruise control	Stop-and-go up to 70 mph	2017
Ford <sup>20</sup>	Traffic jam assist	Stop-and-go highway traffic	2017
Google <sup>21</sup>	Autonomous driving	Fully autonomous vehicle	2020
Apple <sup>22</sup>	Autonomous driving	Fully autonomous vehicle	TBD
Cadillac, Mercedes-Benz, Audi, Nissan, Volvo <sup>23</sup>	Autonomous driving	Fully autonomous vehicle	*2020?
All manufacturers <sup>24</sup>	V2V communication	Pending mandate proposed by NHTSA, potentially issued by 2018	~2022

*\*No definitive assertion that these manufacturers will introduce fully autonomous vehicles by 2020. However, there is industry speculation that these companies could introduce fully autonomous vehicles by 2020.*

*Note: Data from publicly available sources as of June 2015*

While scale is needed to drive down costs, affordable components are needed for mass adoption. We believe that technology companies may act as the catalyst for broader production. Traditional OEMs have tended thus far to include the new sensor-based capabilities only as higher-end options, rather than base components on vehicles. As technology companies enter the market—due to the allure of developing and owning the “brain” of these vehicles—autonomous capabilities will be core features. We believe that this approach will push traditional auto manufacturers to adopt broader usage of this technology, providing the scale of production needed to reduce costs to make the technology accessible to most consumers.

In addition, effective V2V communication requires other vehicles to be similarly equipped, but the current technology costs are expensive. That will change. An official notice of proposed rulemaking announced by NHTSA in August 2014 suggests that a federal mandate could be issued to require that all new vehicles include V2V capabilities<sup>27</sup> (perhaps by 2022 from our view). Such a mandate would force a sufficient network of interconnected vehicles to realize safety gains. It will also drive the scale of production needed to reduce adoption costs.

# SELF-DRIVING VEHICLES ONLY



## Element 3 – Infrastructure availability

Using existing roads to start

With the initial technology embedded into the vehicles themselves, the new vehicles can use existing roads—thereby eliminating any up-front investment in infrastructure to get started.

Over time, however, we believe that the sensors and interactive communication will be incorporated into the core infrastructure—pavement, traffic signals, road signs, and guard rails. This V2I communication should result in a fully integrated driving environment.

The future autonomous vehicle environment will also allow for vehicles to move much more efficiently with each other. The implications on traffic could be dramatic.

Research indicates that the “platooning” of vehicles into organized groups could increase highway lane capacity by up to 500 percent.<sup>28</sup> We believe that as autonomous vehicles become more prevalent, existing infrastructure may be repurposed to promote even further usage. For example, high-occupancy vehicle (HOV) lanes may become autonomous vehicle exclusive with lines of vehicles moving in coordinated cadence, reducing commute times and energy consumption.



## Element 4 – Regulatory permission

Progressing with a focus on safety

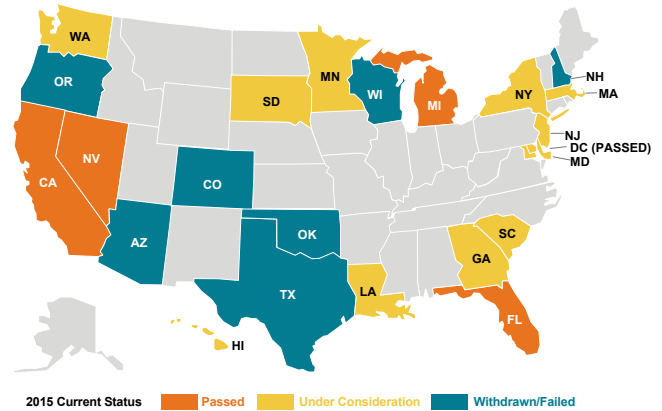
Federal and state regulators must ultimately permit the new vehicles to be driven on the road. As the gatekeepers to usage, regulators maintain a powerful role in which they can potentially accelerate autonomous vehicle progress or apply the brakes. In our conversations with regulators, their focus has been squarely on safety. Permission will only happen after the product or underlying technology has been sufficiently proven as safe and reliable. Dr. Bernard Soriano, deputy director of the California Department of Motor Vehicles, said, “We are concentrating on creating regulation that ultimately ensures that autonomous vehicles are safe—not only for the passengers in the driverless vehicle itself, but for those in other vehicles as well as pedestrians. The reality is that certain safety thresholds must be met before autonomous vehicles will be permitted to operate on the road on a wide-scale basis.”<sup>29</sup>

State legislations have been gearing up for the future. As of earlier this year, Washington, D.C. and four states—California, Florida, Michigan, and Nevada—have enacted legislation permitting the operation of automated vehicles on public roads for testing purposes. Another eleven states have introduced bills.<sup>30</sup> Interestingly, based on our research, those states that have stopped legislation have done so largely to allow for rules to be first defined and tested in the leader states to promote consistency of law.

The next step will be to move beyond testing to allow for autonomous vehicles to be used on the road. Again, we would expect the states of California, Michigan, and Nevada to be leaders in defining and enacting the rules that other states will follow.

NHTSA is responsible for developing and enforcing the federal safety standards for motor vehicles. With a founding purpose to reduce the number of deaths and injuries resulting from motor vehicle crashes, the Administration’s reports are also meant to guide the efforts of state regulators. Reflecting its underlying goal of safety, NHTSA has pushed for many of the improvements found in vehicles today, including safety belts, air bags, antilock brakes, and rear-view cameras.<sup>31</sup> Given that the Administration has issued a comment paper regarding a mandate for vehicle-to-vehicle (V2V) communications, we believe that a V2V directive could come by 2018, with new vehicles required to have this technology possibly by 2022.<sup>32</sup>

## Autonomous vehicle legislation status



Source: Stanford University’s Center for Internet and Society – Automated Driving: Legislative and Regulatory Action and Individual State Legislative Web sites.

Late last year, NHTSA issued another critical paper in this space. The preliminary statement on automated vehicles—from our perspective—stopped just short of a full endorsement. The opening comments of NHTSA’s report summarized their view of the promise of driving autonomy:

“...exciting vehicle innovations have created completely new possibilities for improving highway safety, increasing environmental benefits, expanding mobility, and creating new economic opportunities for jobs and investment. The United States is on the threshold of a period of dramatic change in the capabilities of, and expectations for, the vehicles we drive. In fact, many are inspired by the vision that the vehicles will do the driving for us.”<sup>33</sup>

**We agree.**

**From our perspective, NHTSA’s preliminary statement on autonomous vehicles stopped just short of a full endorsement.**



## Element 5 – Legal responsibility

Defining accountability in the event of an accident

Who will be held responsible in the case of an accident? As the depth and breadth of autonomous technology expands, an inevitable series of lawsuits and court rulings will follow. It doesn't take much imagination to identify a series of potential scenarios that will need to be tested.

For example, does a vehicle decide to hit an unidentified object in the road or swerve into an adjacent vehicle? What is the right choice when faced with two bad options? What happens when the driver hits the manual driving button, and later has an accident while the vehicle is under his or her control? Assignment of legal responsibility will be determined over time—case by case to start. These legal teething pains will be part of the industry growing up and expanding. We don't believe that it will slow progress, but it could shape opportunities for insurers to provide protection to those organizations that are exposed.

Key players—insurers, manufacturers, software companies—are starting to develop legal strategies. We believe that companies within each sector will need to work together to develop industry positions in order to influence legislative and judicial actions. The cumulative voice will carry more weight than that of any individual company.

1



### The key players

Manufacturers, technology firms, and insurance companies will need to define their legal strategies. Companies are starting this process now.

2



### Initial lawsuits

As the depth and breadth of autonomous technology expands, an inevitable series of lawsuits and court rulings will provide tort clarity around a variety of scenarios. Assignment of legal responsibility will be determined over time.

3



### Adapting to change

Insurance companies have an opportunity to define (or refine) policy coverage to protect the parties exposed.

4



### Creating a strategy

Should the insurance industry be working together to define a common voice to help shape the laws and rules? When does the lobbying start and with what messages?



## Element 6 – Consumer adoption

Driving usage through education and awareness

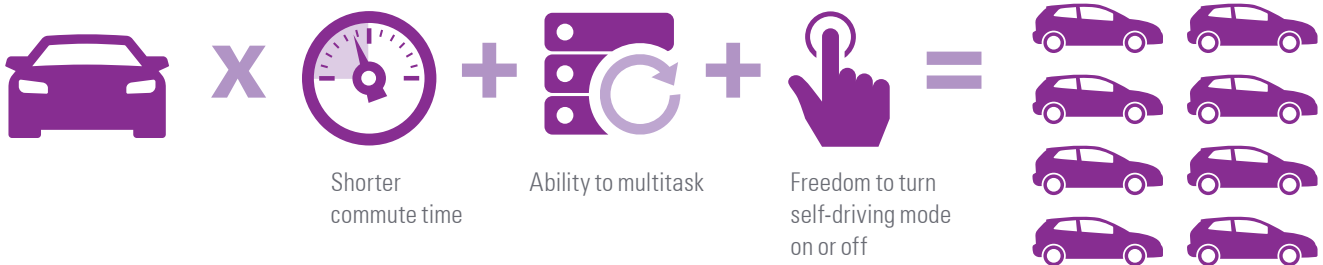
So the supply side for self-driving capabilities looks increasingly robust, but what about demand? Our research showed that once consumers understood the potential benefits, they were significantly more willing to use autonomous vehicles.<sup>34</sup> Each driver has a unique value proposition, and autonomous vehicles offer broad appeal: the ability to multitask, faster commutes, safer travel, and more independence to name a few. KPMG’s Automotive Team conducted research—including focus group discussions—on the topic of consumer adoption, and issued a second white paper titled *Self-Driving Cars: Are We Ready?* Our insurance task force again leveraged their novel work, and identified the following five key points to highlight in this report.

[Click here to read more about KPMG’s consumer research in the report: \*Self-Driving Cars: Are We Ready?\*](#)

### Key point 1 – Focus on improving the consumer’s quality of life to get traction

Through KPMG’s focus group research, we learned that the consumer’s receptivity to use an autonomous vehicle increases significantly when offered the right value proposition. In general, the following combination of value propositions gets traction with customers:

### Getting the value proposition right



The graphic above suggests that a value proposition—centered on a shorter commute time, the ability to multi-task and the option to manually drive—will support broader adoption.

As the way we drive and commute transforms, the amount, types, and purchase of automobile insurance will be impacted. The disruption to insurers may be profound, and the change could happen faster than most expect.



**Key point 2 – The marketplace will be getting an education**

A recent study by the University of Michigan found mixed interest in having an autonomous vehicles.<sup>35</sup> This is not a surprise based on the current level of public awareness and understanding. Consumers have many legitimate questions about the operations, safety, and liability of autonomous vehicles, and most have only a vague understanding of the underlying technology. But we believe lack of knowledge will change—and fast.

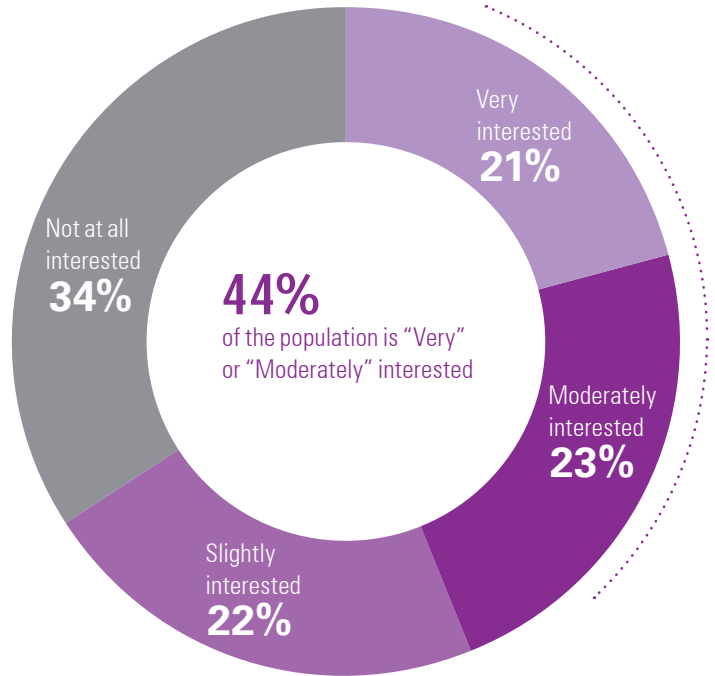
Much time and money will be spent to educate the consumer about the autonomous capabilities, and we are already seeing the advertisements making the public more aware of new capabilities like accident avoidance and self-parking. Manufacturing and high-tech companies have invested billions in research and technology around autonomous capabilities. A study tracking recent venture capital investments into the connected vehicle and connected transportation space found that VC firms have invested billions of dollars in areas including ride-hailing and scheduling; automotive telematics; vehicle sharing; mapping, location, and route optimization; intelligent transit systems; and more.<sup>36</sup>

With these new products and services now getting ready for market, investment will flow more towards marketing and knowledge sharing. Manufacturers’ efforts are also getting a big boost from more consumer-to-consumer conversations.

