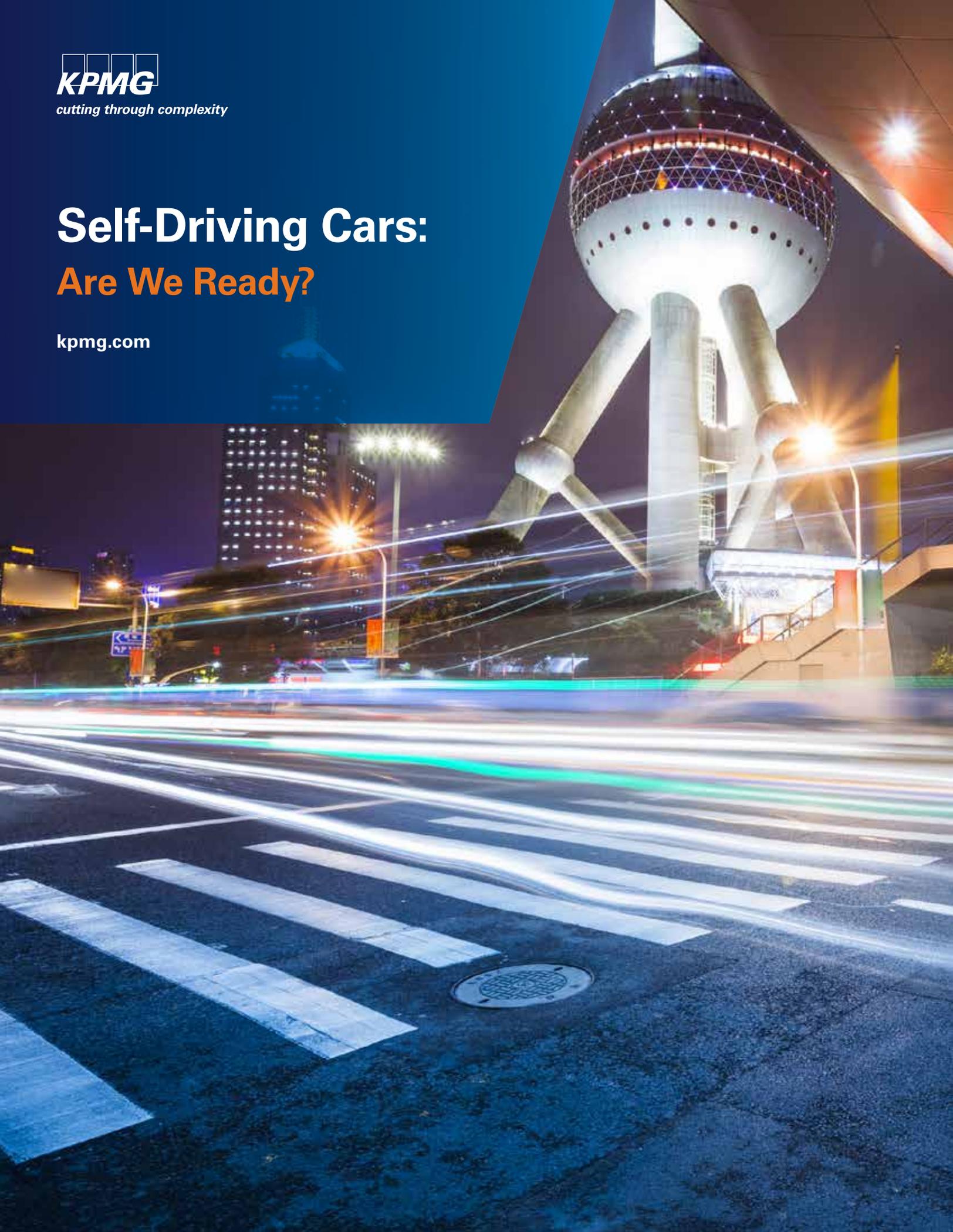




cutting through complexity

Self-Driving Cars: Are We Ready?

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A message from Gary Silberg

A year ago, KPMG's Automotive team released a white paper about self-driving vehicles. That report, *Self-Driving Cars: The Next Revolution*, focused on the emerging technologies and the profound impact self-driving vehicles could have in reshaping our roads, our cities and our lives.¹

A year later the momentum around self-driving vehicles is astonishing. In some ways, the industry is moving even faster than we predicted. Rarely does a day go by without another announcement about a new technological breakthrough or a new joint venture. Traditional automotive manufacturers are teaming up with high tech companies; innovative start-ups are seeking and finding investors. The landscape is shifting before our eyes.

But the introduction of disruptive innovation is fraught with risks. No matter how great the potential of self-driving vehicles, its trajectory will be determined by markets. And those markets are composed of people—consumers—who will ultimately adopt or reject the technology.

So this year, KPMG LLP went directly to consumers to ask the all-important question: If self-driving vehicles were available and safe, would you use them?

We conducted focus groups with vehicle owners in Los Angeles, California; Chicago, Illinois; and Iselin, New Jersey. We also leveraged insights into current sentiment about self-driving technologies using KPMG's Mass Opinion Business Intelligence (MOBI™) capability. Our research yielded three important insights into when, why and how consumers might use self-driving vehicles.

1. There's a distinct self-driving value proposition. Get it right and consumers will clamor (and pay) for the technology.
2. Get ready for the post-powertrain ecosystem. Acceleration time from 0–60 mph may not matter in the self-driving era. Consumers might well buy their self-driving cars from high-tech companies.
3. The growth in self-driving mobility on demand services could mark the end of the two-car family.

The report that follows discusses our findings and the implied opportunities and risks ahead for everyone within the automotive ecosystem. We hope you find the report illuminating and that we will have a chance to discuss our findings with you in the near future.



Gary Silberg

Partner, KPMG LLP

National Industry Leader Automotive

A Glimpse Into the Future

Gaze out at the automotive horizon and you can almost see a new era coming into focus: the age of self-driving cars. An age when humans will no longer need to keep their eyes on the road. No more concerns about distracted driving or those dreaded rush hour commutes. Vehicles will whisk us where we want to go, quickly and efficiently, then scurry away.

Or not.

Ultimately, the shape of the automotive future will depend on consumers—their needs, preferences, fears—and their pocketbooks. Will they trust these new vehicles? Buy them? Rent them by the hour or by the trip? Will people still need to own or lease their own vehicles? Will human operated vehicles become as rare as film cameras and record players? What macro-level changes would have to take place first? Would—or should—government mandate new vehicle automation standards? Or should regulators stay out of the way and let market forces prevail?

If self-driving truly becomes the norm, what will we look for in our vehicles? Think about how we differentiate automobile models and brands today: their powertrains, their handling on the road. Will any of that matter in the era of self-driving cars? If not, what will matter? What will future car buyers care about? If we build self-driving cars, will they come?

The answers to those questions could reshape the entire automotive ecosystem: new strategies, new technologies, new entrants in the automotive market, new joint ventures and alliances, new opportunities—and new risks.

We wanted to know what consumers thought—so we asked. On the pages that follow, we'll introduce you to some of the people who answered.

The Crux of Our Research: Three Insights

1. Focus on Improving Consumers' Quality of Life

While consumers still have many questions about safety, liability and the operation of self-driving cars, their receptivity increased significantly when presented with the right value proposition, which can be summed up as follows: shorter commute times + reduced traffic-related variability + the ability to use the vehicle in either self-driving or human-operated mode (self-driving on/off) = a strong incentive for consumer adoption.

Companies that get the value proposition right – and deliver a mobility/driving experience that is esthetically and emotionally pleasing could dominate the market. Companies that miss the mark on either the technology or the mobility experience could find themselves left behind.

2. Prepare for a Radically Different Automotive Ecosystem

In the brave new world of self-driving machines, powertrains may not matter. People may not care how fast a car accelerates from 0-60. Torque? Turbocharged? Really? If you're not driving, what's the big deal? The size and shape of vehicles might change. Consumers might well buy their next car from a high-tech company, such as Apple, Microsoft, Samsung, Google or Intel, among others.

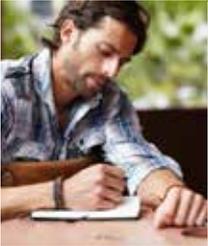
The more the concept of mobility is divorced from the experience of driving a car, the wider the door opens for new competitors. Given the size of the market opportunity, there is no doubt that smart innovators and investors will move in.

3. Expect New Threats and Opportunities from Mobility on Demand Services

Mobility on demand—already a small but growing sector within the transportation industry—could expand significantly, possibly obviating the need for families to purchase more than one vehicle.

The growth of mobility service providers could reshape both demand for vehicles and buying power. If the car you want shows up when you want it, where you want it, does it matter if you own it?

Meet a Few of Our Participants*



Sean. Dressed in a tee shirt, plaid button down shirt and jeans, Sean exudes a kind of slacker cool. In his late 20s, he lives in Los Angeles with his wife and five-month old daughter. He's a writer; his wife's an actress—the quintessential young show business family.



Hank. A retired executive from Chicago, Hank walks slowly with the aid of a cane, but when he speaks he reveals the nimble intellect of one accustomed to making nuanced, evidence-based decisions. Definitely not the type of person to act on impulse.



Gail. At first glance, Gail is a cross between a soccer mom and a business analyst. Her retro black eyeglasses give her a slightly studious air, but her gut reactions are pure “mama bear.” She's a stay-at-home mom with a two-year-old daughter. She's all about safety.



Carmella. A striking woman in a fitted black dress and jacket, large hoop earrings and dark hair piled on top of her head, Carmella has the air of an Italian movie star from the 1950s. Based in the New Jersey suburbs, she works as a realtor and says she drives maybe 200 miles a week, mostly in the suburbs. She loves driving—and she loves her car.



Richard. Young, pensive, a commercial plumber from Los Angeles, Richard drives 400 miles a week and rebuilds cars in his spare time. At any given moment he has a few on the blocks. “I love working on cars,” he says. “I think the internal combustion motor is the single greatest invention we have—at least in the last 100 years—from where it's taken our civilization.”

*We have changed the names and images of our participants to protect their privacy.

Introduction: The Revolution, A Year Later

A year ago, KPMG's Automotive team released a white paper about self-driving vehicles. That report, *Self-Driving Cars: The Next Revolution*, focused on the emerging technologies that could enable fully self-driving vehicles and the profound impact such vehicles could have in reshaping our roads, our cities and our lives.

We said then—and continue to believe today—that the advent of safe, reliable fully self-driving vehicles will require the convergence of two types of technologies: sensor-based solutions and connected-vehicle communications. We laid out a time line suggesting that by 2019 self-driving technology packages would be available on new cars, and that by 2025 there would be sufficient built-in and after-market penetration to support self-driving applications.

