

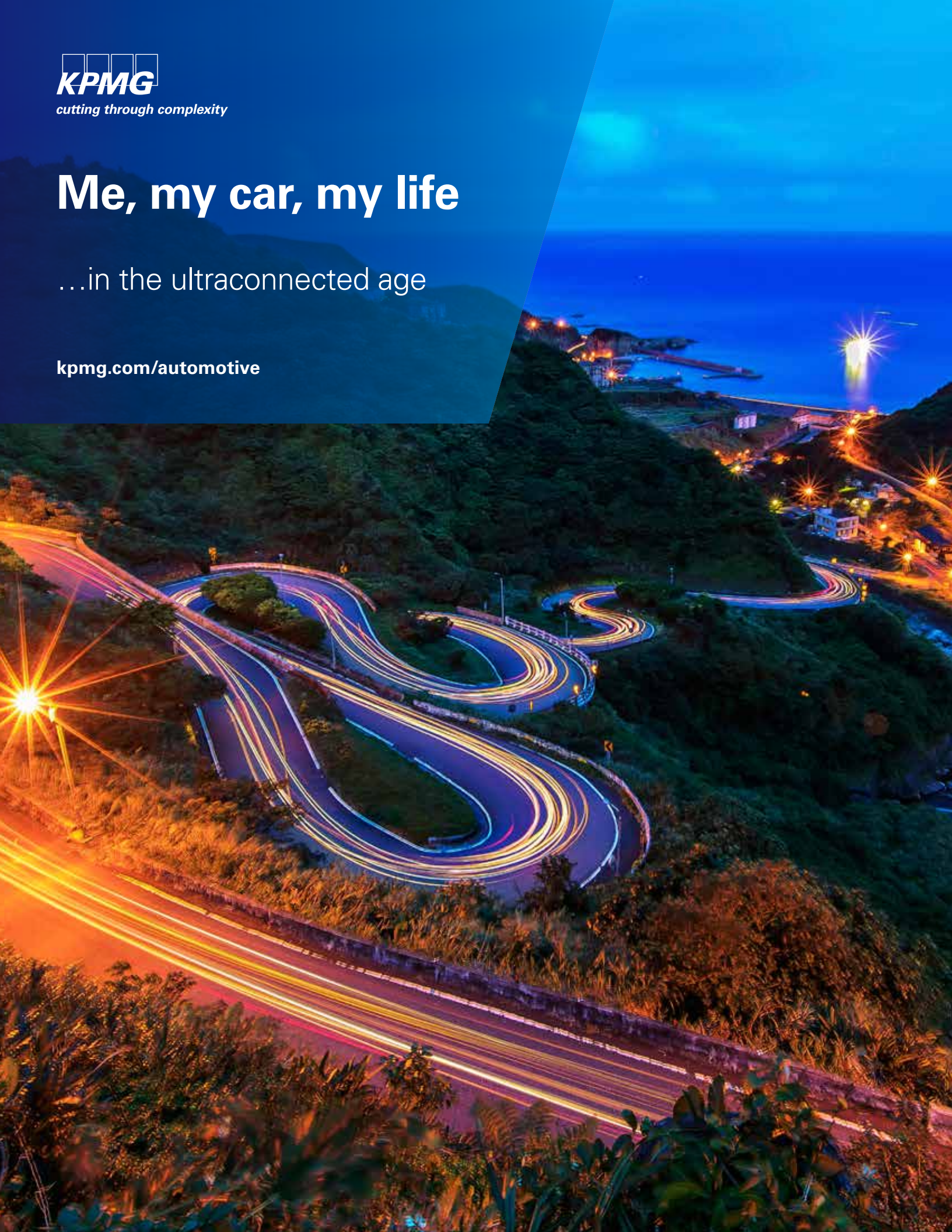


cutting through complexity

Me, my car, my life

...in the ultraconnected age

kpmg.com/automotive





A message from Gary Silberg

Not since the first automotive revolution has there been such stunning innovation in the industry. Autonomous vehicles are only part of the story. The convergence of consumer and automotive technologies and the rise of mobility services are transforming the automotive industry and the way we live our lives.