**Key point 3 – The momentum is building**

The topic of autonomous vehicles is hot, and the level of buzz and discussion is growing rapidly. Press attention around big announcements by Google, Apple, and other companies about plans for self-driving cars has caused spikes in related on-line conversations.

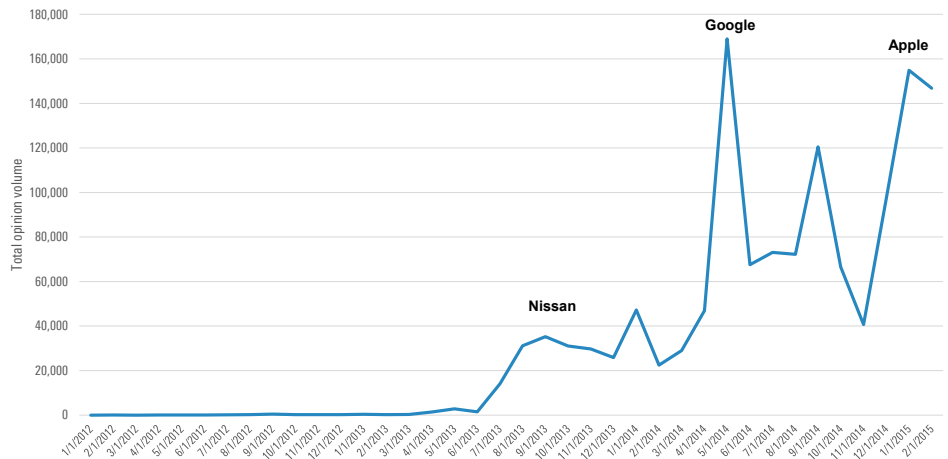
**U.S. public opinion about autonomous vehicles**



Source: The University of Michigan’s Survey of Public Opinion about Autonomous and Self-Driving Vehicles in the U.S., U.K., and Australia (July 2014).

Based on analysis of KPMG’s Mass Opinion Business Intelligence (MOBI) data, the conversations around self-driving cars initially took off in August 2013 when Nissan announced its intention to produce an autonomous vehicle by 2020. The next major spike occurred in May 2014 when Google unveiled its autonomous vehicle prototype. An upward trend has been fueled by recent speculative discussions associated with Apple’s plans in this space. The frequency of press coverage will only increase, and in turn so will the public’s understanding and acceptance of this new technology.

**Consumer conversations about self-driving cars**



Source: KPMG LLP MOBI Data

**Key point 4 – Consumers trust tech companies**

Our market research indicates that technology companies are favored by consumers regarding the perceived quality of their prospective vehicles.<sup>37</sup> KPMG has predicted for some time that leading technology companies will enter the automotive space, and recent announcements by Google<sup>38</sup> and actions by Apple<sup>39</sup> have further confirmed our view. The movements by these companies will—in our opinion—act as a market catalyst for the transformation.

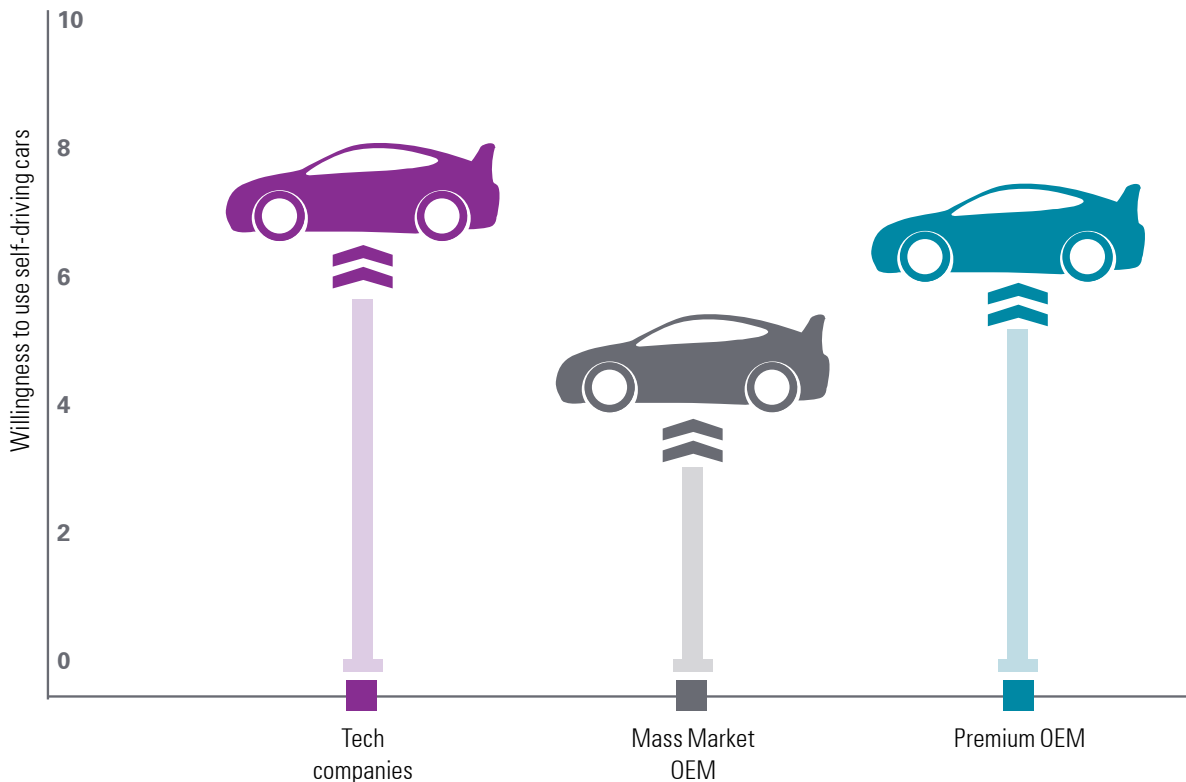
**Key point 5 – Watch for the tipping point**

To work well, autonomous driving will require a large network of similarly equipped vehicles to promote V2V communication. But who will be the early adopters, and when will the masses arrive?

These questions were partially answered when NHTSA recently issued a formal notice of proposed rulemaking to mandate V2V technology in all new vehicles. Feedback is still being gathered, but we expect NHTSA to set a mandate around 2018, with V2V technology embedded in all new vehicles sometime around 2022.<sup>40</sup> The mandatory inclusion of this technology in all vehicles will likely serve as the potential tipping point where we start to see a rapid shift from traditional vehicles towards autonomous driving.

Another possible catalyst for a tipping point is customer momentum. As consumers begin to adopt the autonomous technology, a critical volume – like that exhibited for cellular technology – may be reached that will further accelerate the movement.

**Consumers trust tech companies**



Source: KPMG LLP's Self-Driving Cars: Are We Ready?



## Element 7 – Mobility services

Accelerating the move away from ownership and driving

Over the past decade, a whole new market has emerged of businesses designed to make mobility fast, flexible, and affordable. Car sharing services first popped up in urban settings, where vehicle ownership can be an expensive hassle. Zipcar was first to the game, launched in Boston in 2000. Now this model of vehicle usage has become a standard option for city dwellers and suburbanites alike. Car sharing services in the United States have more than 1.2 million members, who share 17,179 vehicles.<sup>41</sup>

### Sharing vehicles brings down costs

Despite high costs and fast depreciation, substantial utilization can make shared, high-tech “mobility vehicles” economically compelling. KPMG’s Automotive Team did some analysis that underscores the financial viability of incorporating autonomous vehicles into the car share fleets:

Despite high costs and fast depreciation, substantial utilization can make shared, high-tech “mobility vehicles” economically compelling



#### Today’s car



#### Future mobility car



The “mobility vehicle” is based on a small sedan that costs \$25,000 and is completely replaced every three years with no residual value. It is shared and, therefore, driven 40,000 miles per year. The average NYC cab is driven an average of 70,000 miles per year.

-  **Fixed Costs (per mile)**  
Depreciation, insurance, finance, and registration-related costs
-  **Operating Costs (per mile)**  
Gas, maintenance, and tires

Sources: AAA, NYC Taxi and Limousine Commission, “KPMG LLP’s Me, my vehicle, my life... in the ultra connected age”

The two core benefits of vehicle sharing—convenience and cost savings—have been further magnified through the emergence of mobility on demand or ride-hailing—with Uber and Lyft as good examples. Ridership information is not widely available, but Uber globally was estimated in late 2013 to complete about 850,000 rides a week<sup>42</sup> with 430,000 active customers.<sup>43</sup> Despite numerous legal and regulatory challenges, the shift towards this new business model seems solid.

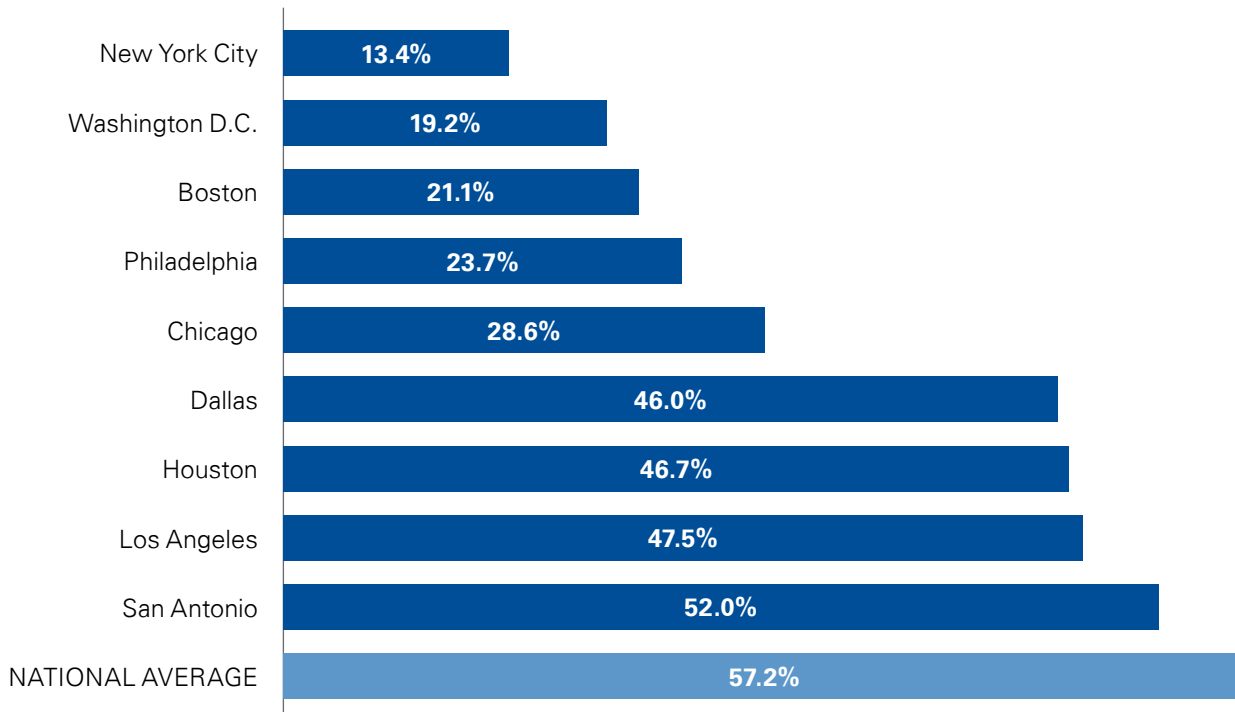
With heavier traffic, shorter commutes, and higher vehicle ownership expense, we believe that urban environments will continue to be at the forefront of mobility change.

As the consumer becomes increasingly removed from the driving experience and vehicle ownership, a shift to autonomous vehicles becomes a more natural evolution. We believe that self-driving vehicles will become part of the broader fleet of shared vehicles, and will provide firsthand exposure to the technology for many drivers. Success here will breed broader market acceptance and further demand. Ultimately, we can envision pools of autonomous vehicles summoned by phone, computer, or calendar entry to transport individuals around town and eventually farther afield.

### Will multi-vehicle families remain the norm in the United States?

These trends—vehicle sharing and mobility on demand—will ultimately affect the size of the overall vehicle stock. Although households with two or more vehicles are still the norm across the United States, urban households already generally own fewer vehicles than the national average of 57 percent.

#### Households with two or more vehicles across the United States



Source: U.S. Census Bureau, 2013 American Community Survey

As the nation's population continues to age and move to urban centers, we believe the shift towards fewer vehicles per household will continue to become more prevalent. Autonomous vehicles will further accelerate this trend away from a two-vehicle household, with the second vehicle more likely to be one used on demand rather than kept in the garage.



## Element 8 – Data management:

Managing the wave of information

A tsunami of data will roll. Autonomous driving requires and generates significant information,<sup>44</sup> which will grow exponentially as the web of information becomes denser between vehicles, infrastructure, and other sources. In addition, the dashboard will become a nerve center connecting the driver to email, Internet, television, and phone. In this highly interconnected environment, data management—integrity, security, privacy, and analytics—becomes core to gaining customer trust and enabling the growth of the platform itself.

### Data security

It seems that hardly a week passes without news of another major data breach, with unauthorized hackers accessing reams of customer data and capturing corporate files. Autonomous driving will no doubt face serious security threats. That is the stark reality of today—and of tomorrow. It doesn't take much imagination to envision the scenarios: data theft, fake driver information, denial of service, residency identification, personal tracking, transportation system attacks, and the list continues to spiral.