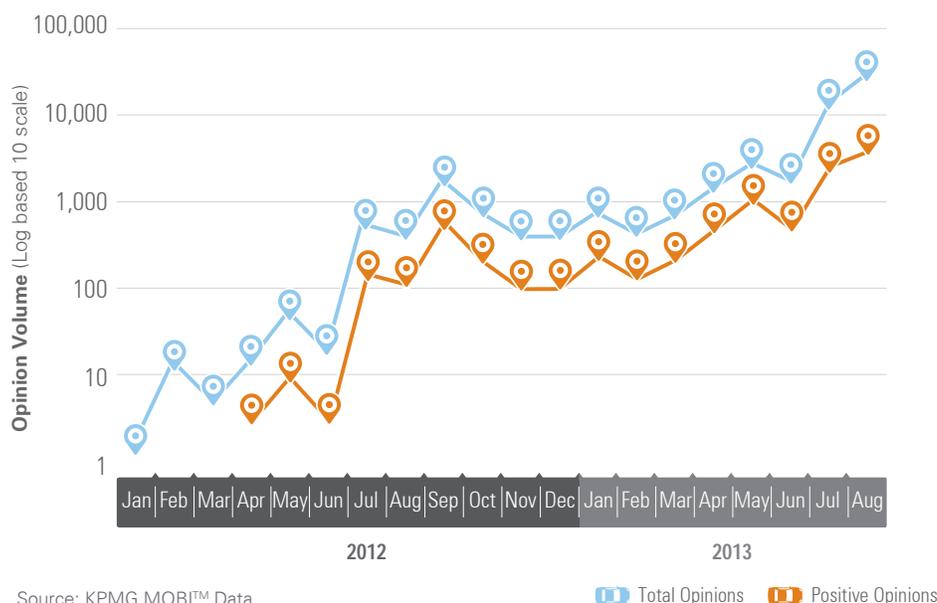
Momentum: A year later we see a great deal of momentum and investment behind self-driving technologies. The Google fleet has now logged more than half a million miles. Almost all the traditional automotive manufacturers are testing self-driving vehicles, and many (including Nissan, Mercedes, Ford and Audi) have opened R&D facilities in Silicon Valley. Tesla Motors is talking about potentially adding self-driving technology to its vehicles;^{2,3} and a start-up, Netherlands-based Mobileye just raised \$400 million to back expansion of its driver-assist technologies. Automotive supplier Continental has mapped out its own path to self-driving, noting, "We are convinced that automated driving will be a key element of future mobility, as it will enhance the safety, efficiency and comfort of individual mobility even further."⁴

The discussion has even made its way to the White House, where: "The prospect of automated cars is a hot topic...[and] policymakers believe the technology could have broad impact on public safety, the environment and economic growth."⁵



An Emerging Topic of Discussion Online

Self-Driving Car discussion is accelerating...



Based upon analysis of KPMG's proprietary Mass Opinion Business Intelligence (MOBI™) data, conversation around self-driving cars started to take off around July 2012. From July 2012 through August 2013, increases in volume were driven by news, regulatory announcements and marketing. Opinion volume increased steadily during that period and then began to spike in July 2013, driven in part by the U.K announcement that self-driving cars were approved for testing, and again in August 2013 when Nissan announced intentions to launch a self-driving vehicle by 2020. Positive commentary has also gradually increased during this period, although given the theoretical nature of discussion, it still remains largely mixed.

Technology Advances: The technology is evolving at a rapid clip. GM plans to have semi-autonomous vehicles on the road by the end of the decade.⁶ Nissan announced that it would “be ready with revolutionary, commercially viable Autonomous Drive in multiple vehicles by the year 2020.”⁷ And in fact, semi-automated cars will be available to consumers in the next model year (2014). Drivers will still have to stay “in-the-loop,” but in certain situations, the car’s automation will be able to control the throttle, brake and steering simultaneously.

For example, Mercedes-Benz’s 2014 model S-Class uses ultrasonic and infrared sensors to deliver its *Distronic-Plus* full-speed adaptive cruise control and active lane-keep assist features in a package Mercedes is calling Stop-and-Go Pilot.^{8,9}

With Stop-and-Go Pilot, the vehicle is essentially driving itself, but it only works when the driver’s hands are on the wheel. Similar offerings are also in the works from other premium and mass market brands:

Table 1 Anticipated semi-automated driving systems and date of expected introduction

Manufacturer	Product Name	Extent of Automation ¹⁰	Expected Introduction
Cadillac	Super Cruise	Full range hands-free	2016
BMW	Traffic Jam Assist	Stop and go up to 25 mph	2014
Ford	Traffic Jam Assist	Stop and go highway traffic	2017
Volvo	Traffic Jam Assistance	Stop and go up to 31 mph	2014
Mercedes-Benz	Stop-and-Go Pilot	Stop and go up to 35 mph	2014



Self-Driving Cars: Are We Ready?

Regulators Ramp Up: Technological innovation often moves faster than legal or regulatory systems. Innovations like the World Wide Web, file-sharing services and drone technology open up new possibilities; and regulators rush in afterwards to establish order, sometimes with unintended consequences. Self-driving technology is prompting a flurry of regulatory discussions at the federal and state level. As of July 2013, Washington, DC and three states, Nevada, Florida, and California had enacted legislation permitting the operation of automated vehicles on public roads for testing purposes. Another nine states introduced bills on self-driving vehicles; however, bills that are not passed and signed by the end of a legislative session are effectively killed. Other states, such as Michigan, have special license plates for automotive manufacturers that permit testing of emerging technologies on public roads. Interestingly, self-driving cars are not explicitly prohibited by any existing state laws, and some commentators have reasoned that they are, therefore, legal in all states.¹¹

In May 2013, the National Highway Transportation Safety Administration (NHTSA) issued a "Preliminary Statement of Policy Regarding Automated Vehicles." The statement, which focuses on safety-related aspects of the technology, defines five levels of automation from Level 0: No Automation (where the driver is in complete and sole control of a vehicle which may or may not include various safety warning signals, such as lane departure warning and blind spot monitoring) to Level 4: Full Self-Driving Automation. At Level 4, vehicles are designed to perform all safety-critical driving functions and can safely operate without any driver intervention. The NHTSA statement is meant to serve as guidance "to help states implement this technology safely so that its full benefits can be realized," but it does not mandate any particular actions by any states.¹²





Is the Market Ready? The introduction of disruptive new technology is always fraught with risks as Clayton Christensen elucidates in his book, *The Innovator's Dilemma*. The inevitable challenge for large, growth-oriented companies, he says, is that "The markets whose emergence is enabled by disruptive technologies all began as small ones."¹³ In the case of self-driving vehicles, starting small presents a conundrum: self-driving is enabled, in part, through peer-to-peer (or vehicle-to-vehicle, aka V2V) technology. Early adopters' vehicles will have few similarly equipped peers with which to communicate. Only when critical mass is achieved will the full benefits of autonomous vehicles emerge.

And history is replete with promising innovations that didn't take hold and companies that failed to recognize the market potential of their own creative breakthroughs. It was a Kodak scientist, Steven Sasson, who invented the first digital camera in 1975—years before Sony and Fujitsu brought their digital

cameras to market. But Kodak never brought the technology to market for fear it would cannibalize its film business. Kodak's failure to capitalize on its own invention arguably led to the company's demise.¹⁴

Xerox PARC developed the first computer mouse and user-friendly icon and window-based Graphical User Interface (GUI) for its personal computer, the Alto, in 1975 and then squandered the commercial opportunity because the leadership didn't fully grasp the value of the technology and, as recounted in *A History of Silicon Valley*, "because of Xerox's poor organizational structure, the Altos would have to be made by a Dallas manufacturing facility that made typewriters. The managers in Dallas just wanted to keep making the same product and get their highest short-term bonuses."¹⁵

Self-Driving Cars: Are We Ready?

Is the Market Ready? (continued) In fact, these stories of myopia and missed opportunities are not the exception; they're the rule. It's exceedingly difficult to reinvent an organization especially when the reinvention involves everything from new technologies and processes to new facilities, core competencies and mindsets.

Will self-driving vehicles or the companies that develop and launch them fulfill their potential? Are consumers ready, willing and able to take the leap? And what about the automotive Original Equipment Manufacturer (OEMs) who don't move fast enough? Will they become extinct?

These are the questions KPMG set out to answer this year. To better understand consumer attitudes, we conducted research on three fronts: First, we went directly to consumers. Between June 10 and June 27, 2013, KPMG conducted three focus groups with a diverse sample of drivers in Los Angeles, California; Chicago, Illinois; and Iselin, New Jersey. Our focus groups had much to say about the joys and frustrations of driving, and strong opinions about the relative merits of different automotive and technology brands—and which companies (or brands) they'd trust to build self-driving vehicles if and when they come to market.

Second, we leveraged insights into current sentiment about self-driving technologies using KPMG's (MOBI™) capability. MOBI™ offers detailed, real-time data that provides a view into the thoughts and actions of a variety of external stakeholders and other influencers, including customers and consumers. Our MOBI™ capabilities transform unstructured data derived from public sources, like comments made online, or proprietary sources, like Customer Relationship Management (CRM) and sales data, and turns it into structured data, in real time, to be used in qualitative and quantitative analytics.

Third, we looked at the adoption paths of other disruptive innovations for insights into what ultimately spurred widespread adoption and how those lessons might apply today.





A Historical Perspective

The First Automotive Revolution

New York City. The year is 1902. The city is teeming with people and commerce: Population has doubled in the past century; per capita income has quadrupled. The horse rules. It is the primary power source for transporting people and goods within urban areas. Horse population within the boroughs of Manhattan and Brooklyn (less than 100 square miles) has soared to 175,000. Into each of those horses goes 1.4 tons of oats and 2.4 tons of hay per year. Out of each horse comes 15 to 30 pounds of manure - each day. One observer worries that by 1930, "horse droppings [will] rise to Manhattan's third-story windows."¹⁶



While tales of horse dung may have been exaggerated, clearly horses are not the ideal powertrains. They are expensive to feed and maintain and prone to kicking and biting; and horse-powered vehicles occupied much of the available public space.¹⁷

Enter the automobile. It seems like the perfect alternative. As *The New York Times* puts it in July of 1902, "When the automobile made its appearance in this country a few years ago it was received with a cordiality that was nothing short of remarkable. Whether on the city streets or the country roads, pedestrians and vehicles stopped to see it pass, and the general sentiment was obviously that of admiration. So much had been published about the probable advent of the horseless vehicle, and such glowing pictures had been drawn of the coming horseless age, with all progression in self-propelled vehicles, that the advent of the vehicle was anticipated for several years before its arrival and the public mind was in a receptive condition."

But innovation didn't triumph so easily. As the *Times* went on to report, admiration for the automobile were quickly "succeeded by open hostility." The cars were scaring the horses and the farmers were shooting the cars.

Pro- and anti-automobilist letters poured into the newspaper. Much of the language was tinged with class warfare, with one writer referring to car owners as the "idle and vicious rich" and others sniping back at anti-car activists, calling them "anarchists." Nonetheless, one letter writer observed, "The automobile is here to stay beyond a doubt, and it is meeting with the usual hostile reception accorded to every innovation, especially if those people with plenty of money take to it first."

And sure enough, within a mere 20 years—from 1900 to 1920—United States (U.S.) vehicle ownership increased from 8000 to 8 million.¹⁸

What Happened?

At the turn of the twentieth century, automotive technology was still in an incubation phase (as is self-driving technology today), with development headed in many different directions. The automobile was still a niche market item. The innovation scholar, Frank Geels explains: “Niches are important, because they provide space for learning processes on several dimensions, e.g., technology, user preferences, regulations, infrastructure and symbolic meaning. That way the seamless web of an innovation can be further articulated. Niches also provide space to build social networks that support innovations, e.g., lobby groups, user associations and new industry networks.”¹⁹

The next step is often the most difficult: getting the innovation from the incubation phase into widespread usage. In his seminal work, *The Diffusion of Innovation*, Everett Rogers describes some of the attributes that determine the speed with which innovations spread through societies:²⁰

1. Relative advantage over existing solutions

2. Compatibility with existing values

3. Relative complexity (is the innovation easy to understand and employ)

4. Triability (can it be test-driven, for example)

5. Observability (can potential users see clear benefits accruing to those who use it)

Rogers’ model is applicable to the initial trajectory of the automobile. Its relative advantages over horses were easy to see: Automobiles were faster and didn’t leave piles of excrement in the street. They took up less space, were easier to feed, and could go faster and further without tiring. One automobile could travel more miles and accomplish far more work than a horse in a single day. There were ample opportunities for people to test out the new vehicles without buying them. Automobiles were aspirational purchases at a time when the American Dream of income mobility was still a prevailing belief. Cars were symbols of wealth, status and modernity.

As Geels points out, the incubation period provides time for developing the requisite supporting systems, including regulations, infrastructure and social networks. In the case of the automobile, the coalescence of an organized lobby hastened adoption. Automobilists formed associations in most major cities; some of which came together in Chicago in 1902 to form the American Automobile Association (AAA). These associations were critical forces in developing the requisite automotive infrastructure, and lobbying for pro-automobile legislation and appropriations to build and improve highways.

The automobile had other hurdles to overcome. In 1902 the cost of an automobile was beyond the reach of most families. The average family income was approximately \$450; the price of an automobile ranged from \$650 to well over \$1000.²¹ However, incomes began to rise and, largely thanks to Henry Ford, automobile prices came down. Ford introduced the Model T in 1908 at a retail cost of \$825; by 1912, the price had dropped by 30 percent to \$575, creating a far more compelling and attainable value proposition for a mass market.

Getting the value proposition right is no easy feat. Consider the case of 21st century electric vehicles (EVs). Despite the promise of cleaner, quieter operation, lower energy costs and a reduction in dependence on foreign oil, EVs haven’t found a strong market in the U.S. Even with the implementation of the Qualified Plug-In Electric Drive Motor Vehicle Tax Credit, which can be as high as \$7500, sales of EVs have been far below expectations. Why? *Car and Driver* explained, “It’s been a combination of problems that the industry saw coming—cost, range, and infrastructure—and the failure of expected fixes to materialize.”²²

Will self-driving technology meet with a more enthusiastic reception?

What We Learned: Who's Ready to Roll?

The 32 participants in our focus groups had a lot to say about the joys and frustrations of driving and lots of questions about the ways in which self-driving vehicles might reshape their lives. But it is worth reminding readers that focus group discussions are valuable for the qualitative, directional insights they provide; they are not statistically valid. (See page 16: About the Focus Groups.) For a quantitative perspective we turned to MOBI™ Data, using publicly available data sourced from January 2012 through August 2013.

Three key insights emerged from our research:

1. Focus on Improving Consumers' Quality of Life

While consumers still have many questions about safety, liability and the operation of self-driving cars, their receptivity increased significantly when presented with the right value proposition, which can be summed up as follows: shorter commute times + reduced traffic-related variability + the ability to use the vehicle in either self-driving or human-operated mode (self-driving on/off) = a strong incentive for consumer adoption.

Companies that get the value proposition right – and deliver a mobility/driving experience that is esthetically and emotionally pleasing could dominate the market. Companies that miss the mark on either the technology or the mobility experience could find themselves left behind.

2. Prepare for a Radically Different Automotive Ecosystem

In the brave new world of self-driving machines, powertrains may not matter. People may not care how fast a car accelerates from 0–60. Torque? Turbocharged? Really? If you're not driving, what's the big deal? The size and shape of vehicles might change. Consumers might well buy their next car from a high-tech company, such as Apple, Microsoft, Samsung, Google or Intel, among others (see page 15).

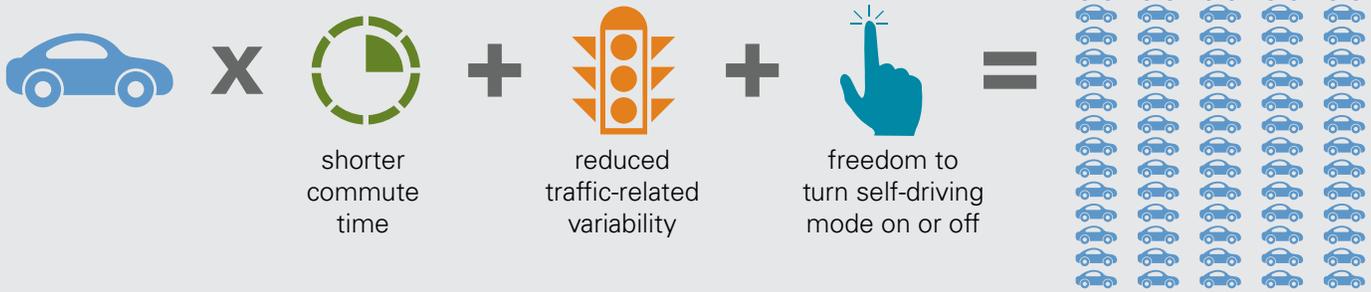
The more the concept of mobility is divorced from the experience of driving a car, the wider the door opens for new competitors. Given the size of the market opportunity, there is no doubt that smart innovators and investors will move in.

3. Expect New Threats and Opportunities from Mobility on Demand Services

Mobility on demand – already a small but growing sector within the transportation industry – could expand significantly, possibly obviating the need for families to purchase more than one vehicle.

The growth of mobility service providers could reshape both demand for vehicles and buying power. If the car you want shows up when you want it, where you want it, does it matter if you own it?

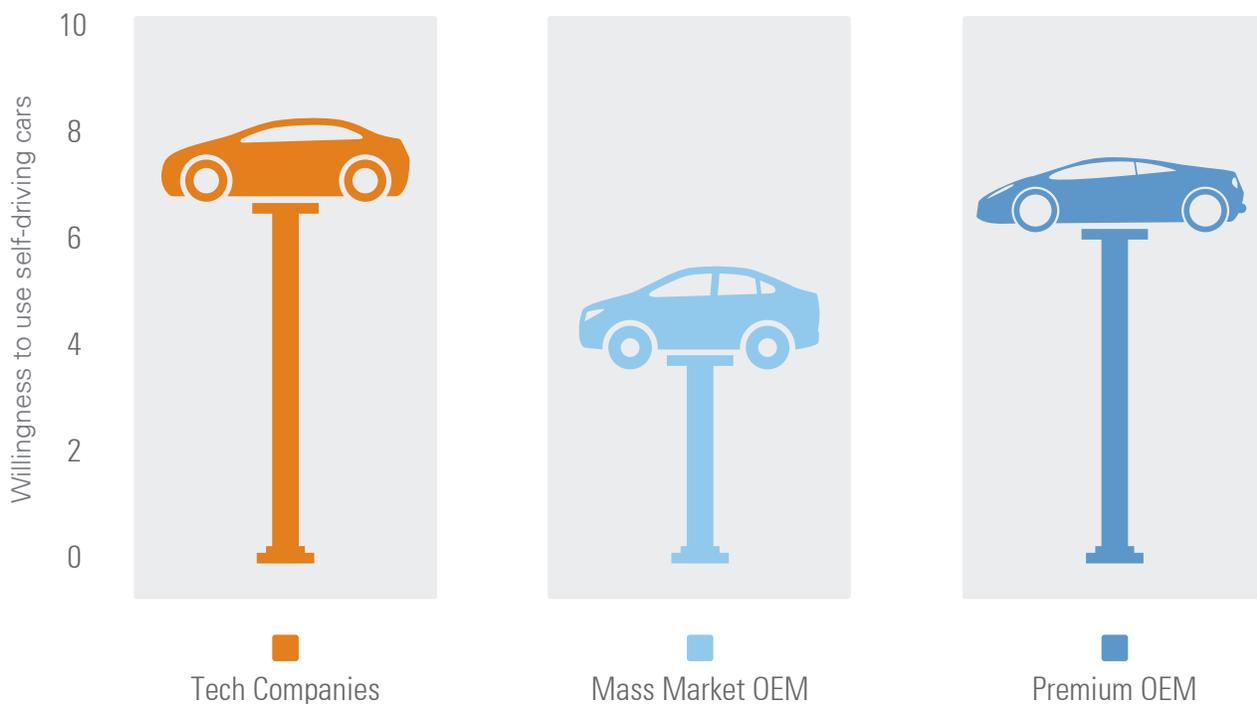
Getting the Value Proposition Right.



Source: Focus Group Data

Consumers Trust Tech Companies

In spite of having little to no experience in manufacturing cars, technology brands are trusted as much as premium auto brands



Source: Focus Group Data

Self-Driving Cars: Are We Ready?

Different Audiences and Perspectives

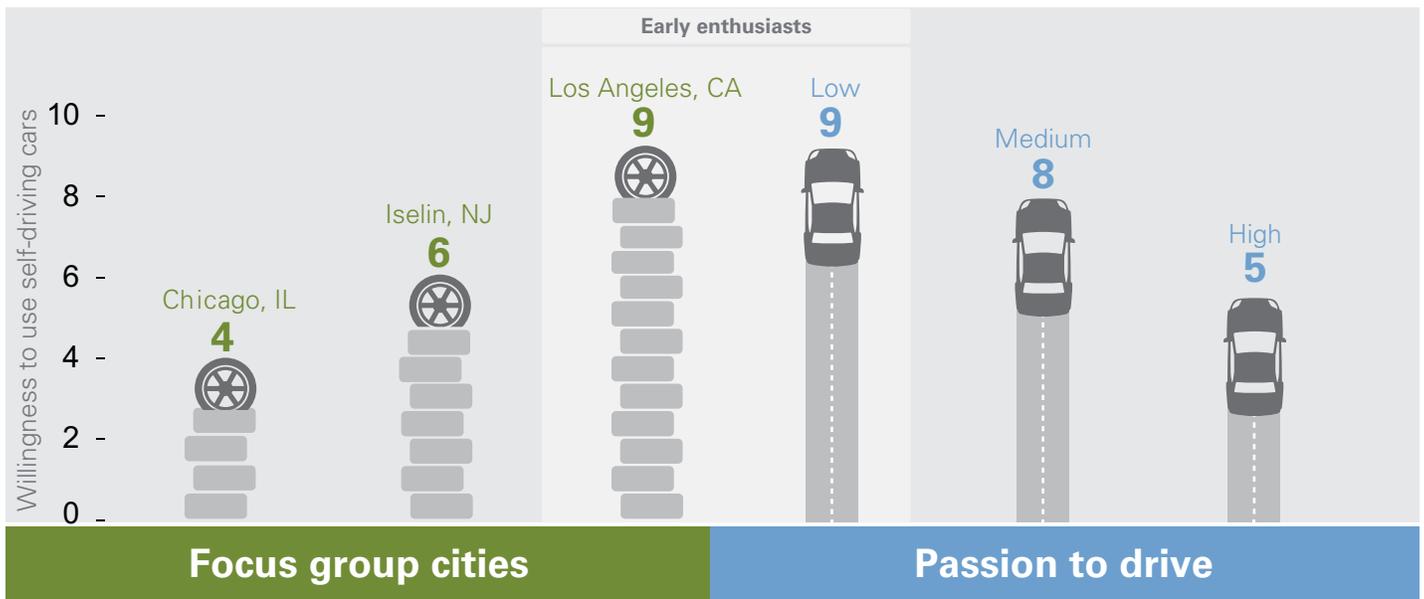
In each city, we began our focus groups by asking participants to tell us how they rated their passion for driving; what kind of car they drive; their approximate weekly mileage; and whether they drive most on highways, suburban roads or city streets. We then showed them a YouTube video of the self-driving vehicle being operated by a blind man²³ and asked them to rate the likelihood that they would be willing to use a car like that on a daily basis (using a 10-point interval scale, where 10 is equivalent to “most willing” and one is “not at all willing”). During the ensuing two-hour discussion, we asked the same

question two more times to see how attitudes changed as people were able to discuss more about the self-driving experience and the potential advantages and disadvantages.