The public is wary. Data attacks in other industries from banks to department stores surely add to the concern. The consumer will need to ultimately “trust” that information challenges are being properly addressed, and that the driving technology isn't prone to logical or system-wide failure. And there may be some gaps to address. A recent U.S. Senate survey of automobile manufacturers noted technology vulnerabilities. Senator Markey, a member of the Commerce, Science, and Transportation Committee noted, “Even as we are more connected than ever in our cars and trucks, our technology systems and data security remain largely unprotected.”<sup>45</sup>

This issue has not been lost on manufacturers. Data security will become an increasingly important component of the development process. Some of the array of potential technology responses to date have included vehicle identification, driver identification, data sanitization, data suppression, encryption, and tamper-proof hardware. More will need to be done, however, with significant time and investment to follow.

The amount of data involved will be staggering. It is predicted that by 2020, there will be >150 million connected vehicles on the road, generating 11 petabytes of data annually.<sup>46</sup> (A petabyte of data is one quadrillion bytes, or  $10^{15}$  – that's a lot of data!)

### Information privacy

We already live in a highly connected world, with cell phones, email accounts, and social networking apps all fixtures in our daily routine. Maintaining privacy in this environment can be hard. As the use of autonomous and connected vehicle solutions expands, keeping individual privacy may become even harder due to more sensing, tracking, and real-time behavior evaluation. Combining this driving data with other personal information raises further concerns. Important decisions about how information is collected, stored, and shared must be made.

Legislative eyes will focus more on the issues, we believe, unless the driving ecosystem – including insurers, manufacturers, and high-tech firms – can proactively organize and self-regulate. In fact, this trend has already started. In November 2014, several automobile manufacturers agreed to a voluntary set of principles on privacy, likely due to address concerns raised by a U.S. Senate inquiry on the topic.<sup>47</sup>

### Data analytics

The ability to gather, aggregate, and harness the information will be critical. Those organizations that glean insights from this pending wave of information will likely gain a competitive advantage. Insurance companies underwrite driver risk based on a snapshot view across a standard set of factors like miles driven and traffic violations. What happens when the driving information becomes real time and comprehensive? We believe there will be “black box” records containing details about the driving environment, the vehicle's every movement, and the driver's decisions. Another critical question is which insurance companies even have the ability to handle such a large volume of data.

## A new normal within a decade: Four potential phases of incremental change

The magnitude of change will be historic—perhaps the biggest change since the introduction of automobiles themselves a century ago. Clearly, a market conversion to autonomous vehicles will not happen overnight, and no one has a crystal ball to predict the future pace of change. However, based on a synthesis of our analyses, we believe that there will likely be four incremental stages of the transformation, moving from the current “training wheels” phase of curiosity and introduction into “full speed” as the vehicle stock starts to widely convert in 2025. Each phase of change will require advances within and alignment across the eight core elements, ultimately leading to a full transformation.



### Phase 1 – Training wheels

Introduction to autonomous vehicles as manufacturers roll out some of the underlying technology. High-tech companies express interest in fast-tracking production of fully autonomous vehicles.



### Phase 3 – Acceleration

Five years from now, fully autonomous all-speed vehicles become more common. V2V capabilities are likely to be embedded in all new vehicles and the increase in scale drives down costs, making the technology accessible to a larger segment of consumers.



### Phase 2 – First gear

In 2017, partial driver substitution technology is introduced. A broader set of consumers experience this technology, witnessing first-hand its safety and soundness. This helps shift market perceptions. Likely mandate from NHTSA for V2V communications.



### Phase 4 – Full speed

In 2025, a broad-based transformation begins. All new vehicles have autonomous capabilities and existing vehicles are potentially retrofitted. Over the next 15 years, integrated driving emerges, a web of information is flowing between vehicles, and infrastructure tightens. A new normal is realized by 2040.

## Four potential phases of incremental change

	Today	PHASE 1 2017	PHASE 2 2020	PHASE 3 2025	PHASE 4 2040
		<b>“Training wheels”</b>	<b>“First gear”</b>	<b>“Acceleration”</b>	<b>“Full speed”</b>
Technology		Preliminary passive	Partial driver substitution	Fully autonomous	Converged network – sensor + V2V communications
Capability accessibility		Selective safety options	Full product suite/ dropping price	Affordable technology	Full car stock conversion
Consumer adoption		Buzz-curiosity/ education	Broad consumer knowledge/ initial adoption	Embedded mainstream adoption	Broad market acceptance
Regulatory permission		Leader state adoption	Full state adoption	Rule harmonization V2V mandate	New vehicle/ potential retrofit
Legal responsibility		Conceptual design	Core strategies/ Initial lawsuits	Diversity of opinion/ Cases and appeals	Tort law clarified
Infrastructure		Existing roads	Experimental vehicle-to-infrastructure (V2I)	Broader V2I	Integrated driving
Mobility		Car sharing and ride-hailing	Rise of mobility on demand	Autonomous vehicle options	Autonomous fleets on demand
Data management		Vehicle “black box” data	Data security protocols	Driving system data Security responses	Privacy rules focus



**What happens if  
the transformation  
occurs sooner than the  
insurance industry  
anticipates?**



## Overcoming skepticism across the automobile insurance sector

The advent of the autonomous vehicle era is upon us. Our analysis has made increasingly clear that the automotive landscape is poised for radical change. The conversion to autonomous vehicles should change the amount, type, and purchase of automobile insurance. Building on the insights from KPMG's automotive research, our insurance task force asked: What do insurance companies think, and how prepared are they for the potential transformation ahead?

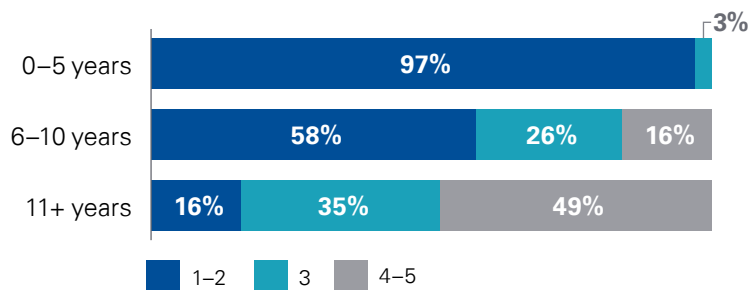
To answer those questions, KPMG conducted a survey of insurance company senior executives, whose companies in aggregate accounted for almost \$85 billion in personal and commercial auto premiums.<sup>48</sup> These will be the insurance leaders at the front line of change.

The survey found skepticism about the potential transformation. Few carriers have taken action—not due to doubts about the possible ramifications, but rather because most believe the change will happen far into the future, if at all. This point stands in contrast with the pace of change we anticipate. When the transformation starts to take hold, most respondents agreed that there will be major changes across all the core functions, from underwriting to claims. The executives surveyed also anticipated a shift in the insurance landscape, with traditional manufacturers and high-tech companies playing significantly bigger roles in the future.

The following section highlights a few key findings from the survey.

For a more in-depth view, please click here to access the full survey summary.

**Q** Over the time horizons shown below, what type of impact will driverless vehicles most likely have on your business? Rate each time horizon using a 1-5 rating scale where 1="No impact at all," 3="Somewhat significant impact," and 5="Extremely significant impact."



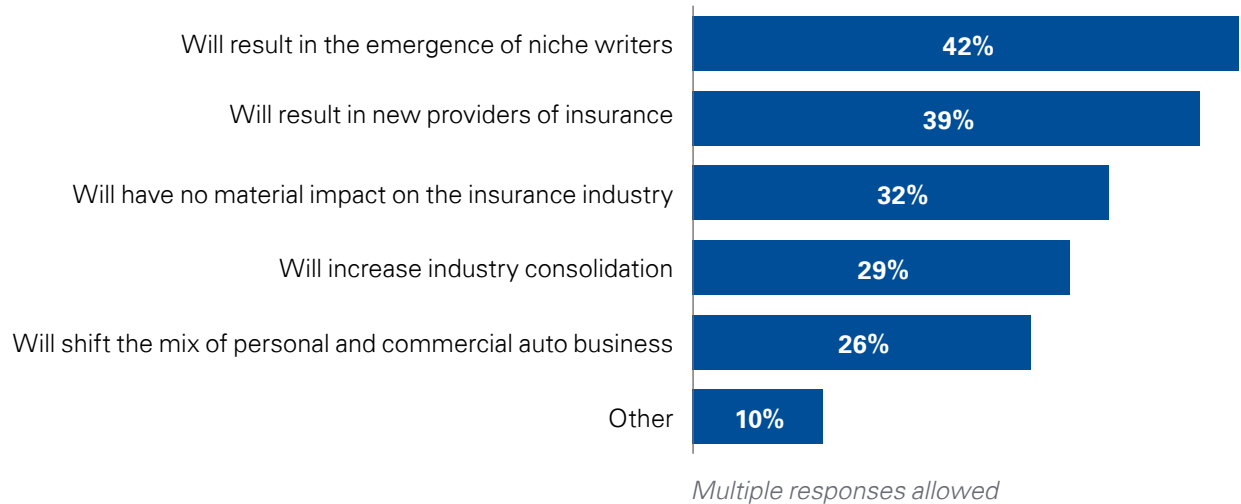
Source: KPMG LLP's 2015 Automobile Insurance in the Era of Autonomous Vehicles Survey Results

According to the insurance executives surveyed, most respondents believe the effects of self-driving vehicles will not have a significant impact on their business over the next decade. KPMG believes that the effects on the business will be realized sooner, and may be already upon us.

We respect this conservatism. In fact, we carried a similar viewpoint as we started our task force on this topic. The more we learned, however, the more we became convinced that the transformation is real and is happening now. As we have outlined in the front section of this paper, the core ingredients for a transformation are clearly aligning. Each day we read about more change around autonomous vehicles, and the momentum will only continue to pick up speed.

With each advancement, the implications for automobile insurers will become more pronounced. As we will describe in significant detail in the next section, we believe autonomous vehicles will dramatically affect an insurance company's entire business, from functional operations to market strategy. The survey responses acknowledged some of these implications, but many felt there will be no material impact or the changes will be relegated to niche underwriting practices. The scale of change may not be fully appreciated.

**Q** How do you think driverless vehicles will impact the insurance industry over the next ten years? (Select all that apply)



Source: KPMG LLP's 2015 Automobile Insurance in the Era of Autonomous Vehicles Survey Results

Over the next 10 years, survey respondents expect the emergence of niche writers and new providers of insurance to be the largest direct result of driverless vehicles, while 32 percent of firm leaders expect that driverless vehicles will have no material impact on the insurance industry. We are concerned that the scale of potential change over the next decade may not be fully appreciated.

Probably due to the belief that the effects of autonomous vehicles will be felt years away, few insurance companies have taken steps to prepare for the change. There have been internal conversations, but for many carriers, no meaningful focus, effort, or money spent has been directed towards the topic. This is a concern for us.

The implications for the insurance industry will likely be profound—the most disruptive since the industry's inception. There will be significant tactical demands—from setting new pricing schedules to updating policy forms and defining legal claim approaches. Computer systems will need to be changed, people will need to be trained, and customers will need to be managed. And perhaps not at first apparent—costs will likely need to be sliced to reflect a much smaller volume of business. Those efforts will take much time and money to address. A shift in business strategy will also likely take years to realize. Now is the time to act.

Some new entrants, such as Metromile, an insurance provider based out of San Francisco, have already started to act. The company offers usage-based insurance via an app for low mileage drivers and has also designed a policy to complement the commercial coverage of Uber drivers so they have personal auto insurance when they are not "on the clock." Dan Preston, CEO of Metromile, said, "The various macro trends impacting insurance—whether they be mobility on demand or autonomous vehicles—will continue to provide opportunities for product and technology-focused insurance businesses like ourselves. Nimble companies that offer innovative insurance products that address the needs of consumers in a rapidly changing driving landscape will be best positioned to succeed."<sup>49</sup> We believe that the market changes will present ample opportunities for those companies that continually innovate and adjust their business models.

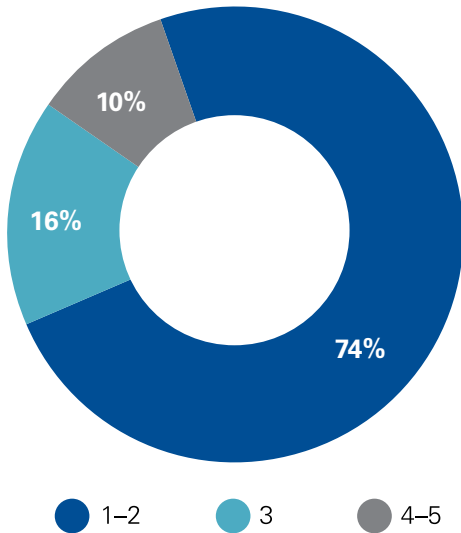


A shift in business strategy will  
also likely take years to realize.

**Now is the time to act.**

**Q** How prepared do you believe your organization is for driverless vehicles? Please rate on a 1-5 scale where 1="Not at all prepared" and 5="Extremely prepared."