In almost every case, attitudes changed as people learned more about the technology and discussed the implications. However, there were some marked differences in responses from different segments of our audience. Our analysis revealed a few characteristics that were associated with higher receptivity to self-driving. The factors that seemed most significant included: the region where the respondent lived, the respondent’s passion for driving, the type of vehicle (premium or mass market) the respondent drove, their gender and their age group.

Who Were the Early Enthusiasts?

(Median Score)



Source: Focus Group Data

Low (1–3) | Medium (4–7) | High (8–10)

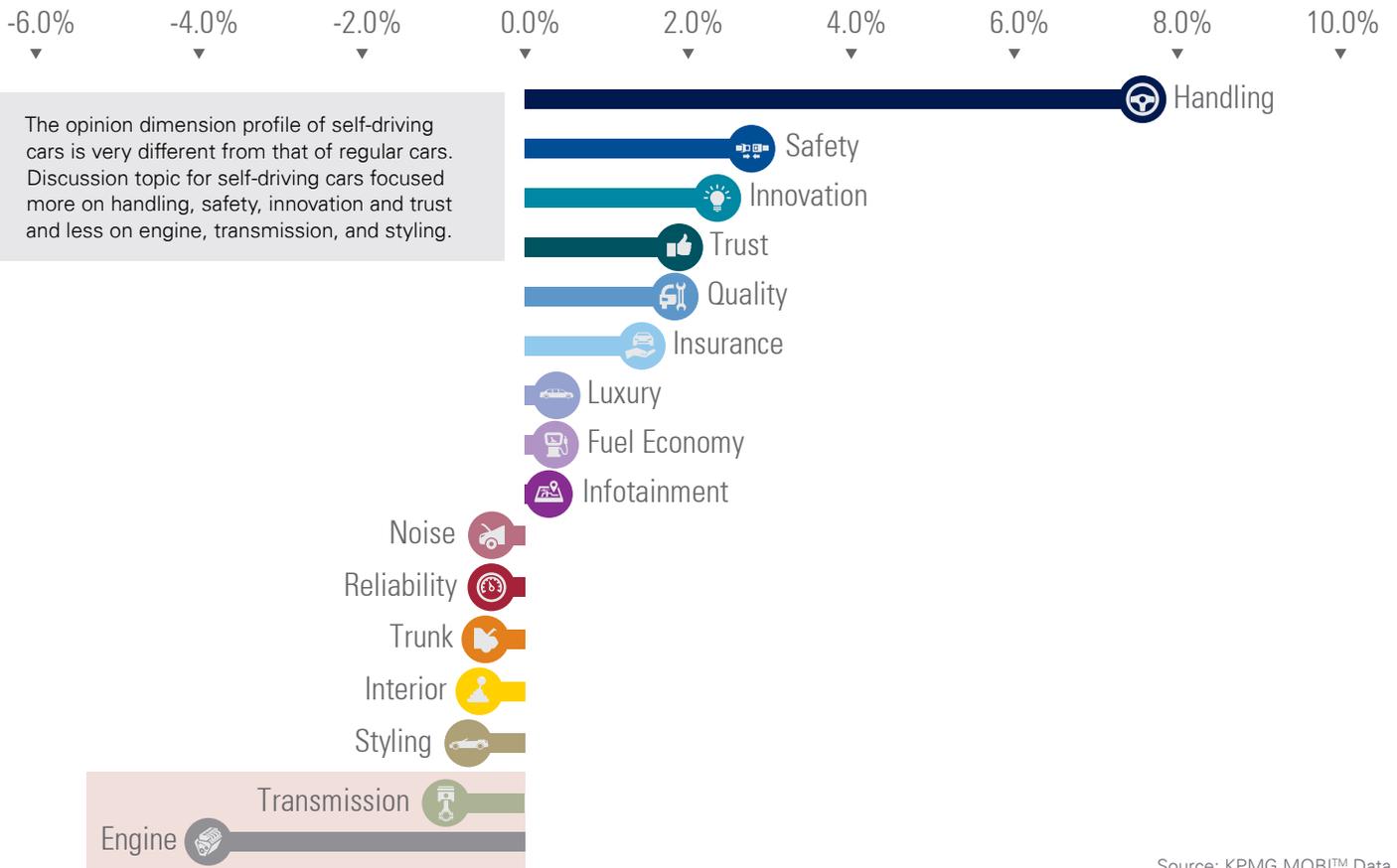
About Our Focus Groups

KPMG held focus groups in three locations: Los Angeles, California; Chicago, Illinois; and Iselin, New Jersey. We selected the locations to achieve both geographic diversity and cultural diversity. Los Angeles is an expansive city with relatively little in the way of public transportation and high vehicle ownership. Chicago has a clearer center of gravity and is far better served by public transportation. It is possible to live in Chicago without owning a car, although 71% of residents do, in fact, own a vehicle. Iselin, New Jersey is a bedroom community, approximately 31 miles south of midtown New York. Commutes from Iselin into New York can be long—more than an hour each way in rush-hour traffic. The commute by mass transit can take as long as 90 minutes, depending on the time of day.

Participants in our focus groups were selected from licensed drivers at least 21 years of age who owned at least one vehicle. All had completed high school and college or vocational school. All had family incomes over \$50,000 per year. All had purchased a vehicle within the past seven years.

Self-Driving Cars. What Matters Most? What Doesn't?

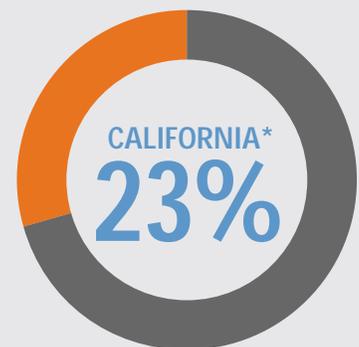
Difference between Self-Driving Car Dimensional Discussion Ratio against all other Vehicles



Source: KPMG MOBI™ Data

Regional Differences: Californians were significantly more open to self-driving from the start. When we asked the Los Angeles group about their willingness to ride in a self-driving car, their median rating was a nine. In contrast, Chicago's median score was a four; Iselin's was a six.

MOBI™ analysis reinforced the impression that Californians are more likely to be the early adopters of self-driving technology. Based upon analysis of MOBI™ external website and social media data across major markets within the U.S., 23 percent of self-driving-car-related comments (that have geographic tagging) come from California, the most of any state.²⁴



Source: KPMG MOBI™ Data – Analysis based on major cities

Sean



Gender: M

Age: 15–34

Car: 2008 Prius

Occupation: Writer (self-employed)

Education: College Grad

Income: \$75k–\$100k

Average Miles Per Week: 100

Type of Driving: Suburban

Passion for Driving: 5

Q1 Answer: 10

Q4 Answer: 10

Q10 Answer: 10

In Los Angeles the discussion is lively, impassioned, verging on unruly. But Sean sits quietly at the end of the table, arms folded, listening to the more vociferous members of our focus group. Dressed casually in a tee shirt, plaid button down shirt and white baseball cap, Sean appears to be in his late 20s, a member of the “Gen Now” generation (those aged 15–34).

From his description, Sean and his wife seem to be the quintessential young show business couple. He works freelance as a writer; his wife is an actress. They have a five-month old baby and two cars. Sean’s is a 2008 Prius, which, by his estimate, he drives about 100 miles a week. Does he love to drive? Not really. “Maybe if I had a Jaguar, I would,” he muses.

“For me, a car is mostly functional,” Sean says. It’s not that he doesn’t enjoy the freedom a car provides, he explains. “I love being *in* the car; I like driving less.” So right from the start, he’s sold on the concept of self-driving vehicles: “You still get to be in the car; [you] get the experience of getting out of the house and going on the road. But you’re not putting your foot to the pedal, not worrying about other drivers. And you can multitask.”

While others in the group fret over the potential dangers of driverless cars, Sean has the opposite reaction. “I lived in Manhattan,” he says, “and I would trust that car more than I’d trust a bus driver in Manhattan. I’d trust that car more than I’d trust myself. I think the technology is that much more intelligent than I am.”

How much would he be willing to pay for self-driving functionality? Sean says he’d spend an extra \$5000 over the base price for a \$30,000 car. “I think the value is much greater than five grand,” he explains, “but it’s not as advantageous for me because I don’t take the highway that often. Five thousand is all I would dish out for that extra convenience.”

What Sean is not likely to do, is give up owning a vehicle. Although he is sure he would use a service that provided self-driving vehicles on demand, he would still need to own a car. He describes his car as a “home away from home,” filled with his daughter’s toys, her car seat, his wife’s headshots and costume changes, various phone chargers and other personal effects.

When the discussion turned to brands, Sean is more trusting than many of the others in our focus groups. Whereas many of our test groups make sharp distinctions between mass-market and premium brands, Sean rated all the automotive companies at an 8 or higher on a scale of 1 to 10. “I gave them the benefit of the doubt. Because in this world where they’re putting out a self-driving car, they had to invest in that technology and that’s a huge process for them.” He is equally willing to consider branded driverless vehicles from a few of the top technology companies we asked about. Sean rated his trust of Apple and Google at a 10, Intel at an 8.

Microsoft and Samsung fared less well in his estimation, earning a 5 and a 1, respectively. “I guess I don’t know their product lines as well,” he explains. “But I don’t have any evidence of them having anything as sophisticated as Apple and Google, so I didn’t trust them with my life.”

Sean believes the biggest hurdle to widespread adoption will be in convincing the rest of the public. “You can’t do that through a commercial [targeted at] the mass public. They’re going to look at this and roll their eyes,” he says. “I don’t see most people buying into it, he adds. “And that’s unfortunate.”

Passion for Driving: Those who said they were passionate about driving (rating “passion for driving” at an eight or higher on a 10-point scale) were initially resistant to self-driving (rating their likelihood to use the technology at a median score of 5.5). However, those were the same drivers who showed the most movement during a two-hour session. Their median score at the end was an 8. Not surprisingly, those who rated their passion for driving at less than four gave self-driving the highest initial score (median score of nine), so there was little room for movement. Those who were ambivalent about driving rating their passion between four and seven were also ambivalent about automated vehicles. Their initial median score was an 8, but by the end of the session they had ticked down slightly to a 7.5.

Even Passionate Drivers Are Open to Self-Driving Cars.



Source: Focus Group Data

For the purposes of our analysis, KPMG broke down the numerical ratings into three categories: High (8-10 on a 10-point scale), Medium (4-7 on a 10-point scale) and Low (1-3 on a 10-point scale).

Self-Driving Cars: Are We Ready?

Premium Versus Mass Market Brands: Roughly a third of our focus group members (10 out of 32) drove premium brand vehicles. As a group, premium vehicle owners and owners of mass market vehicles started out with the same median score on willingness to use a self-driving car (6 on a 10-point scale). However, the two groups showed a markedly different response to the added incentive of a special lane for self-driving (see incentives below). Premium vehicle owners' raised their scores from 6 to 10; mass market drivers' median rating moved only slightly, from 6.0 to 6.5.