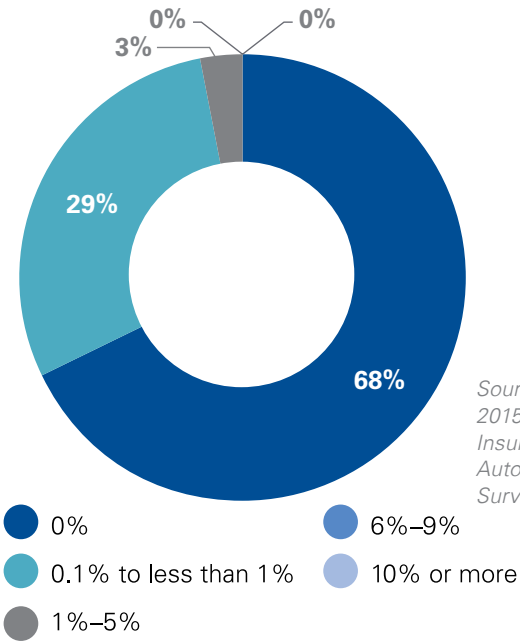
Of the participants polled, 74 percent feel they are unprepared for driverless vehicles.



Source: KPMG LLP's 2015 Automobile Insurance in the Era of Autonomous Vehicles Survey Results

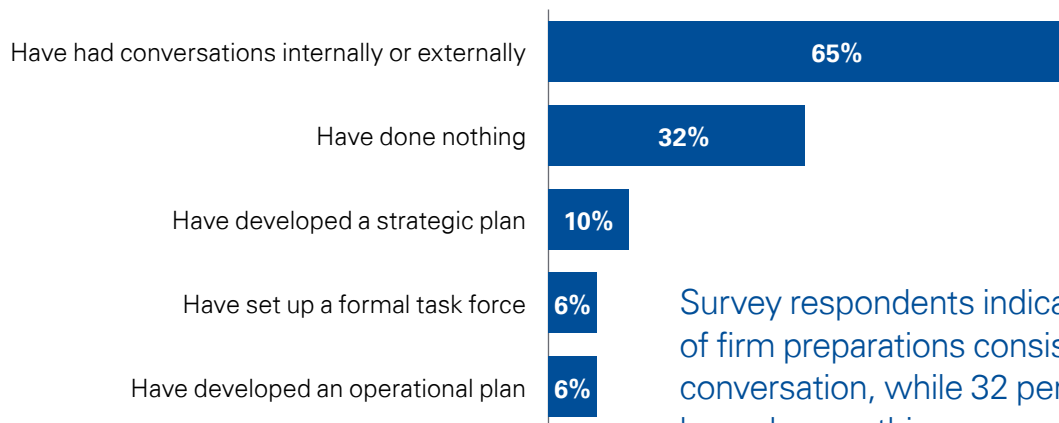
**Q** What percentage of your operations budget have you allocated to getting prepared for driverless vehicles? (Select one)

Only 3 percent of participating firms have allocated more than 1 percent of their operations budget toward preparing for driverless vehicles and 68 percent of respondents have allocated nothing.



Source: KPMG LLP's 2015 Automobile Insurance in the Era of Autonomous Vehicles Survey Results

**Q** What, if anything, has your company done to prepare for driverless vehicles? (Select all that apply)



Multiple responses allowed

Survey respondents indicated that the majority of firm preparations consist of internal or external conversation, while 32 percent of firms admit they have done nothing.

Source: KPMG LLP's 2015 Automobile Insurance in the Era of Autonomous Vehicles Survey Results

## Automation in trucking – In the passing lane

### A potential leading indicator?

The use of autonomous technology extends beyond automobiles to include large transportation vehicles like semi-trucks. In our discussions with executives at commercial auto insurers, the point was often raised that adoption of the technology could happen more quickly with trucking fleets. Some key considerations noted were driving limitations (such as caps on consecutive hours drivers can spend behind a wheel), scarcity of qualified drivers, and the high severity of trucking accidents.

Daimler is already experimenting in Nevada with a new version of its 18-wheeler – the Freightliner Inspiration. This test vehicle—which incorporates sensor, radar, and camera technologies—also offers some restricted self-driving highway capabilities.<sup>50</sup> With a potential for more efficient, safer, and profitable use of their fleets, long haul carriers could potentially lead in autonomous technology adoption and be a leading indicator of marketplace feasibility. Developments in this sector warrant on-going monitoring.



## Survival of the fittest: A new insurance landscape

While there will be a wide variety of effects on insurance from the rise of driverless vehicles, KPMG believes that the increased safety features of these vehicles will have the most profound impact on auto insurers over the long term. The components improving safety will be the underlying force behind industry trends such as reduced auto insurance market size, consolidation in the personal lines space, and dramatic operational changes within carriers.

### **Safety first!**

It all starts with safety.

With more than 90 percent of accidents each year caused by driver error, well-tested, road-ready safety technology—the beginning of which we have seen in traffic jam assist, lane departure warnings and other collision avoidance technology—will partially remove the erroneous human element of driving from the streets.<sup>51</sup> Furthermore, especially as fully autonomous vehicles become increasingly commercially viable over the medium term, human involvement in the driving experience will literally take more and more of a back seat.

The removal of the human element may yield substantial safety benefits. According to industry experts such as Dr. Josh Switkes, the founder and chief executive officer of Peloton, an automated vehicle technology company, “Automated vehicles can react much more quickly to events on the road, as the sensors, wireless communications and computers are dramatically faster than human perception and reaction. In addition, these sensors and computers can have a much higher reliability of detection compared to a human, partly because human beings cannot always pay attention to everything that is going on around them while they’re driving. With proper engineering, our roads will become significantly safer with the increased deployment of automated vehicle technology.”<sup>52</sup>

For example, it only takes roughly one tenth of a second for safety technology to react to a vehicle suddenly slamming on its brakes in front of you. While you, as a much slower, mere mortal, require at least one full second of reaction time to do the exact same thing.<sup>53</sup> That amount of time can mean the difference between crashing and not. And for an insurer, that’s the difference between paying a claim and not spending anything at all.

The safety technology of driverless vehicles can go beyond preventing mere fender benders, but can also have a more profound impact on road safety, helping to reduce crashes caused by drunk drivers. According to J.T. Griffin, the chief government affairs officer at Mothers Against Drunk Driving (MADD), “It’s pretty simple. The fewer intoxicated people behind the wheel operating a vehicle, the fewer injuries and deaths caused by impaired driving. Automated vehicles and the associated safety technology have the potential to save lives on our roads.”<sup>54</sup>

KPMG believes that, over the long term, with the vehicle stock being replaced by more and more autonomous vehicles, the risk profile of vehicles on the road will substantially decrease, leading to much lower total losses for carriers. The implications of radically safer vehicles will—in our view—change the insurance landscape.

### **Accident frequency could drop by 80 percent**

Working closely with our Automotive Team and leveraging their extensive research, the insurance task force developed actuarial models to translate the technology and market changes into shifts across the core factors that drive insurance company performance. In particular, our models estimated potential moves in:

- Autonomous technology adoption rates
- Accident frequency
- Severity trends
- Miles driven
- Size of the vehicle stock.

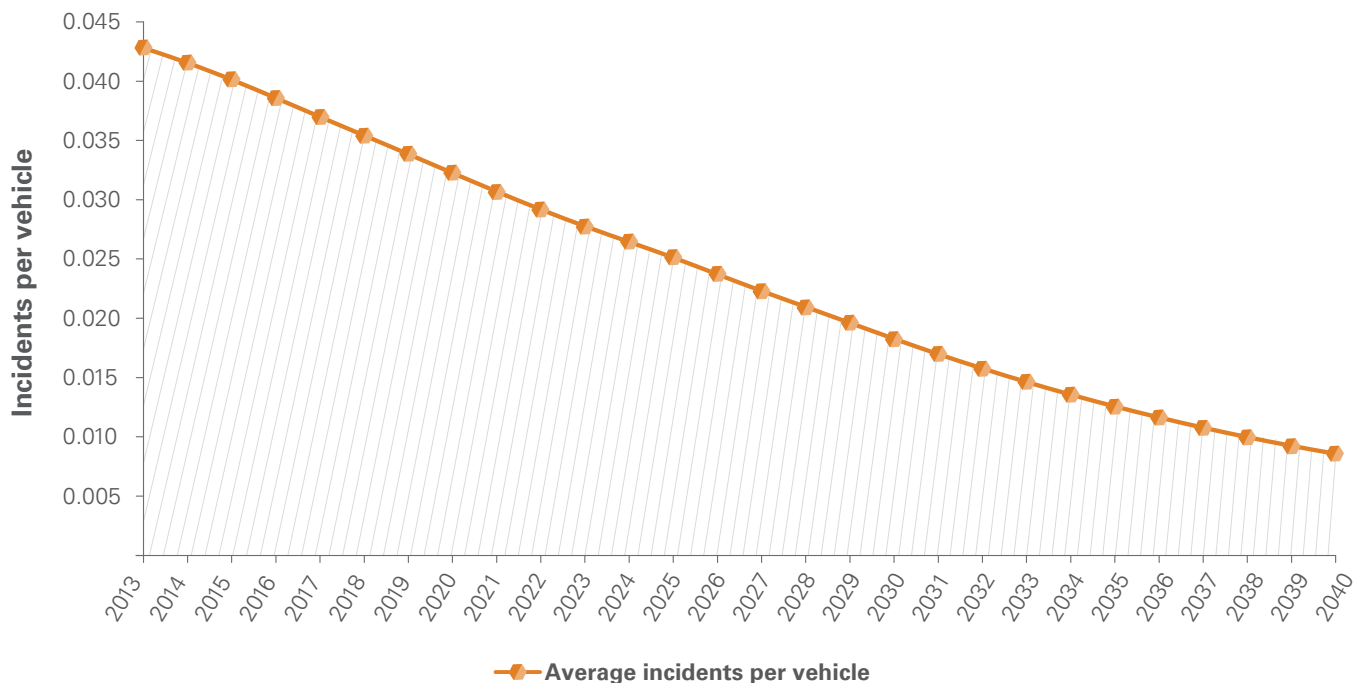
KPMG’s baseline scenario is presented below with accident frequency projected to 2040, taking into consideration a variety of factors, including the increased proliferation of safety technology such as accident avoidance and parking assist commonly found in driverless vehicles today until fully autonomous vehicles are widely available in 2025. In the final “full speed” phase of the conversion—from 2025 until 2040—the vehicle stock will likely be replaced by or retrofitted with autonomous technology. Our Team estimated an 80 percent potential reduction in accident frequency per vehicle by 2040, resulting in roughly 0.009 incidents per vehicle.<sup>55</sup> This change would result in a new normal—sooner than most in the industry anticipate.

Insurance companies will start to experience the effects of the autonomous technology soon, if not already. According to David Zuby, executive vice president and chief research officer of the Insurance Institute for Highway Safety, a nonprofit supported by the insurance industry and focused on increased safety on the nation’s roadways,

“Our research is showing that automating some parts of the driving task is leading to reductions in claim frequency. In particular, vehicles equipped with front crash prevention technology have a 7-15 percent lower claim frequency under property damage liability coverage than comparable vehicles without it. Further automation, if successful, could lead to even further reduction of insurance claims.”<sup>56</sup> As portfolios of new products—with each release offering more depth and breadth of autonomous technology—come to market, the downward drop in frequency will likely only continue.

Of course, accidents will never completely go away. Our models recognize this fact. Weather, road conditions, wayward animals, and technology failures will cause problems. Perhaps most importantly, we also expect that drivers will have the option to flip off the technology at times and drive manually instead. Interestingly, the level of self-driving may well become a core dimension of driving risk. Still, as better and faster driving decisions are made by the vehicle rather than by a human, the frequency of accidents is expected to decline.

Accident frequency per vehicle by year (baseline scenario)



Source: KPMG LLP actuarial analysis

### More expensive components could increase severity—maybe

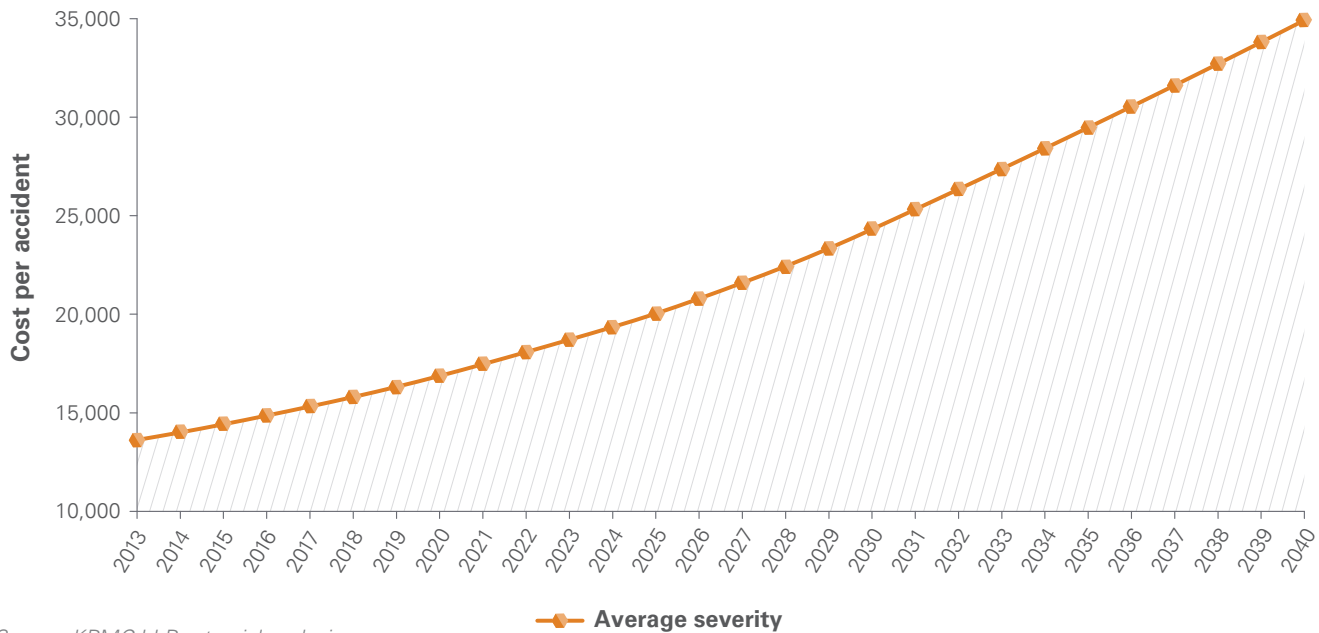
The potentially drastic reduction in incidents per vehicle will be somewhat offset by the increased severity incurred in each accident, given the greater likelihood of higher priced vehicles with more costly technology underpinning the autonomous capability. KPMG estimated the current accident expense could increase from almost \$14,000 to roughly \$35,000 by 2040.<sup>57</sup> There is some debate about how expensive the future vehicles may actually be. An alternative view is that vehicles—or at least a large subset—become more like “transportation pods,” which are inexpensive, basic vehicles used to move people in urban settings. Such a scenario could flatten or reduce severity.

While the increased exposure and severity assumptions both imply elevated losses, KPMG’s baseline scenario model suggests the decline in frequency could be even more pronounced with the average number of miles driven per accident increasing from roughly 280,000 miles per occurrence to an incident every 1.6 million miles by 2040.<sup>58</sup>

### Industry loss costs could drop by 40 percent

When combining the accident frequency and severity assumptions, there is the potential for a 40 percent plus drop in total losses in 2040 when compared to those of 2013.<sup>59</sup> We again took a middle-ground approach. For example, government mandates around the technology—including a broader and faster web of V2V technology—could further accelerate the downward frequency trend.

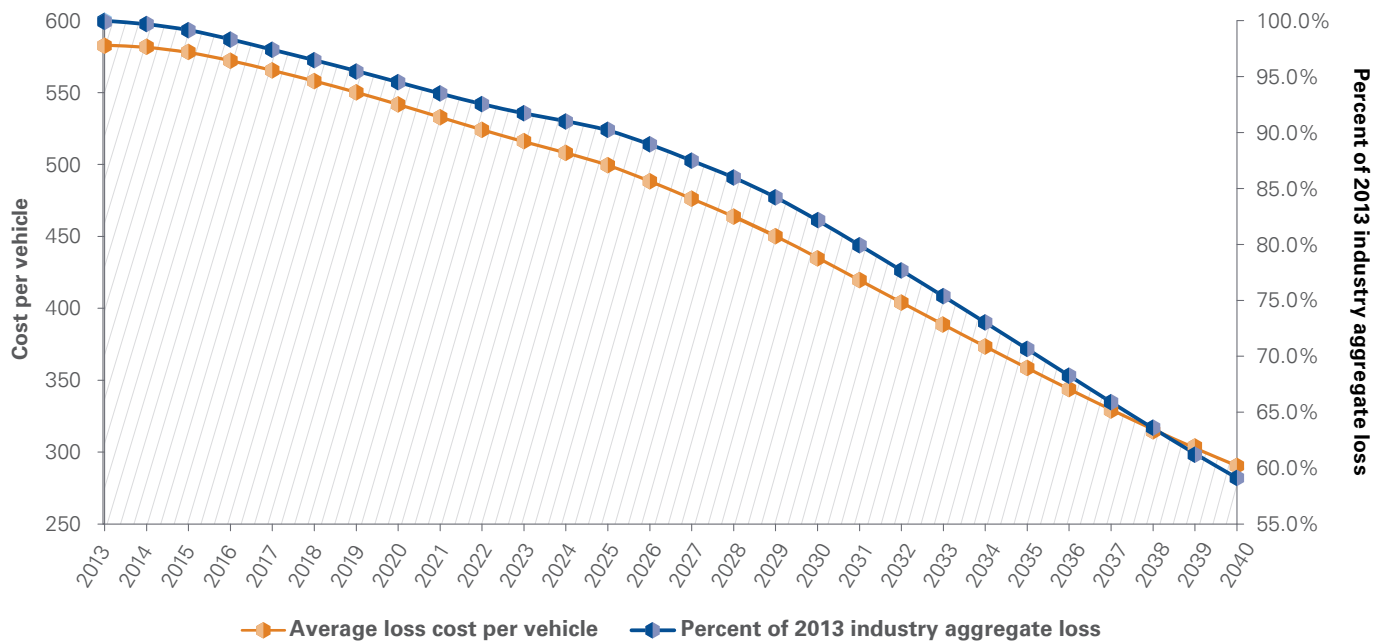
Severity per accident



Source: KPMG LLP actuarial analysis



Expected loss (baseline scenario)



Source: KPMG LLP actuarial analysis  
 Note: Based on total auto insurance market

**The mix of insurance lines will likely change**

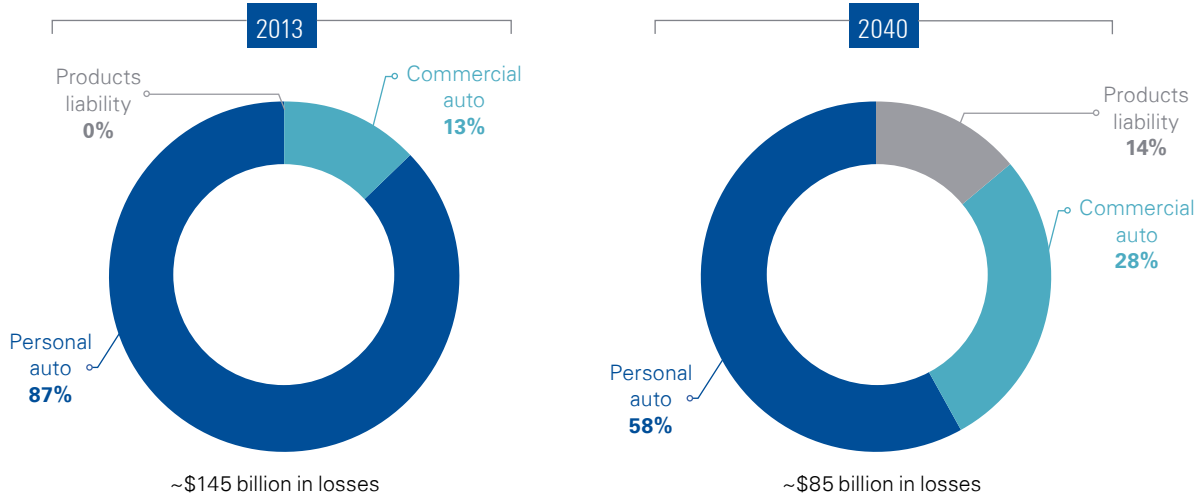
The allocation of the types of insurance coverage could also change. Our analysis suggests that commercial lines could take a larger share, as the marketplace moves towards vehicle sharing and mobility on demand. As the vehicle makes more decisions, the potential liability of the software developer and manufacturer will increase too. Both of these factors would further reduce the share of the personal automobile insurance sector.

The trend towards vehicle sharing and mobility on demand is clear, with this more efficient use of vehicles now a common part of urban living.

As households decide to use fleets on demand—imagine a Zipcar pulling into your driveway after you summon it on your smart phone—they could decide not to buy a second vehicle, which could result in a smaller personal auto car stock. As a result, KPMG believes personal auto losses could decline, while commercial auto insurance, which covers these fleets, would account for a larger percentage of the overall losses.

Furthermore, according to our analyses, losses covered by products liability policies will most likely increase due to the fact that the sophisticated technology that underpins driverless vehicles will also need to be insured.<sup>60</sup>

Loss splits between personal auto, commercial auto, and products liability



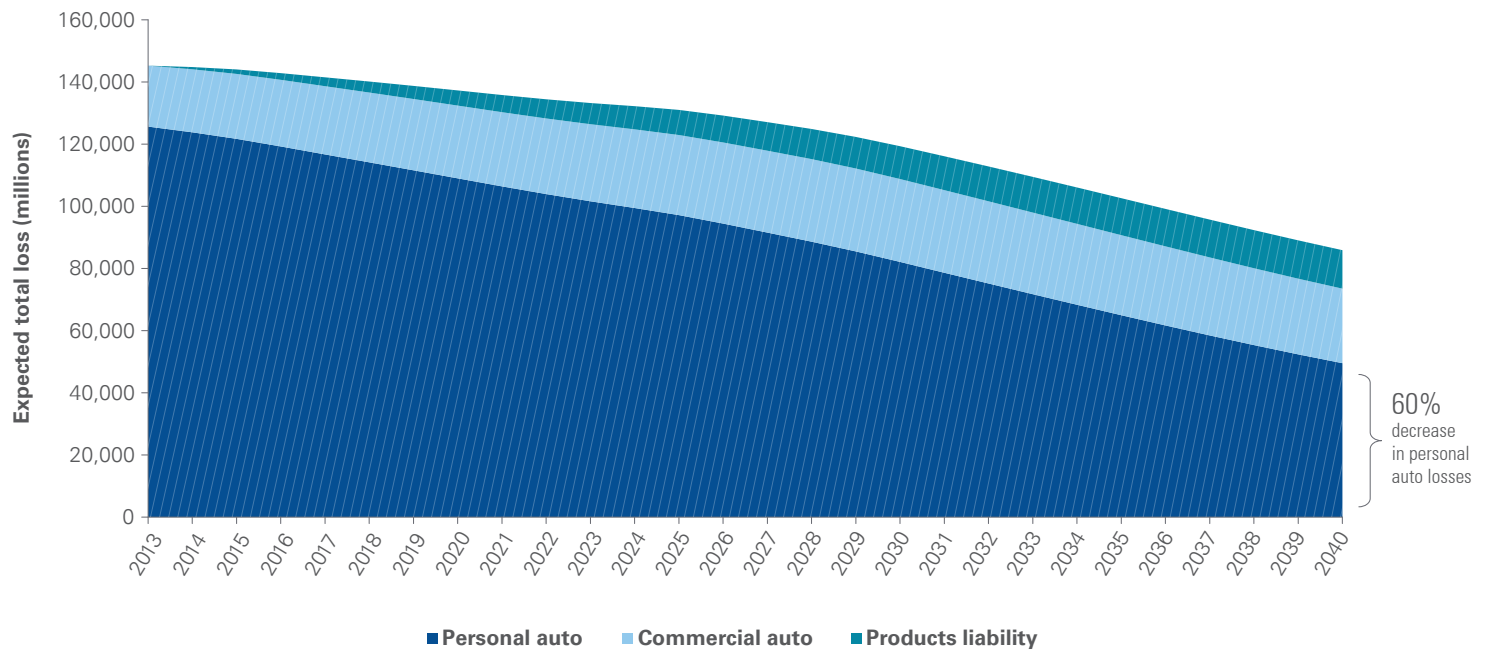
Source: KPMG LLP actuarial analysis

**The personal lines sector could fall to 40 percent of current size**

When we pull together all of the analyses, the indications are clear. The personal lines automobiles sector will likely bear the brunt of the transformation, as it will hold a smaller share of a

smaller market. Currently, the personal auto sector accounts for roughly \$125 billion in loss costs. By 2040, we believe this sector could cover less than \$50 billion in loss costs.<sup>61</sup>

Expected loss allocated to products liability, personal auto, and commercial auto



Source: KPMG LLP actuarial analysis

**Lower losses lead to lower premium**

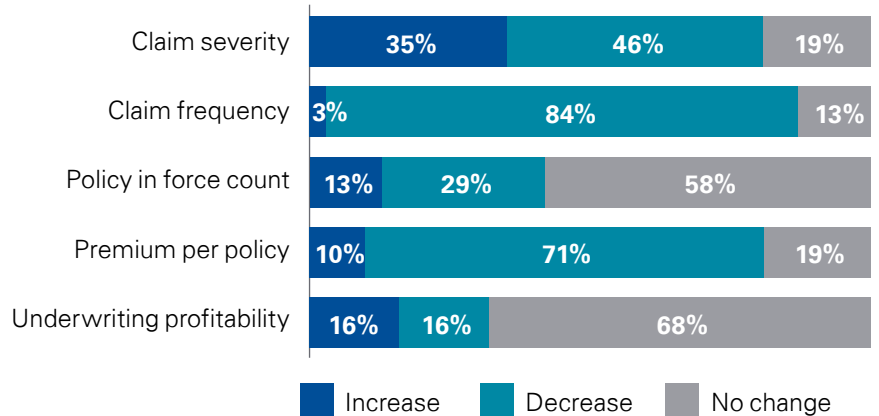
Premium follows loss costs. Whether personal or commercial, auto insurance is a mature and competitive industry and given these market potential dynamics, it would be naïve to think that premium will stay the same while losses drop, thereby dramatically increasing underwriting profit for carriers. To the contrary, KPMG believes that carriers could potentially drop price in order to stay competitive. Plus, consumers will no doubt demand lower premiums to reflect fewer accidents.