Why were premium vehicle owners more receptive to self-driving? We didn't delve into detailed psychographic profiles, but we have some hypotheses: First, premium vehicle owners are already accustomed to high-tech bells and whistles, so adding a "self-driving package" is just another option. They spend a lot of money to have a premium car for performance and status. Once we suggested that they might be able to turn self-driving capability on or off at will, they were sold on the concept.

Hank



Gender: M

Age: >60

Car: 2012 Nissan Murano

Occupation: CEO, Manufacturing

Education: College Grad

Income: \$100k–\$150k

Average Miles Per Week: 150

Type of Driving: Suburban

Passion for Driving: 5

Q1 Answer: 10

Q4 Answer: 10

Q10 Answer: 10

Hank carries himself with the gravitas of one who is used to being in command. A retired executive from Chicago, Hank walks slowly with the aid of a cane, but when he speaks he reveals the nimble intellect of one accustomed to making nuanced, evidence-based decisions. Definitely not the type of person to act on impulse.

Yet when we show him a video of the Google self-driving car, Hank's reaction is swift. "Where do you buy one? Great concept!" he says, adding, "Obviously, the cost would be a concern, as would the safety aspects. [In] the video we just saw, the car was by itself with no other vehicles around it. But conceptually that's what I want. I'll take one in red."

Now that he's in his 70s, Hank no longer enjoys driving the way he did when he was young. "If I could have someone do all the driving for me, that would be fine," he says. "It's work now."

In many ways, Hank represents the perfect target audience for self-driving technology: he is affluent, well informed and already experiencing age-related limitations to his mobility. And while he sees a number of hurdles along the road to adoption, he's confident that the industry can overcome them. "[The car] would have to have an override so that you could take control of it at any time. It wouldn't make sense otherwise," he says. He adds that programming the car would be a massive undertaking and that the user interface would have to be easy for consumers to operate. But assuming those challenges can be addressed, he says, "If the costs are anywhere reasonable, what's not to like about it?"

So what is Hank willing to pay for self-drive capability? More than anyone else we interviewed: Hank says he'd pay a 50 percent premium (\$15,000 above the price for a \$30,000 car). "Realistically, at least initially, you're not going to buy [a self-driving package] for less than 50 percent," he says. "And the infrastructure work [to enable V2I communication and other self-driving features] is very considerable and very expensive. All of us will have to pay [for] that, whether or not we invest in a car like this."

When the conversation turns to automotive brands, Hank is again an outlier: "I have a lot more faith in American cars than some of the other people here, particularly in terms of their engineering going forward," he says. "These are not dummies. I happen to know many of them personally; I've gone to school with them. Financial constraints have resulted

in cars that are not super terrific, but they certainly have the engineering capability going forward to do this. I feel that there are certain [auto manufacturers] that would not only have the engineering jump but the wherewithal and the push behind it to really go into this new concept. I'd say a BMW, Mercedes, Nissan or Volkswagen. Volkswagen is terribly sophisticated," he adds. "And if the other brands are not smart, Volkswagen will be the major largest auto company in the world shortly."

The one area where Hank is solidly in line with the majority of our focus group participants is in his reaction to National Highway Traffic Safety Administration (NHTSA). When we ask if participants would be more or less trusting of a vehicle or brand that received a high rating from NHTSA, Hank responds: "Are there negative numbers?"

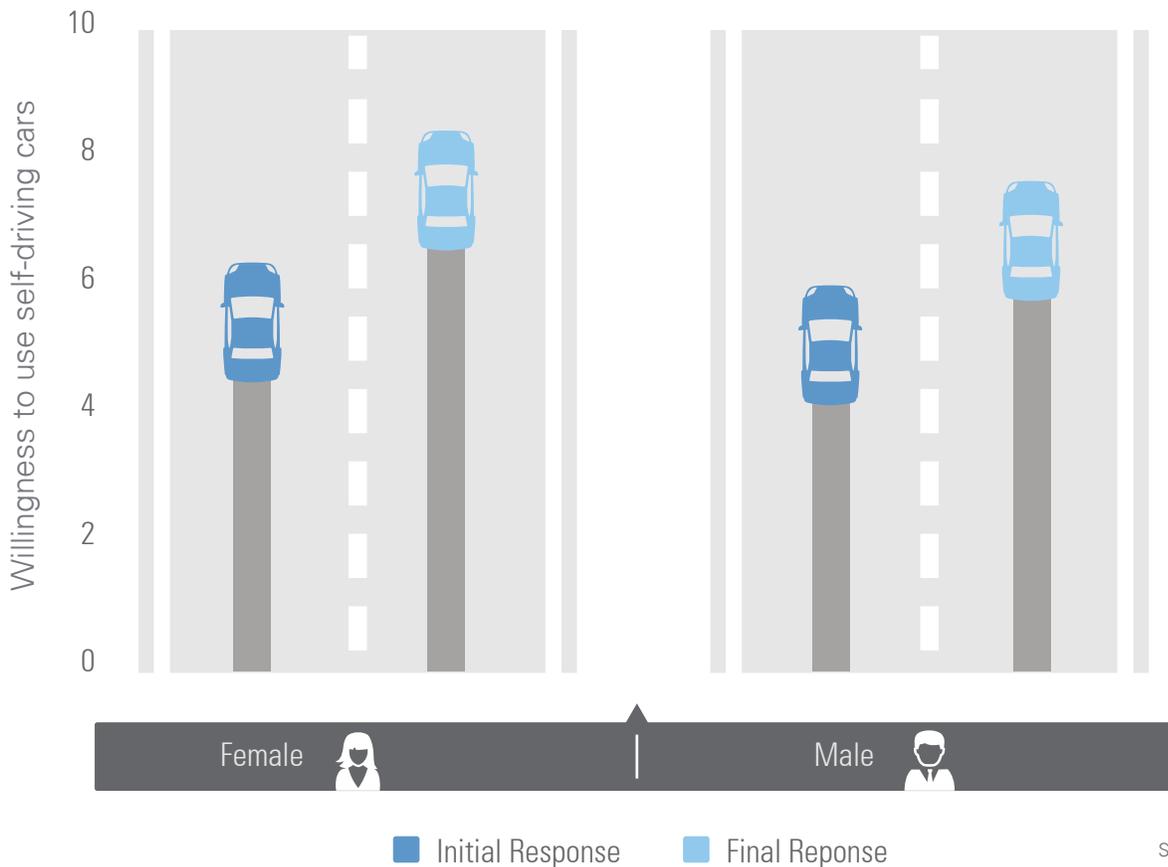
"The government has no expertise in my mind. [I would trust] someone like Consumer Reports, [which] is completely independent and [on which] I have relied on in the past...but the government has no expertise in this area, and it has no credibility."

But as the conversation draws to a close, Hank's mind has already gone beyond the nuances of the technology to consider the broader ramifications of self-driving cars. "It's going to change society completely," he says. "It's going to change the way every one of us lives and acts and conducts our day. It's a very substantial change."

Gender Differences: Women in our focus groups were slightly more receptive to self-driving. Initially, women rated their willingness to ride in a self-driving car at 6.5, compared to 6.0 for men. By the end of the session, the median score for women had risen to 8.25; for men the score had risen to 7.5. More significant than the numbers were the differences in the types of issues raised by men and women. Women in our focus groups were far more likely to focus on how self-driving would free them to focus on their children in the back seat or enjoy an evening out without worrying about having a drink with dinner. They were also more likely to note how self-driving would benefit those whose mobility was in some way restricted (by injury, illness, blindness or age-related limitations).

Some of the men, on the other hand, were more likely to resist because self-driving vehicles would force them to stay in a lane and follow speed limits. As one New Jersey participant explained, "I do a lot of highway driving and...on a highway people don't do speed limit... and I like to go in and out of the lanes. I like to get to places fast." Jim, from Los Angeles, suggested that the vehicles could provoke road rage, "If you're driving 65 [when there's no traffic], most people are tailgating you, wondering why you're driving so slow on the freeway, right? These vehicles obviously are not going to speed, and that may cause people to get very upset at them."

Slight Gender Differences

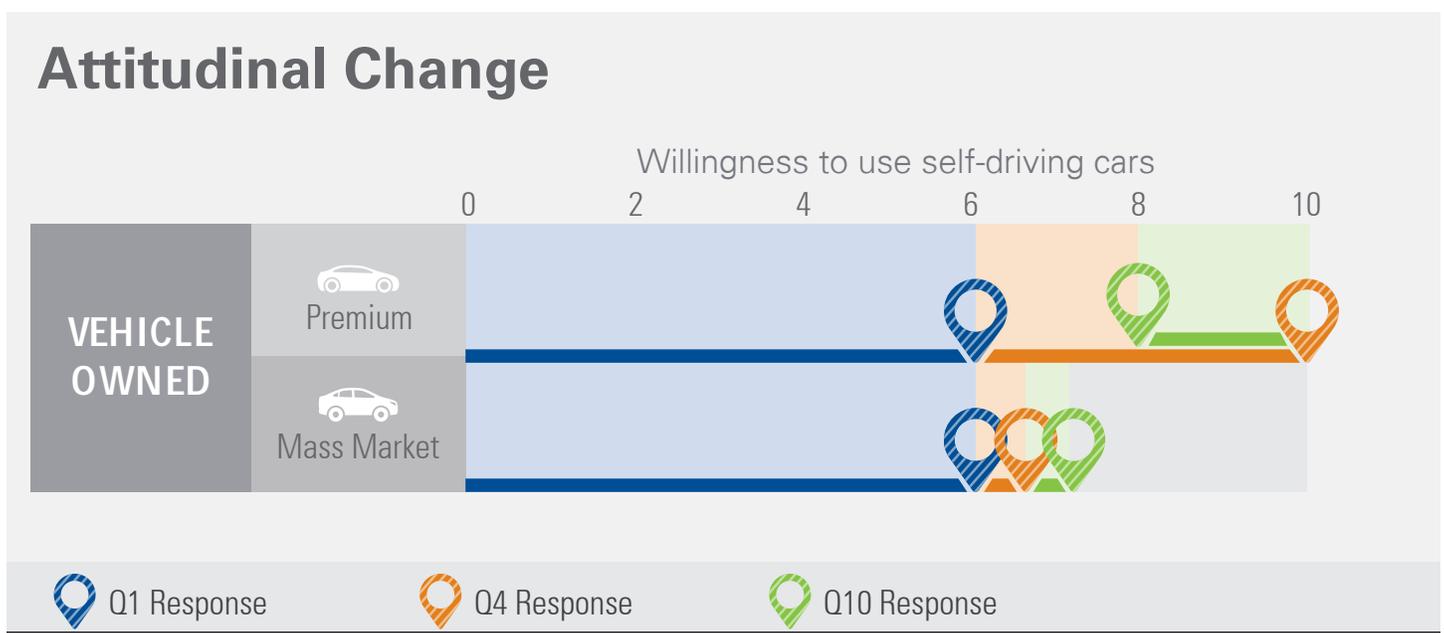


Source: Focus Group Data

Self-Driving Cars: Are We Ready?

Focus Group Questions

- Q1** On a scale of 1-10, what is the likelihood that you would ride in a self-driving car for your everyday use?
- Q4** On a scale of 1-10, rate your likelihood to ride in a self-driving car if your travel time were reduced by approximately 50%, and your car provided a predicted arrival time using a self-driving lane?
- Q10** Based on everything we've discussed today, what is the likelihood that you would ride in a self-driving car for your everyday use?