As the size of the market shrinks, we anticipate the potential for frenzied competition as firms attempt to maintain premium volume to cover basic operational expenses or preserve market share. Carriers could potentially lose sight of pricing business for profit. This irrational pricing behavior by either well-capitalized or troubled companies could result in a dangerous downward underwriting spiral for the broader industry. Things could get ugly.

Our survey respondents held a different view of the future. While 71 percent agree that premium per policy will decrease over time, 68 percent held the opinion that underwriting profitability will remain the same.<sup>62</sup> This may be due to the fact that carriers believe that, over the long run, their cost structures will be variable leading to a lock step downward trend in expenses as premium falls. Many carriers, however, may lack the structural agility to reduce costs fast enough in the near or medium term, to adequately respond to a potential fall in premiums. We are concerned that insurance company profits could be severely challenged by a combination of irrational pricing pricing and inelastic costs.

**Q** How do you believe driverless vehicles will most likely impact your business model from the following perspectives? (Select one for each category)

Insurance industry executives perceive that the adoption of driverless vehicles will likely decrease both claim frequency and premium per policy. Interestingly, the survey respondents also predicted little affect on underwriting profitability. We believe, however, that industry profits will be severely tested in the new environment.



Source: KPMG LLP's 2015 Automobile Insurance in the Era of Autonomous Vehicles Survey Results

**As the size of the market shrinks, we anticipate frenzied competition as firms attempt to maintain premium volumes to cover operational expenses or market share.**

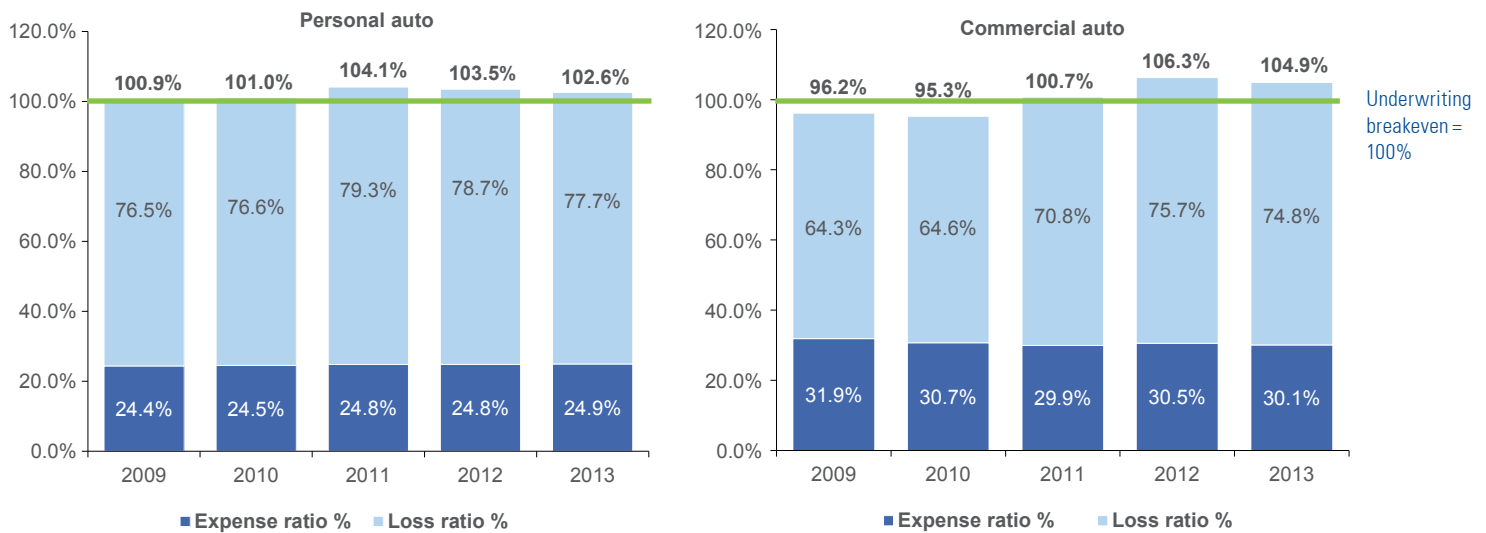
There is no profitability cushion to erode. Once the massive market disruption begins—flipping insurance business models upside down—we predict that there will be significant turmoil across the industry.

### No margin for error

To fully appreciate the implications of a contracting premium environment, let's first look at the historic level of profitability for automobile insurance. Competition has been strong, and the industry has been at a break-even point or worse for the past several years. Simply put, whether in personal or commercial auto insurance, carriers aren't making much money on underwriting activities. In fact, according to the most recent comprehensive statutory data analyzed by KPMG, the last year the industry as a whole generated an underwriting profit was 2010 in commercial auto. The last time private auto did this? 2008. Industry combined ratios from 2009 to 2013 averaged 102.4 percent and 100.7 percent for private and commercial auto, respectively.<sup>63</sup> On an aggregate basis, carriers are not making money underwriting automobile insurance.

So to put this in perspective, carriers are losing money by providing these coverages in what is considered a "normal" market environment—one without fully autonomous vehicles. If insurers are having difficulty generating an underwriting profit now, how are carriers going to make money in the future when the onslaught of driverless vehicles will put considerable strain on their businesses? There is no profitability cushion to erode and once the massive market disruption begins—flipping insurance business models upside down—we predict that there will be significant turmoil across the industry.

### Automobile insurance – Industry combined ratio



Source: Gross combined ratios calculated by KPMG LLC using statutory data from SNL Financial

Note 1: Combined ratio total may not be equal to the sum of the expense ratio and loss ratio due to rounding

Note 2: All figures on direct basis

**Beware of the clunky cost structures**

Insurance companies have both variable and fixed type of expenses. For example, claim costs and commission expenses are highly variable—the more premium written, generally speaking, the more loss and agent payments an insurer will incur. In contrast, general expenses—those associated with buildings, systems, and management—tend to stay relatively fixed. In between, there are several categories of semivariable costs associated with acquisitions, claims handling, and legal defense.

From our experience working with insurers of various sizes across all lines, we have noted that many do not possess the structural agility to shed cost quickly, especially in an environment of rapid change. This lack of flexibility could be due to a variety of factors such as non-scalable, legacy technology, outdated processes, or a protective culture of no employee reductions.

Given the cost structure limitations of many insurers and the fixed components of their expense bases, a shrinking premium pie, which KPMG believes is a strong possibility in the world of driverless vehicles, could have significant detrimental profitability implications. Insurers with clunky cost structures who are not appropriately prepared for the onset of driverless vehicles, could face distorted underwriting profitability ratios quickly.

KPMG has put together a simple analysis – for a hypothetical P&C personal lines carrier – intended to illustrate the potential impact on insurer underwriting profitability given sticky expense bases in the world of a contracting premium pie. Per the chart below, the categories of underwriting expenses according to statutory filings have been divided into several different categories with corresponding adjustments or “cost fluctuations” to match changes in premium.

More specifically, cost fluctuation represents the percentage change in expenses associated with a reduction in premium. So, for example, incurred losses are classified as a variable expense with 100 percent cost fluctuation. This means that a \$1 decrease in premium would result in a corresponding 100 percent decrease in incurred losses or \$1. A step variable expense, such as defense and cost containment expenses, would reduce by \$0.75 or 75 percent, with a \$1 decrease in premium. And assuming that all fixed expenses have some element of variability over time, a \$1 drop in premium would result in a 25 percent or \$0.25 decline in fixed costs such as general expenses.

Personal line company example

Combined ratio cost components:	Type of expense	Potential cost fluctuation
Incurring losses	Variable	100%
Defense and cost containment expenses	Step-variable	75%
Adjusting and other expenses	Fixed	25%
Commissions and brokerage expenses	Variable	100%
Taxes, licenses and fees	Variable	100%
Other acquisitions, field supervision and collection	Step-variable	75%
General expenses	Fixed	25%

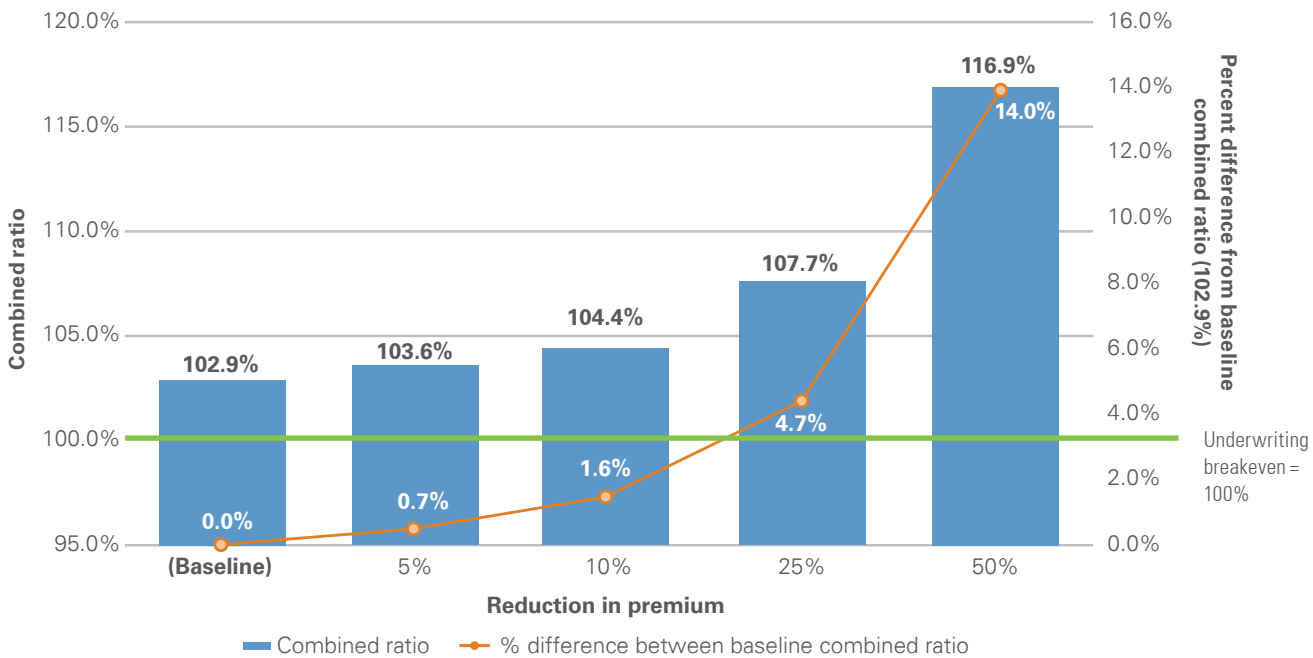
*Note: Combined ratio components per statutory filings in SNL Financial*

The sensitivity of the combined ratio given a 5 percent, 10 percent, 25 percent or 50 percent drop in premium over the next five years is compared to the “baseline” combined ratio. Consistent with other analyses in this white paper, the industry is not even breaking even on underwriting activities in a “normal” environment, let alone one with falling premium.



As illustrated in the chart below, the combined ratio, despite incorporating the downward adjustments to the carrier's cost structure, increases from the baseline 102.9 percent—which represents the recent historical aggregate combined ratio for both personal and commercial auto—to as much as 116.9 percent, assuming a 50 percent reduction in premium.<sup>64</sup> While a 50 percent reduction in premiums may not be realistic in the near-term, a major contraction in premiums must eventually follow the fall in losses. The key point is that the proliferation of autonomous vehicles has significant potential to strain auto carrier profitability.

Potential impact on combined ratio due to fall in premium (personal lines example)



Source: SNL Financial and KPMG LLP Analysis

Note 1: Illustrative example

Note 2: In the reduction in premium scenario, the difference between calculated combined ratios and the baseline ratio may not be exact due to rounding

In summary, there will be detrimental profitability consequences for insurers who do not proactively plan and manage expense bases far in advance of the shrinking premium pie. Given that the results of the survey indicate that nearly three quarters of carrier respondents believe their organization is unprepared, KPMG believes the probability of increasing combined ratios for many insurers is high.



The automobile insurance marketplace will likely face unprecedented change, with traditional business models up-ended. The turmoil will bode trouble for many but could also provide opportunity for others that chart a course of differentiation.

### Eat or be eaten

KPMG believes there could be potential for large scale consolidation across the industry. Without implementing enterprise wide preparations for autonomous technology, many personal and commercial auto carriers will be left particularly vulnerable from a competition perspective. The transformation could ultimately affect all dimensions of an insurer's business. The tactical responses will likely take much time and resources, with strategic moves taking significantly more. Yet, according to the KPMG survey, less than 10 percent of respondents have set up a taskforce, or developed a strategic/operational plan to ready themselves for this change.