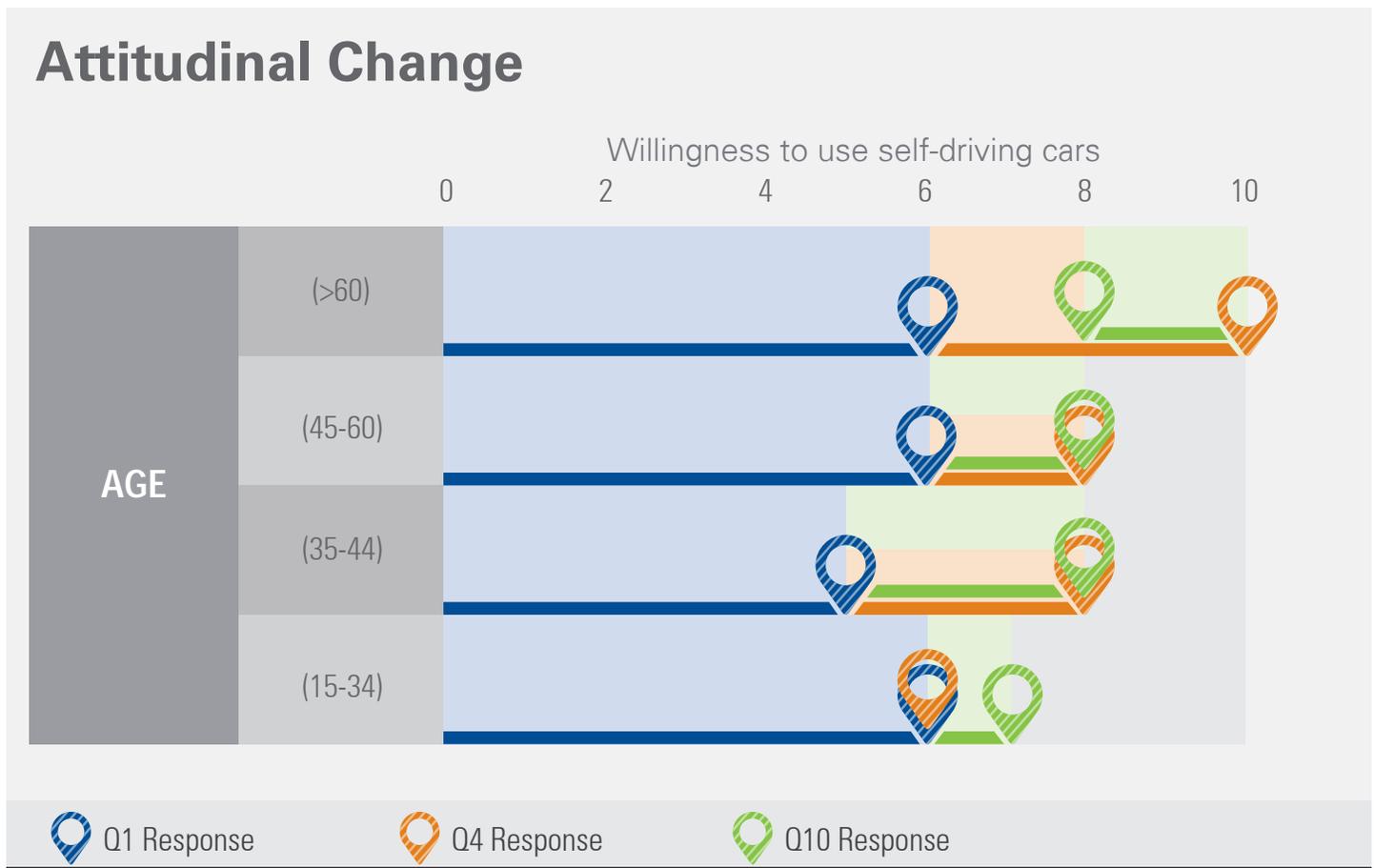
Source: Focus Group Data

The chart above shows how respondents' attitudes changed during the two-hour focus group. Three times during the discussion we asked participants to rate their likelihood to ride in a self-driving vehicle on a 10-point scale. We first asked the question (Q1) after they had seen a video of the Google Self-Driving Car Test. We asked a second time (Q4) after discussing possible incentives, such as special self-driving lanes, which would cut commute times in half. At the end of the sessions—after discussing a number of other topics, including risk factors and obstacles, such as liability issues, cyber security and computer malfunctions—we asked the question for the final time (Q10).

Generational Differences: All the participants in our focus groups were licensed car owners, so we didn't have representation from the youngest age cohorts. But the data already show that younger people are not rushing to get their driver's licenses the way baby boomers did.²⁵ Among the eight focus group participants between 21 and 34 years of age, four rated self-driving at 8 or higher; two of the remaining four were car buffs, and the other two remained noncommittal.

The only two people who said they were not at all likely to use a driverless car were both young men in their twenties. One, Richard (see page 29: Richard's Story) is a car buff who buys and refurbishes cars as a hobby. The other, Aiden, is a Formula One racing fan from Chicago whose comments had the ring of youthful invincibility. Richard didn't budge from his assertion that he would never use a self-driving vehicle (unless it was mandated). Aiden moved slightly, raising his score from a 1 to a 3 if using a self-driving car would cut his commute time in half.

The most unequivocally enthusiastic response came from one of our older participants, Hank, a retired executive from Chicago (see page 20: Hank's Story). When we showed his group a video of the Google car driving a blind man²⁶, his reaction was swift. "Where do you buy one? Great concept!" he said, adding, "Obviously, the cost would be a concern, as would the safety aspects. [In] the video we just saw, the car was by itself with no other vehicles around it. But conceptually that's what I want. I'll take one in red."



Source: Focus Group Data

The chart above shows responses to the same three questions broken down by age cohort.

Delivering the Right Value Proposition

Incentives: Most people who started out resistant to self-driving perked up when we mentioned access to special lanes for self-driving vehicles. Those lanes, in which cars would form platoons all moving at a constant speed, could (as we explained in our first white paper) increase highway capacity by as much as 500 percent, making commutes much shorter and far more predictable.²⁷ We offered a hypothetical, suggesting that special self-driving lanes might cut commute times in half, and vehicles would provide commuters with an exact time of arrival at their destination. That got people's attention.

Given those incentives, overall median responses went up by two points. The movement was most significant among two

groups: those who owned premium vehicles and those over age 60. Both groups moved from a median score of 6 to a median score of 10.

Raymond, aged 35–44, from our New Jersey group, was particularly enthusiastic. His commute is long—as much as two hours each way from suburban New Jersey to New York City. Initially, he was on the fence about self-driving cars, rating his likelihood to use one at a 5. But after considering the possibility of a special lane for self-driving vehicles that could cut his commuting time in half, his rating went up to 9. “It’s going to take me 45 minutes from my door to anywhere in New York City? Every day, 45 minutes? That’s a dream come true.”



Safety and Trust: Safety was a dominant topic of discussion. Many focus group participants had a hard time believing the technology will work presumably, to go back to Everett Rogers, because they haven't seen it work yet. Their trust in technology has been shaped by their experiences with computers, smart phones and GPS devices. Focus group participants mentioned software crashes, security breaches and imperfect maps. Few could fully truly grasp the idea that the car would see and react more safely and efficiently than any human. But that's a lot to take in during a two-hour discussion.

Gail



Gender: F

Age: 35–44

Car: 2011 Honda CRV

Occupation: Homemaker

Education: College Grad

Income: \$75k–\$100k

Average Miles Per Week: 100

Type of Driving: Suburban

Passion for Driving: 8

Q1 Answer: 3

Q4 Answer: 7

Q10 Answer: 4

At first glance, Gail seems like a cross between a soccer mom and a business analyst. Her retro black eyeglasses give her a slightly studious air, but her gut reactions are pure “mama bear.” And right from the start she makes her priorities clear: “I have a two-year-old daughter so ...my concern is always safety when I’m driving.”

Not so long ago Gail was commuting from her home in suburban New Jersey to a full-time job in New York City; now she’s a stay-at-home mom. Gail and her husband have two cars: hers is a 2012 Honda CRV, which she drives, about 100 miles a week mostly on suburban roads; his is a 2012 Volkswagen Jetta.

Gail’s initial reaction to self-driving is on the low side. She rates her likelihood to use the technology at a 3. Her issue is control. “What if...you have plans to go to the mall or something and all of a sudden your passenger gets violently ill?” she asks. “Do you speak to your car and say, ‘hospital’?” Past experiences with voice recognition technology don’t inspire much confidence. “I’m so used to [having] to repeat things and repeat things.”

Her experience with GPS isn’t much better. As recently as this evening on her way to the focus group, GPS failed her. Gail explains, “I put this location into my GPS, and instead of telling me to go left it kept telling me to go right. Because I’m familiar with the area and I see [the building] in front of me, you know, I use my own brain. So I have a hard time sometimes trusting, giving 100 percent trust in GPS.” Gail usually checks online maps before she goes to an unfamiliar location even though she uses her GPS when she’s in the car. “What if there’s a computer glitch...[or] some sort of outage and you’re in the middle of the highway and your car just stops?” she asks, adding, “Just having a hard time giving [my] complete trust...where you can die if, God forbid, something goes wrong.”

But when the discussion turns to commuting and the possibility that a special self-driving lane would cut commute times in half and let the rider know exactly when she will reach her destination, Gail ups her score from a 3 to a 7. “I used to commute to New York every day so I know the frustration of sitting in traffic and having to constantly call my job and say I’m running late,” she says. “[With the self-driving car] you get to sit down and relax, close your eyes, drink your cup of coffee, read your paper, but you know for sure that you’re going to arrive at work on time... That’s a beautiful thing ...a dream scenario.”

But as much as she loves the idea of a fully automated commute, Gail isn’t keen on sending the car away when she gets to her destination. Mobility on demand doesn’t work for her. “I just kind of want my car there all the time,” she says. Why? She offers a couple of reasons: First and foremost, is safety: What if “in the middle of the night... there’s an emergency [and] I have to get to the hospital?” she asks. Besides, her car is like her personal office with all her stuff inside.

“Like a large purse,” another female panelist interjects.

“Exactly!” says Gail.

Self-Driving Cars: Are We Ready?

Safety and Trust: (continued) Respondents were almost unanimous in expressing a need to be able to take control of the car at will. There are two distinct reasons they felt strongly about having the ability to turn self-driving on and off:

1. They didn't fully trust that the vehicle will be as safe (much less safer) than human-driven cars. They wanted to know what would happen if the technology were to fail in the middle of a trip. Would the car stall? Would the driver-passenger be able to take control back? How will that work if the driver is blind or unlicensed?
2. They still wanted the option to go for a drive just for the fun of it, to savor the open road. (Whether the open road is as inviting as urban and suburban commuters imagine is a query for another day.)

We believe the hand-off of control between self-driving vehicles and their human passengers may present the greatest challenge. If self-driving becomes a reality and those who are incapable of assuming control of the vehicle (whether because they are asleep, drunk, unlicensed or impaired in some way), what exactly will happen? Would passengers and their vehicles be stranded?

MOBI™ results reveal similar concerns among those discussing self-driving online, where topics of discussion

deviate from the standard automobile discussions. Much of the online conversation is fairly theoretical, focused on whether the technology can really work. There is a good deal of discussion around the technology, especially about vehicle handling capabilities.

That leads into another top concern, not just whether the technology exists, but if it works well and can be trusted. "Even if it works, would I get in it?" Taken as a group, "safety, innovation, trust, quality, insurance, and vehicle problems" are the key words that reflect those concerns.

At the other end of the spectrum, the terms "engine" and "transmission" are far less relevant to self-driving car discussions. As the act of driving becomes irrelevant, there is less concern around the powertrain.

Most participants said they would be slightly more likely to trust the technology if it were certified or endorsed by an independent third party, such as Consumer Reports. An endorsement from the NHTSA did not increase confidence in the technology. In fact, it had the opposite effect. In each of our focus groups, participants laughed at the mention of the federal government influencing their opinions. But the reaction seemed clearly reflective of general frustration with partisan politics rather than a real understanding of NHTSA and its role.



Deliver Value and Consumers Will Pay: Despite the many questions and concerns our participants raised, there was one area of startling agreement: almost every person was willing to pay a significant premium for a self-driving package given the right value proposition, which, as noted above, includes significantly faster commute times, reduced variability in commute times and the ability to use the vehicle either mode: self-driving or manual control.

In launching the discussion about how much consumers would pay, we asked them to imagine two identical vehicles with a \$30,000 base price. The only difference was that one came with the self-driving package. We asked, “How much more would you be willing to pay over the \$30,000 base price.” We gave people the option to answer with a percent or a dollar amount. The median premium was \$4500, or 15 percent over the base

price. (Although, as anyone who has conducted focus groups knows, stated willingness to pay does not always correlate with actual willingness to pay.) Two age groups indicated the highest willingness to pay the oldest cohort (over 60) and the youngest (ages 21–34). The former makes sense: older Americans are more likely to have the resources to pay for extra bells and whistles on their cars and more likely to experience age-related impairment. But what about the youngest cohort? We had two theories: 1) they’re the most tech savvy and most likely to place a high value on the freedom to stay connected to their digital lives while in transit; or 2) they’re less concerned about money because they’re assuming their parents will foot the bill.

Only one person, Richard, our car enthusiast, wasn’t willing to pay extra for a self-driving package because, as he said, he wouldn’t use it.

Carmella



Gender: F

Age: 45–60

Car: 2012 BMW 5 series

Occupation: Realtor (self-employed)

Education: College Grad

Income: >\$150k

Average Miles Per Week: 200

Type of Driving: Suburban

Passion for Driving: 9

Q1 Answer: 0

Q4 Answer: 5

Q10 Answer: 5

Carmella loves her car. Her face lights up as she recounts her automotive history, which culminated with her purchase of a 2012 BMW 5 Series. “My husband was always a fan of German cars,” she says. “I always had my American cars, and then I had a Jaguar.” She pauses slightly to let the brand name resonate. “And finally after 12 years, [I] didn’t want to get rid of this fabulous car, but everything started going on it. So I bought a BMW.” She sounds almost surprised by the affect the car had on her. “It was a whole new body change, and it’s just fabulous. I love driving my car!”

A striking woman in a fitted black dress and jacket, large hoop earrings and dark hair piled on top of her head, Carmella has the air of an Italian movie star from the 1950s. Based in the New Jersey suburbs, she works as a realtor and says she drives maybe 200 miles a week, mostly around the in suburbs.

How much does she love her BMW? On a scale of zero to 10, Carmella rated her passion for driving at a nine. “Not that I don’t like driving it,” she says quickly. “But there’s a blind spot in the car that drives me crazy.” Otherwise it’s a great car, she adds. “It’s economical. It’s only a four cylinder, but it has this turbo engine so the car flies. I was used to the Jaguar, which has a V8 engine. And this is great on gas and has a great pickup.

“I love my car!”

After her ode to the BMW, it wasn’t surprising that Carmella rated self-driving a zero. “You buy a car because you like [it] and you like to drive,” she says. “Sometimes you get tired and you don’t want to drive,” she admits, but exhaustion isn’t enough to get her into a self-driving vehicle. She doesn’t trust the technology. “I would not be comfortable not being in control behind the wheel,” she says. “Technology makes a lot of mistakes; navigation makes mistakes. Why wouldn’t this [self-driving vehicle] make a mistake and cause you to have a horrible accident?”

The “aha” moment comes when we mention the possibility of a special self-driving lane that would allow platoons of self-driven vehicles to move more quickly and predictably through rush-hour traffic. After hearing about the special self-driving lane, Carmella raises her interest in self-driving from zero to five. “The special lane gave me more of a...comfortable feeling,” she says. “If I was going long distance on a highway, and I knew I could save half the time getting there, then I’d be ok with [a self-driving car]. But it would have to be [in] that one lane,” she says.

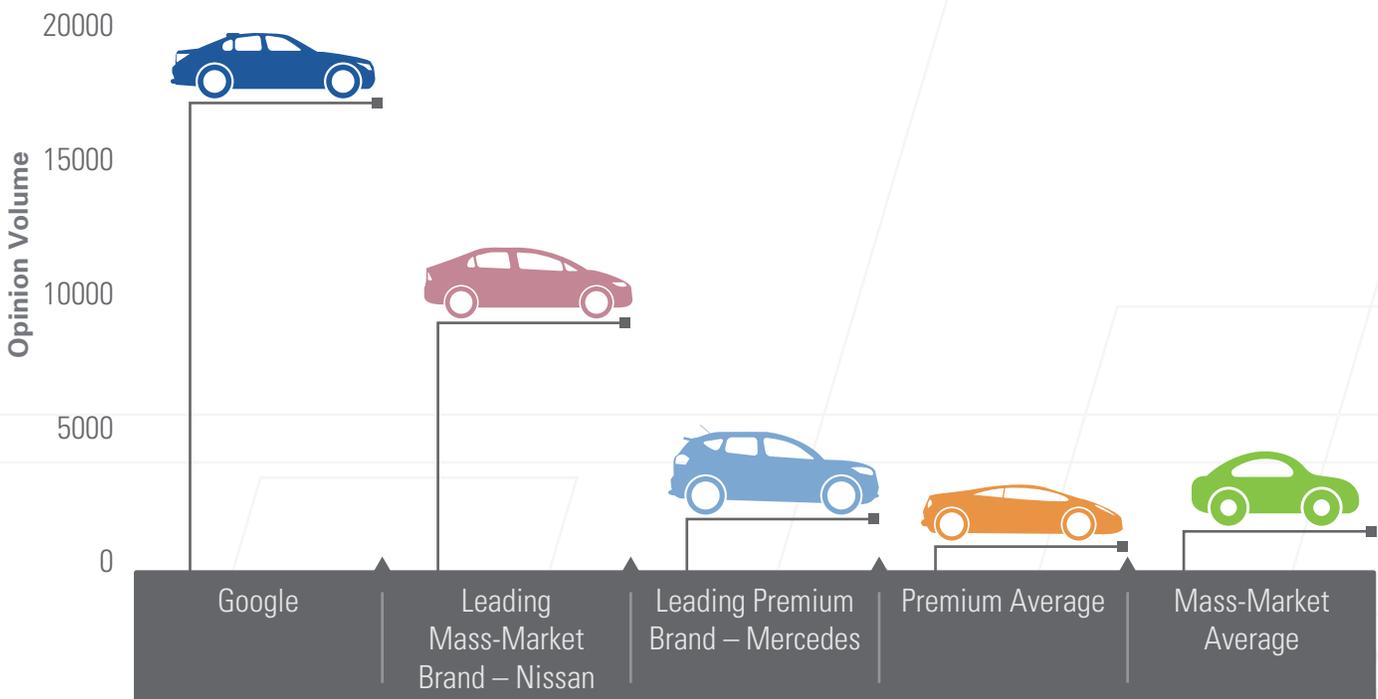
Self-Driving Cars: Are We Ready?

Which Brands Will Matter?

When imagining how automated driving technology might reshape the industry, it's worth recalling that in 1900 there were more than 1,500 automobile manufacturers operating in the U.S.²⁸ By 1950 there were fewer than 50. For several decades the Big Three U.S. automotive manufacturers dominated the competitive landscape; now they fight for market share with major European and Asian manufacturers. And once again, a handful of startups, such as Tesla, are emerging. Our findings suggest that the shift in the competitive landscape has only just begun.

We asked participants in our focus groups which automotive brands they would trust to build a self-driving vehicle. Our list was not comprehensive but included many of the best-known mass-market and premium automotive brands. Mass-market brands did not fare well in our results particularly U.S. mass-market brands. Premium brands received a median score of 7.75 compared with a median score of 5 for mass-market brands.

Self-Driving Cars – Associated Brands



Source: KPMG MOBI™ Data

We used KPMG MOBI™ data to analyze brand associations and found, not surprisingly, that Google is the brand most associated with self-driving cars. Nissan is the top mass-market brand associated with self-driving cars, driven by its August 2013 pledge to launch an affordable self-driving car by 2020.

The discussion revealed a noticeable bias against American cars within our focus groups. For example, one Chicago panelist explained, “I made it real simple – and this might not be socially correct – but [I gave] all the Asian brands a 10. All the European brands...an eight. All the American cars, zero. Real simple. The Asians can really make a car. A very good, reliable, strong car. I believe the American market – the industry, vehicle-wise is dead.”

On the other hand, Hank, our retired executive from Chicago, stood up for American manufacturers: “I have a lot more faith in American cars than some of the other people here, particularly in terms of their engineering going forward...Financial constraints have resulted in cars that are not super terrific, but they certainly have the engineering capability going forward to do this.”

Given that two thirds of our participants came from the East and West coasts and large urban markets, our data is not necessarily reflective of broader national trends.

Richard



Gender: M

Age: 21–34

Car: 2008 Camry

Occupation: Commercial Plumber

Education: College Grad

Income: \$75k–\$100k

Average Miles Per Week: 400

Type of Driving: Highway

Passion for Driving: 10

Q1 Answer: 1

Q4 Answer: 1

Q10 Answer: 1

Richard is the outlier in our Los Angeles focus group: a true automobile enthusiast. A commercial plumber in the 21-34 age cohort, Richard isn't merely passionate about driving: he has a hobbyist's appreciation for the machines. “I love working on cars,” he says. “I think the internal combustion motor is the single greatest invention we have – at least in the last 100 years – from where it's taken our civilization. Being able to get where you want to go at a moment's notice...so I think they're really important in our culture.”

Richard's primary vehicle is a 2008 Toyota Camry, which, by his estimation, he drives approximately 400 miles per week. But at any given moment he's likely to own several other cars. “I've got quite a few [cars] rotating...at the moment,” he explains. “I'm constantly getting project cars on the side that I kind of do my thing with and then resell.”

Although he confesses that self-driving vehicles are interesting in theory, Richard won't be in the market anytime soon. “I definitely see how awesome that technology is – and it's intriguing. But personally I don't ever see myself owning one if I don't have to. I enjoy driving. I'm the type of person that has a manual [transmission] – I won't even drive an automatic because I enjoy feeling my car.”

Nothing changes Richard's mind. He starts the session rating self-driving at a one (on a 10-point scale) and two hours later, he's still in the same place. Access to special self-driving lanes doesn't sway him because, as he tells us, he leaves home early enough to avoid traffic on his daily commute. Plus, he admits, he doesn't trust the technology. “I think it's a great idea in a lot of ways but personally I don't think I could ever trust a computer to drive for me.”

Would anything convince him to buy into self-driving technology? “Probably not,” he says, adding, “It even kind of creeps me out the more we're dependent on computers and technology. I'm a big science fiction fan so I'm probably a little paranoid.”