Insurers that have adequately prepared their business models for driverless vehicles are likely best positioned to survive this industry game changer, while the odds are high that those companies that maintain a business as usual approach could suffer severe consequences. As the industry contracts – with the potential for irrational pricing in the process – unprepared companies could suffer significant financial losses, compelling them to potentially seek out strategic alternatives for their auto books or companies as a whole.

A new insurance landscape could emerge that consists of a few mega-large 'Mother Mutuals' and 'Scale Whales' strategically focused on profits through scale of operation, with a small set of niche players. The scale players – likely well capitalized forward thinking stock or mutual carriers – could gobble up smaller, unscalable businesses with less flexible cost structures and minimally diversified risk portfolios.

More specifically, subscale P&C carriers with high concentrations of personal auto in their overall book will likely be affected the most. Additionally, non standard auto carriers, who write risks of drivers who, amongst other factors, may not have the most stellar driving record, will also probably be under pressure due to the fact that the safety technology of driverless vehicles may reduce their customers' risk profiles, enabling them to be covered by a standard, rather than a non preferred, policy.

### Possible business strategies



#### Consolidate

With the size of industry likely to contract, there will be fewer places at the table. We envision 'scale' whales and 'mother mutuals' to dominate through economies of scale advantages.



#### Diversify

Move into other products that could potentially shield the company from challenges across the personal auto line of business.



#### Innovate

With new areas of risk, there will be new areas to provide insurance protection. Identify these areas and launch new products to meet the needs, but recognize that competition will follow. Will there be a first mover advantage?



#### Partner and ally

Consider new business models and where insurance could be embedded into the cost of a vehicle or part of usage fees? These new models will likely require partnering with others, but alliances may be few and fast to happen.



**Convergence of consumer and automotive technologies** along with the rise of mobility services could transform the way we drive and commute – and in turn could change the amount, type, and purchase of automobile insurance.



# Key considerations

We are convinced that a period of unprecedented change has begun. As insurance companies start to navigate through the shifts ahead, we believe that industry executives will need to first contemplate and then ultimately address a series of key considerations related to the conversion to autonomous vehicles and the implications on their organizations.

Now is the time for robust discussion. To get the conversation started, we have identified an initial set of questions for an insurance company to consider.

## Timing and competitive landscape



### Timing

- » What if the conversion to autonomous vehicles happens faster than you expect?
- » What type of scenario analyses have you conducted? Did the “what if” cases capture an array of timing possibilities, ranging from distant change to fast-track implications? What scenario does your organization believe to be most likely? Why?
- » Who will be the early adopters? How prevalent are these individuals in your customer base?
- » How does vehicle sharing, ride sharing, and mobility on demand affect your book of business? What happens if the size of the vehicle stock starts to drop?
- » How is your organization monitoring the changes in the marketplace? How will you know to shift course? What are your leading indicators?
- » How much lead time will you need to get ready? How does the amount of preparation time vary across the tactical and strategic actions?



### Competitive landscape

- » Who are the potential insurance winners in this future marketplace? Why are they well advantaged? What can we do to gain similar strength?
- » What firms could be new entrants? What is their competitive advantage?
- » If industry premium gets smaller, the pie gets smaller—which firms will thrive? Why? How could your organization respond to potential market consolidation?
- » Will pricing remain rational as the market starts to shrink? With margins already tight across the sector, how can further price erosion be handled?

## Functional responses



### Product development

- » What will be the new areas of risk in an autonomous environment?
- » With more decisions made by the vehicle, how will products liability be handled?
- » How will fleet and commercial coverage grow?
- » What new product models will evolve (insurance coverage part of cost of vehicle)?
- » What type of niche opportunities can be pursued?



### Underwriting

- » If driver variability becomes more standard, what are the appropriate factors of risk?
- » What happens to non-standard and high-risk programs?
- » How will the organization absorb real-time data that captures every movement of the vehicle and decision by the driver?
- » Who owns the vehicle data? What happens if the vehicle manufacturer or some high-tech firm like Google controls and/or keeps the “black box” driving data?
- » What about data privacy and security?

---

# The magnitude of change will be historic

—perhaps the biggest change since the introduction of automobiles themselves a century ago. Clearly, a market conversion to autonomous vehicles will not happen overnight, and no one has a crystal ball to predict the future pace of change.

---



## Rating

- » What will be the effects of the new capabilities—accident avoidance, lane change warnings, self-parking—on loss frequency? Has your company already started to see a change?
- » What could the effects be of the next generation of products like stop-and-go piloting and V2V communications? How best to conduct the analysis?
- » When will customers start to demand a discount for these features? How much is appropriate?
- » What happens if there is a permanent downward decline in loss frequency? How will rates change in response?
- » How will severity change?
- » Will new rate plans be needed? When? How best to file with state regulators? Should conversations be started?
- » Does a not-at-fault construct make sense?



## Distribution

- » What type of insurance distribution is appropriate when vehicles are autonomous?
- » With the level of premiums likely to decline following the drop in loss costs due to lower frequency of accidents, how much can be spent to acquire business?
- » How do channels need to be educated?



## Claims

- » Who holds liability in the case of an accident—driver, manufacturer, driving software manufacturer? How will this liability shift as the vehicle makes more decisions?
- » What is the appropriate legal strategy?
- » Does there need to be an industry-wide approach for traction and consistency? Does lobbying need to begin? What do you want to accomplish? Can you shape tort law and shape precedence?

## Strategic options and change management



### Cost structure and expense management

- » What is the right level of investment to make? How does this change over time? What triggers additional investment?
- » How much to invest to update core systems—underwriting, rating, claims—in an environment of flux? What is critical versus optional?
- » Do your current and future IT plans contemplate the effects of autonomous technology?
- » If premium volume falls, how will costs be reduced? How much? What is the current cost structure? Where to cut first? What are the variable and fixed components?
- » How quickly can costs be cut?



### Strategic change

- » What is your business strategy and operating model in the future marketplace?
- » What will be your competitive advantage?
- » How will you make money?
- » What is the right mix of business?
- » Is there an ability to leverage and monetize your data?
- » Do you expand into new products and areas? What will that take? Is there brand permission to do this? What is the available market?
- » Are there alliances and partnerships to consider? Who and why? How quickly will the market move to lock in these agreements?
- » What are the expectations of key stakeholders—policyholders, shareholders, debt holders, etc.?



### Change management

- » Does your organization genuinely believe that autonomous vehicles will be a “game changer”? If not, how can they be convinced that it is, in fact, a serious threat?
- » What messages do you want to send to your organization? How do your messages vary by key internal stakeholders?
- » How best to manage external stakeholder? What should be the actions for and messages to policyholders, shareholders, regulators, and rating agencies?
- » Does the company structure need to change? What about its culture?
- » How much do you and your organization know about autonomous vehicles—the technology, manufacturer commitments, consumer adoption, and regulatory requirements?
- » Who needs to know? What do they need to know—what is relevant and important? How does this vary by constituent?
- » How will your organization educate its employees? Should there be a formal education curriculum and training? Who drives this effort?



### Risk management

- » What are the risks—strategic, operational, financial, and reputational—of this transformation on the organization?
- » How should these risks be monitored, measured, and reported?
- » What is the financial exposure? How best to quantify the potential effects?
- » Who is responsible to manage the risk? What level of oversight and governance is needed? By whom?
- » How should these risks be mitigated?

# Next steps – call to action

In this marketplace of uncertainty, we recommend auto insurers take a combination of strategic and tactical efforts.





## KPMG can help

KPMG remains at the forefront of the conversation about autonomous vehicles—we bring our breadth of leading research around the marketplace transformation as well as the depth of knowledge to discuss the potential effects on the insurance industry. Our Team of professionals can help you evaluate your strategic options and also support your tactical efforts.

**We look forward to the opportunity to have a conversation with you soon.**

Our Insurance and Automotive practices have issued a series of leading research. In case you missed these papers, you can download them now.

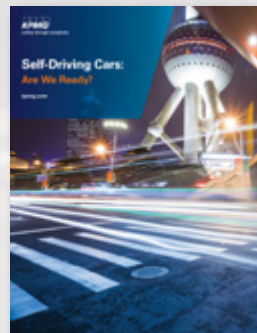


### KPMG's Insurance practice

KPMG's survey on this topic, ***Automobile insurance in the era of autonomous vehicles***, has been cited in a variety of domestic and international publications.

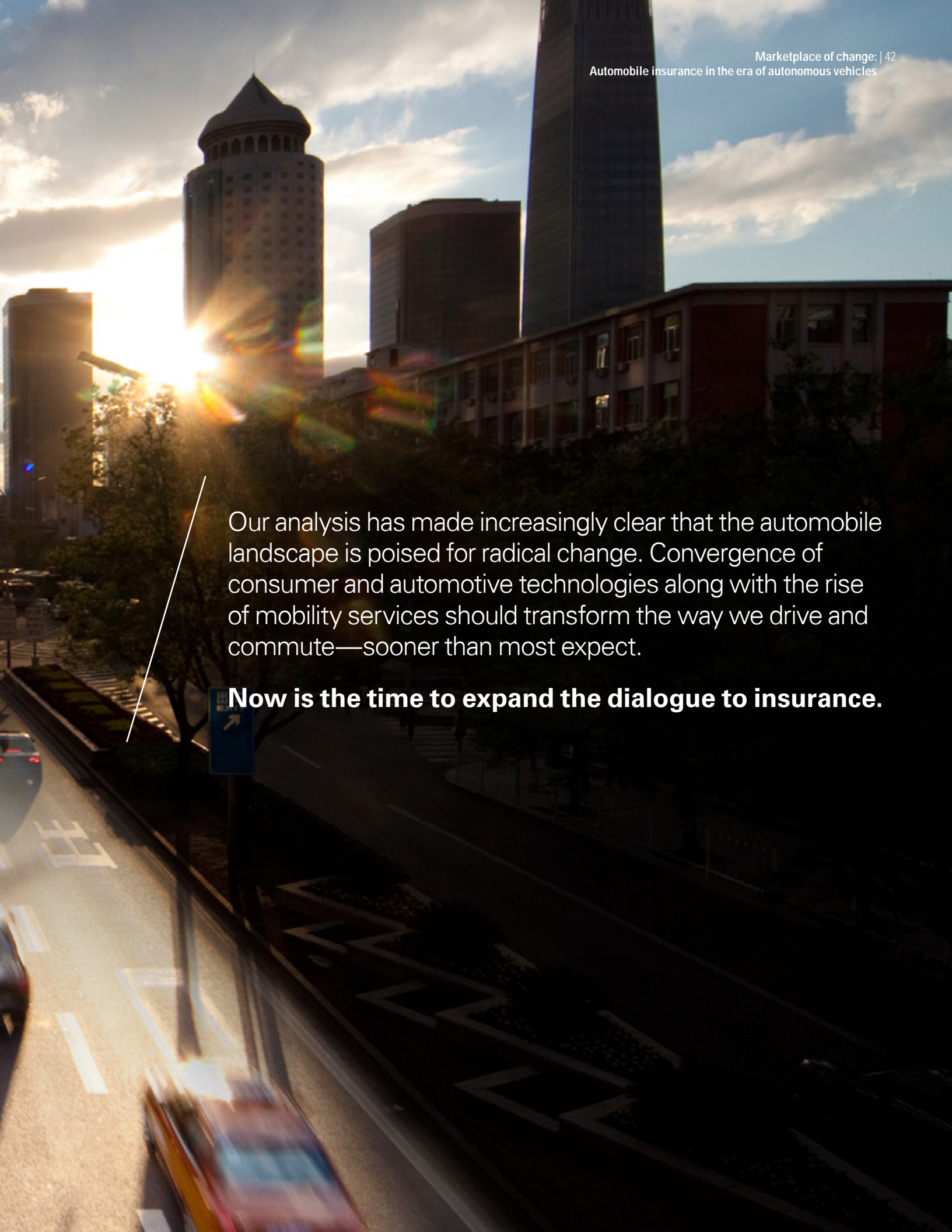
### KPMG's Automotive practice

In case you missed them, you can download from KPMG's Web site our previous papers related to the future of the automotive industry.



---

**A special thanks to the following individuals for their contributions on this white paper:**  
Amitai Bin-Nun, Garrett Branisel, Nick Failla, Laura Hay, Dylan Jaffee, Richard Kertis, Nate Loughin, Matt McCorry, Gary Silberg, Heather Stead, and David White.

A photograph of a city street at sunset. The sun is low on the horizon, creating a bright lens flare and casting long shadows. In the background, several skyscrapers are visible, including a prominent one with a rounded top. In the foreground, a car is blurred, suggesting motion. A blue street sign with a white arrow pointing right is visible on the left side of the road.

Our analysis has made increasingly clear that the automobile landscape is poised for radical change. Convergence of consumer and automotive technologies along with the rise of mobility services should transform the way we drive and commute—sooner than most expect.