Mobility on Demand: Why Own a Car?

What if you could install an app on your phone that would allow you to summon a self-driving car in a matter of minutes? Would you still need to own a car? In our first white paper on self-driving cars, we suggested that self-driving vehicles could enable new ownership models. We noted that, “Even when vehicle usage is at its peak—near 5:00 p.m. in the U.S.—fewer than 12 percent of all personal vehicles are on the road, which means, of course, that 88 percent are not in use.”²⁹ But will American drivers willingly give up the convenience of having their car parked nearby 24/7?

In 2013 Americans are expected to buy approximately 15.5 million light vehicles.³⁰ But if self-driving catches on, that might change. Most of our focus group participants said they would not give up owning a car altogether, but many were ready to give up their second car as they began to consider the options. More than half of our participants (18 out of 32) said they would consider giving up their second car in favor of being able to summon a self-driving vehicle when they needed one assuming the car could be there within 15 minutes. Even an hour wait for a car didn’t seem to diminish the value of mobility on demand significantly, as long as the wait for a self-driving vehicle was not going to be longer than the expected wait for a taxi.

As one woman in Los Angeles put it, “There are times, like I just had to make the decision to give up my [premium brand] convertible because I don’t have enough room for my bike and it costs so much money for gas to get to the beach. I’m like, ‘which one is more important? The air or being able to ride my bike?’ But if I had the option of ‘Oh, I need a big car today and I need a little car—I would love that. Absolutely.”

Carol, from New Jersey, was also ready to give up one of the family’s two cars: “It would be absolutely perfect for us. Because my husband flies to work every week.” His car sits at the airport from Monday morning to Friday night.

However, we noticed a gender gap: Men were more willing to give up ownership than women. Two women in our New Jersey focus group summed up the dilemma. One thinks of her car

like a mobile office; the other equated her car to a big purse. (See page 25: Gail’s Story.) The sentiment was particularly true for people with young children who ride in car seats.

The men were fairly enthusiastic, especially as they started considering the possibilities. Jim in Los Angeles commented, “My wife and I both drive, but one of my cars just sits in the garage and nobody ever drives the thing. But sometimes she’s out and I need it. So, this for me [mobility on demand] is perfect. I get rid of one of my cars. I own one car and then when I need another car, I’ll call up. Why pay for two cars when you can just pay for one and just use [service]?”

Ken in New Jersey liked the idea of a different car for different activities. “If I’m going to the beach I want a convertible...if I’m going skiing I want something with a roof rack, right?”

If half of all American families who currently own two or more cars were to give up owning one of their vehicles, how would that affect the automotive industry? Would demand for cars shrink dramatically? Would new mobility on demand businesses emerge? Already, Avis Budget Group seems to have placed a bet in that direction when it acquired Zipcar Inc. at the end of 2012. Avis spelled out its rationale for the acquisition in its 2012 annual report: “Zipcar supplements our traditional car rental offerings by targeting typically younger customers in urban markets and on college campuses, providing ‘wheels when you want them’ by the hour or day. Zipcar is an excellent fit as its customers use Zipcar vehicles largely in lieu of vehicle ownership, for the daily vehicle use needs...”³¹

If the ownership model changes, the ratio of fleet sales versus retail sales could change dramatically. Companies that buy and manage large fleets are likely to gain bargaining power. Also, consumers may see a drop in the cost of using a vehicle. If the cost of driving declines significantly, demand for vehicles may actually increase. Ensuring that cars are available when and where they are needed will depend on big data analytics and dynamic pricing. And eventually, mobility on demand may prove a better investment than new mass transit systems.



Implications: The Open Road Ahead

It is clear from our research that we're entering another age of great creativity and innovation for the automotive industry. A time when fundamental change seems possible, even likely. What is less clear is whether the self-driving car will change the world as decisively in the 21st century as did the automobile in the 20th century. But we are highly optimistic.

The technology is evolving. In some ways, the industry is moving even faster than we predicted in our last white paper, *Self-Driving Cars: The Next Revolution*. Most major automotive companies are developing prototypes and exploring joint ventures with high-tech companies. The application of Advanced Driver Assist technologies is expanding, and a few manufacturers now promising that self-driving vehicles will be here within five years.

Consumers seem open to the idea that they may someday opt for a vehicle that is capable of driving itself. They see a value proposition that might be appealing. And already a small but growing percent of car buyers are paying extra for advanced driver assist packages, which are helping them understand and trust that the technology could, in fact, improve their ability to get safely from point A to point B.

We realize significant hurdles and open questions remain. What infrastructure investments will be necessary to deliver the time savings and reduced variability in commute times that consumers are hoping for? And who would make those investments? What kinds of product liability and insurance policies will self-driving vehicles require? Cyber security is already a growing global threat; how will we ensure that self-driving vehicles are protected from cyber attacks?

Ultimately, the future will be shaped by the self-interest of many constituencies from creative automotive startups to laser and guidance system manufacturers, mass transit associations and even driver safety advocacy groups such as Mothers Against Drunk Driving (MADD). The market opportunities are enormous, the potential societal benefits profound. And we believe in the enormous power of scientific discovery, commercial innovation and creative destruction to solve the most complex human challenges.





Self-Driving Cars: Are We Ready?

Focus Group Questions

1. On a scale of 1–10, what is the likelihood that you would ride in a self-driving car for your everyday use?
2. Do you drive mainly in the city streets, suburbs or highways? 2.a. Approximately how many miles do you drive per week?
3. On a scale of 1–10, how would you rate your passion for driving?
4. On a scale of 1–10, rate your likelihood to ride in a self-driving car if your travel time were reduced by approximately 50%, and your car provided a predicted arrival time using a self-driving lane?
5. How much, if any, would you be willing to pay above the base price of a \$30,000 car for self-driving technology?
6. Which automotive brands would you trust to develop self-driving cars?
7. Which high tech companies would you trust to develop self-driving cars?
8. On a scale of 1–10, rate your likelihood to ride in a self-driving car if it had been certified by a third party, such as Consumer Reports.
9. On a scale of 1–10, rate your likelihood to ride in a self-driving car if it had been certified by NHTSA.
10. Based on everything we've discussed today, what is the likelihood that you would ride in a self-driving car for your everyday use?

Notes

- ¹ "Self-Driving Cars: The Next Revolution," KPMG and the Center for Automotive Research, 2012, available online: <http://www.kpmg.com/US/en/IssuesAndInsights/ArticlesPublications/Documents/self-driving-cars-next-revolution.pdf>
- ² <http://www.cnn.com/id/100779662>
- ³ <http://www.bloomberg.com/news/2013-05-07/tesla-ceo-talking-with-google-about-autopilot-systems.html>
- ⁴ http://www.continental-corporation.com/www/pressportal_com_en/general/ov_automated_driving_en/automated_driving_intro_en.html
- ⁵ July 17, 2013, *Wall Street Journal*, "CIO Journal" by Steve Rosenbush, available online: <http://blogs.wsj.com/cio/2013/07/17/white-house-weighs-in-on-google-cars/>
- ⁶ http://www.gm.com/vision/design_technology/emerging_technology.html
- ⁷ Announcement posted on Nissan's website: <http://nissannews.com/en-US/nissan/usa/releases/nissan-announces-unprecedented-autonomous-drive-benchmarks>
- ⁸ <http://www.youtube.com/watch?v=7m9qI70L2yQ>
- ⁹ http://www.motoraauthority.com/news/1080502_2014-mercedes-benz-s-class-autonomous-steering-tested
- ¹⁰ To some extent, traffic-jam oriented applications behave like adaptive cruise control. Both rely predominantly on the same sensors, but they use different algorithms, or rules, to operate the vehicle. Adaptive cruise control works to keep a vehicle from getting too close to the one ahead of it; traffic-jam assist keeps you close to the lead vehicle. At some speed, set by the algorithm, the driver—or the vehicle—must switch between the two sets of rules. Detailed specifications are not yet available for automation coming from Cadillac or Ford.
- ¹¹ 2012, Bryant Walker Smith, "Automated vehicles are probably legal in the United States," <http://cyberlaw.stanford.edu/publications/automated-vehicles-are-probably-legal-united-states>
- ¹² May 30, 2013, National Highway Transportation Safety Administration, "Preliminary Statement of Policy Regarding Automated Vehicles," available online: <http://www.nhtsa.gov/search?q=self-driving&x=-1094&y=-12>
- ¹³ 1997, Christensen, Clayton, *The Innovator's Dilemma*, HarperBusiness, p. 158
- ¹⁴ http://www.huffingtonpost.com/2013/05/21/digital-camera-inventor-kodak-bankruptcy_n_3315622.html
- ¹⁵ *A History of Silicon Valley* by Arun Rao and Piero Scaruffi, excerpts available online here: <http://www.scaruffi.com/svhistory/sv/chap84.html>
- ¹⁶ 2007, "From Horse Power to Horsepower" by Eric Morris, Access, Number 30, Spring 2007, p. 2.
- ¹⁷ 2005, "The dynamics of transitions in socio-technical systems: A multi-level analysis of the transition pathways from horse-drawn carriages to automobiles (1860-1930)" by F. W. Geels, Eindhoven University of Technology, The Netherlands, published in *Technology Analysis & Strategic Management*, Vol 17, No. 4, p. 445-476.
- ¹⁸ *America on the Move*, © National Museum of American History, Smithsonian Institution. online; http://amhistory.si.edu/onthemove/themes/story_48_1.html
- ¹⁹ December 2005, "The dynamics of transitions in social-technical systems: a multi-level analysis of the transition pathways from horse-drawn carriages to automobiles (1860-1930)," in *Technology, Analysis & Strategic Management*, Vol. 17, No. 4, p. 445-478.
- ²⁰ 2003, *The Diffusion of Innovation* by Everett M. Rogers, Fifth Edition,
- ²¹ *The Economist* online: <http://www.economist.com/node/457272> gives one price point. Additional information on car pricing is available here: <http://www.earlyamericanautomobiles.com/americanautomobiles5.htm>
- ²² <http://www.caranddriver.com/features/the-spark-is-gone-whats-going-on-with-electric-cars-feature>
- ²³ Self-Driving Car Test: Steve Mahan, posted by Google on YouTube: <http://www.youtube.com/watch?v=cdgQpa1pUUE>
- ²⁴ Source: KPMG MOBI™ Data.
- ²⁵ "Is digital revolution driving decline in U.S. car culture?" in *Ad Age Digital*, <http://adage.com/article/digital/digital-revolution-driving-decline-u-s-car-culture/144155/>
- ²⁶ YouTube, Self-Driving Car Test: Steve Mahan, <http://www.youtube.com/watch?v=cdgQpa1pUUE>
- ²⁷ "Platooning With IVC-Enabled Autonomous Vehicles: Strategies to Mitigate Communication Delays, Improve 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.
- ²⁸ <http://bentley.umich.edu/research/guides/automotive/>
- ²⁹ "Self-Driving Cars: The Next Revolution," KPMG and the Center for Automotive Research, 2012, p. 28
- ³⁰ Sept. 2, 2013, *Automotive News*, Prices on rise but at what cost?, by Mike Colias and Ryan Beene, available online here: <http://www.autonews.com/apps/pbcs.dll/article?AID=/20130902/RETAIL02/309029954/prices-on-rise-but-at-what-cost#axzz2dn04DnqC>
- ³¹ *Avis Budget Group 2012 Annual Report*, p. 3, available online: <http://ir.avisbudgetgroup.com/annuals.cfm>

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