**Now is the time to expand the dialogue to insurance.**

## End notes

1. "Automobile insurance in the era of autonomous vehicles survey results," KPMG LLP. 2015.
2. Silberg, Gary. "Me, my car, my life.. in the ultraconnected age," KPMG LLP. 2014. <https://www.kpmg.com/us/en/IssuesAndInsights/ArticlesPublications/Documents/me-my-life-my-car.pdf>
3. Actuarial analysis, KPMG LLP. 2014.
4. Weiner, Gabriel and Bryant Walker Smith. "Automated Driving: Legislative and Regulatory Action," September 3, 2014. [Cyberlaw.stanford.edu/wiki/index.php/Automated\\_Driving:\\_Legislative\\_and\\_Regulatory\\_Action](http://cyberlaw.stanford.edu/wiki/index.php/Automated_Driving:_Legislative_and_Regulatory_Action)
5. "Preliminary Statement of Policy Concerning Automated Vehicles," NHTSA. May 30, 2013. <http://www.nhtsa.gov/search?q=self-driving&x=-1094&y=-12>
6. "Federal Motor Vehicle Safety Standards: Vehicle-To-Vehicle (V2V) Communications," NHTSA. August 20, 2014. Web. April 15, 2015. <http://www.regulations.gov/#!documentDetail;D=NHTSA-2014-0022-0002>
7. Silberg, Gary. "Self-Driving Cars: Are We Ready?" KPMG LLP. 2013. p 22. <https://www.kpmg.com/US/en/IssuesAndInsights/ArticlesPublications/Documents/self-driving-cars-are-we-ready.pdf>
8. "Big Data And The Connected Vehicle – When We Build It, The Data Will Come," Intelligent Transport Systems, 21st World Congress. September 8, 2014. <http://detroit2014.itsworldcongress.org/sessions/big-data-and-the-connected-vehicle-when-we-build-it-the-data-will-come/>
9. Taylor III, Alex. "General Motors and BMW Venture Capital Arms Gain Momentum," Fortune. February 23, 2011. Web. June 24, 2015. [http://archive.fortune.com/2011/02/23/autos/general\\_motors\\_bmw\\_venture\\_capital.fortune/index.htm](http://archive.fortune.com/2011/02/23/autos/general_motors_bmw_venture_capital.fortune/index.htm)
10. Thomson Reuters Research. Web. June 25, 2015.
11. "Intel Capital to Invest in Future of Automotive Technology," February 29, 2012. Web. June 8, 2015. [http://newsroom.intel.com/community/intel\\_newsroom/blog/2012/02/29/intel-capital-to-invest-in-future-of-automotive-technology](http://newsroom.intel.com/community/intel_newsroom/blog/2012/02/29/intel-capital-to-invest-in-future-of-automotive-technology)
12. Edelstein, Stephen. "Volvo Traffic Jam Assistance Brings Self-driving Cars One Step Closer," Digital Trends. N.p., October 25, 2012. Web. April 14, 2015. <http://www.digitaltrends.com/cars/volvo-traffic-jam-assistance/>
13. Kurylko, Diana T. "Mercedes-Benz's Autonomous Driving Features Dominate the Industry – and Will for Years," Automotive News. N.p., August 4, 2014. Web. April 14, 2015. <http://www.autonews.com/article/20140804/OEM06/308049979/mercedes-benzs-autonomous-driving-features-dominate-the-industry>
14. "BMW at the Consumer Electronics Show (CES) in Las Vegas 2014," July 1, 2014. Web. June 25, 2015. [https://www.press.bmwgroup.com/usa/pressDetail.html?title=bmw-at-the-consumer-electronics-show-ces-in-las-vegas-2014&outputChannelId=9&id=T0163066EN\\_US&left\\_menu\\_item=node\\_\\_5238](https://www.press.bmwgroup.com/usa/pressDetail.html?title=bmw-at-the-consumer-electronics-show-ces-in-las-vegas-2014&outputChannelId=9&id=T0163066EN_US&left_menu_item=node__5238)
15. Moscaritolo, Angela. "Nissan: Expect Self-Parking Cars by 2016," PCMag. N.p., July 17, 2014. Web. April 14, 2015. <http://www.pcmag.com/article2/0,2817,2461031,00.asp>
16. Vijayenthiran, Viknesh. "Audi A8 To Adopt Autonomous Traffic Jam Assistant In 2016: Video," Motor Authority. N.p., January 24, 2013. Web. April 14, 2015. [http://www.motorauthority.com/news/1081891\\_audi-a8-to-adopt-autonomous-traffic-jam-assistant-in-2016-video](http://www.motorauthority.com/news/1081891_audi-a8-to-adopt-autonomous-traffic-jam-assistant-in-2016-video)
17. Ireson, Nelson. "Tesla To Make Fully Autonomous Cars By 2016?" Motor Authority. N.p., September 18, 2013. Web. April 14, 2015. [http://www.motorauthority.com/news/1087030\\_tesla-to-make-fully-autonomous-cars-by-2016](http://www.motorauthority.com/news/1087030_tesla-to-make-fully-autonomous-cars-by-2016)
18. "Company Overview," Mobileye. Web. April 14, 2015. <http://www.mobileye.com/about/>



19. Naughton, Keith. "GM to Introduce Hands-Free Driving in Cadillac Model," Bloomberg. September 7, 2014. Web. June 25, 2015.  
<http://www.bloomberg.com/news/articles/2014-09-07/gm-to-introduce-hands-free-driving-in-cadillac-model>
20. Silberg, "Self-Driving Cars: Are We Ready?" op. cit., p. 7.
21. Cava, Marco Della. "A Look inside the Google Car Lair," USA Today. March 17, 2015. Web. April 14, 2015.  
<http://www.usatoday.com/story/tech/2015/03/17/google-car-usa-today-visits-search-company-autonomous-car-lair/70302176/>
22. Tweedie, Steven. "Here's Our Best View Yet of Apple's Alleged Self-driving Car Prototype," Business Insider, Inc. April 1, 2015. Web. June 25, 2015.  
<http://www.businessinsider.com/best-video-of-apple-self-driving-car-prototype-2015-4>
23. Cathers, Tristan, and Max Katsarelis. "Who Will Be the First to Sell an Autonomous Car?" Mojo Motors Blog. N.p., November 13, 2014. Web. April 14, 2015.  
<http://www.mojomotors.com/blog/7-companies-to-launch-driverless-cars-by-2020/>
24. "Federal Motor Vehicle Safety Standards: Vehicle-To-Vehicle (V2V) Communications," NHTSA, op. cit., p. 1.
25. Tweedie, "Here's Our Best View Yet of Apple's Alleged Self-driving Car Prototype," op. cit.
26. Baptiste Su, Jean. "Exclusive Interview: Ford CEO Expects Fully Autonomous Cars In 5 Years," Forbes. February 5, 2015. Web. June 29, 2015.  
<http://www.forbes.com/sites/jeanbaptiste/2015/02/05/exclusive-interview-ford-ceo-expects-fully-autonomous-cars-in-5-years/>
27. "Federal Motor Vehicle Safety Standards: Vehicle-To-Vehicle (V2V) Communications," NHTSA, op. cit., p. 1.
28. "Platooning With IVC-Enabled Autonomous Vehicles: Strategies to Mitigate Communication Delay, Improving Safety and Traffic Flow." IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS, VOL. 13, NO. 1, MARCH 2012. Pedro Fernandes, Member, IEEE, and Urbano Nunes, Senior Member, IEEE.
29. Soriano, Bernard, Ph.D. deputy director of the California Department of Motor Vehicles. Telephone interview. January 28, 2015.
30. Weiner, and Walker Smith. "Automated Driving: Legislative and Regulatory Action," op. cit.
31. "About NHTSA," NHTSA. Web. June 8, 2015.  
<http://www.nhtsa.gov/About>
32. "Federal Motor Vehicle Safety Standards: Vehicle-To-Vehicle (V2V) Communications," NHTSA, op. cit., p. 1.
33. "Preliminary Statement of Policy Concerning Automated Vehicles," NHTSA, op. cit., p.1.
34. Silberg, "Self-Driving Cars: Are We Ready?" op. cit., p. 22.
35. Schoettle, Brandon and Michael Sivak. "A Survey of Public Opinion about Autonomous and Self-Driving Vehicles in the U.S., the U.K., and Australia," Rep. no. UMTRI-2014-21. Ann Arbor: U of Michigan Transportation Research Institute, 2014. The University of Michigan Sustainable Worldwide Transportation. July 2015. Web.  
<http://deepblue.lib.umich.edu/bitstream/handle/2027.42/108384/103024.pdf>
36. Pacer, Nathan. "Where VC Money Is Going in Connected Transportation," Venture Scanner Insights. N.p., September 15, 2014. Web. March 23, 2015.  
<http://insights.venturescanner.com/2014/09/15/where-vc-money-is-going-in-connected-transportation/>
37. Silberg, "Self-Driving Cars: Are We Ready?" op. cit., p. 15.
38. Cava, "A Look inside the Google Car Lair," op. cit.
39. Tweedie, "Here's Our Best View Yet of Apple's Alleged Self-driving Car Prototype," op. cit.
40. "Federal Motor Vehicle Safety Standards: Vehicle-To-Vehicle (V2V) Communications," NHTSA, op. cit., p. 1.
41. "Carsharing," California Berkeley. Web. March 23, 2015.  
<http://tsrc.berkeley.edu/carsharing>
42. Huet, Ellen. "Uber Says It's Doing 1 Million Rides Per Day, 140 Million In Last Year," Forbes. December 17, 2014. Web. June 5, 2015.  
<http://www.forbes.com/sites/ellenhuet/2014/12/17/uber-says-its-doing-1-million-rides-per-day-140-million-in-last-year/>

## End notes

43. Tiku, Nitasha. "Leaked: Uber's Internal Revenue and Ride Request Numbers," Valleywag. December 4, 2013. Web. June 5, 2015.  
<http://valleywag.gawker.com/leaked-ubers-internal-revenue-and-ride-request-number-1475924182>
44. "Big Data And The Connected Vehicle – When We Build It, The Data Will Come," ITS World Congress, op. cit.
45. "Markey Report Reveals Automobile Security and Privacy Vulnerabilities," Senator Ed Markey. Feb. 9, 2015. Web. June 30, 2015.  
<http://www.markey.senate.gov/news/press-releases/markey-report-reveals-automobile-security-and-privacy-vulnerabilities>
46. "Big Data And The Connected Vehicle – When We Build It, The Data Will Come," ITS World Congress, op. cit.
47. "Markey Report Reveals Automobile Security and Privacy Vulnerabilities," Markey, op. cit.
48. Statutory data from SNL Financial.
49. Preston, Dan. CEO at Metromile. Telephone interview. May 4, 2015.
50. Gear, Alex Davies. "The World's First Self-Driving Semi-Truck Hits the Road," May 15, 2015. Web. September 1, 2015.  
<http://www.wired.com/2015/05/worlds-first-self-driving-semi-truck-hits-road/>
51. "National Highway Traffic Safety Administration. National Motor Vehicle Crash Causation Survey: Report to Congress," July 2008. Tech. no. DOT HS 811 059. NTIS No. 200907. National Technical Reports Library. Web. May 27, 2015.  
[https://ntrl.ntis.gov/NTRL/dashboard/searchResults.xhtml?searchQuery=National Motor Vehicle Crash Causation Survey](https://ntrl.ntis.gov/NTRL/dashboard/searchResults.xhtml?searchQuery=National%20Motor%20Vehicle%20Crash%20Causation%20Survey)
52. Switkes, Josh, Ph.D. founder and chief executive officer of Peloton Technology Inc. Telephone interview. March 9, 2015.
53. Ibid., Switkes.
54. Griffin, J.T. chief government affairs officer at Mothers Against Drunk Driving (MADD). Telephone Interview. March 12, 2015.
55. KPMG Actuarial analysis, op. cit.
56. Zuby, David. executive vice president and chief research officer of the Insurance Institute for Highway Safety. Telephone Interview. February 11, 2015.
57. KPMG Actuarial analysis, op. cit.
58. KPMG Actuarial analysis, op. cit.
59. KPMG Actuarial analysis, op. cit.
60. KPMG Actuarial analysis, op. cit.
61. KPMG Actuarial analysis, op. cit.
62. "Automobile insurance in the era of autonomous vehicles survey results," KPMG LLP, op. cit., p. 21.
63. SNL Financial, op. cit.
64. SNL Financial and KPMG LLP analysis.





[kpmg.com](http://kpmg.com)



The views and opinions from the survey findings are those of the survey respondents and do not necessarily represent the views and opinions of KPMG LLP.

The information contained herein is of general nature and is not intended to address the circumstances of any particular individual or entity. Although we endeavor to provide accurate and timely information, there can be no guarantee that such information is accurate as of the date it is received or that it will continue to be accurate in the future. No one should act upon such information without appropriate professional advice after a thorough examination of the particular situation.

© 2015 KPMG LLP, a Delaware limited liability partnership and the U.S. member firm of the KPMG network of independent member firms affiliated with KPMG International Cooperative ("KPMG International"), a Swiss entity. All rights reserved. Printed in the U.S.A. The KPMG name, logo and "cutting through complexity" are registered trademarks or trademarks of KPMG International. NDPPS348936