Two years ago, the KPMG automotive team did a deep dive into emerging autonomous vehicle technologies. The result was our 2012 white paper, *Self Driving Cars: The Next Revolution*, a look at the convergence of sensor and communication technologies needed to create self-driving cars. The more we learned about the technologies and their impact, the more enthusiastic we became about their potential for reshaping our lives.

Last year we followed up by asking the question, “If self-driving cars were safe and affordable, would consumers buy them and/or use them?” The answer was an unequivocal, “yes!” As we reported in our paper, *Self-Driving Cars: Are We Ready*, once consumers understood the potential benefits of autonomous vehicles, they were hooked.

This year, as we enter the Ultraconnected Age, we examined the forces that are reshaping the entire automotive ecosystem. Because at this moment every aspect of the automotive business is changing: from how cars are designed, produced and built, to how they are marketed and sold, to the underlying economics.

Once again, we found ample reason for optimism. The industry is crackling with innovation and entrepreneurship. It’s attracting some of the best and most creative thinkers from major universities around the world as well as billions in research and development dollars from Silicon Valley, venture capital and from within the auto industry itself.

But automakers are also facing tremendous challenges:

1. The era of the two-car family will likely decline.

In fact, the argument for owning a car gets weaker by the moment. Spending approximately \$30k for an asset that loses 11 percent of its value the minute you drive it off the lot and then sits idle more than 90 percent of the time isn’t the most rational economic decision. Mobility-on-demand companies like Uber and Zipcar now provide compelling alternatives to ownership, especially in urban areas. With the potential shift in ownership demand, OEMs better update their economic models.

2. Enormous opportunities in new markets.

Mature markets are becoming saturated, while new markets are emerging. History teaches that when people make it into the middle class, they go shopping for cars. In China, India and sub-Saharan Africa millions, if not billions of new buyers are reaching that threshold. But the future won’t look like the past, because just as these new buyers get ready to open their wallets, new alternatives to ownership are popping up and gaining traction.

3. Tame complexity or lose your customers.

Some high-end cars now have more lines of code than fighter jets, and the complexity is wreaking havoc with production costs and new product launches. Vehicle recalls are at a record high, and customers are complaining vociferously about the design and usability of in-vehicle infotainment. The value of a car increasingly resides in software and electronics—and how well they work together. Get it right or lose your customers.

4. OEMs are falling from the top of the pyramid.

In fact, there isn’t going to be a pyramid any more. The structure of the automotive ecosystem is changing fast. Designing and producing new vehicles have become far too complex and expensive for any one company to manage all on its own; in the future, horsepower may matter less than processing power. The winning companies will be nimble, future oriented – and prepared to invest in new technologies, new talent and new strategic alliances.

I can’t imagine a more exciting time to be part of the automotive industry. The future is full of possibilities – and it’s up for grabs. We hope you enjoy this report and that we will have an opportunity to discuss it with you soon.



Gary Silberg
Partner, KPMG LLP
National Industry Leader Automotive



Watch the related video:
[click here](#)

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Your mobile ecosystem

Mornings are nonnegotiable. You have your cadence, your rituals. And your life is programmed accordingly.

5:49 a.m.: The sleep app on your phone senses your emergence from REM sleep and launches your wake-up soundtrack. You hit “OK” and your morning playlist fades in. Downstairs, on cue, a coffee maker starts. A connected health app checks your pulse and blood pressure. An alert blinks. You’re not surprised. The end of the fiscal year is always a crunch time.

6:23 a.m.: You take a quick sip of your espresso and head out to the garage. As you close the door behind you, you swipe the autostart app on your phone. Your car practically salutes: motor boots on, doors unlock, your apps light up the dashboard. It’s all there: your e-mail, your calendar, your call list. The seat glides back to your settings, your morning playlist pumps through the speakers.

6:28 a.m.: As you slide behind the wheel and buckle up, you see that your connected health app has already rattled you out. The dashboard displays your current vitals: 5.3 hours of sleep at less than 60 percent efficiency, blood pressure 139 over 90, resting pulse 72.

You’re keen to drive; last night your operating system updated itself and you downloaded a new “travel docent” app that narrates the social and architectural history of the routes you take. But the connected health alert blinks yellow and flashes a message, “Medication alert: please take one Diruil and one multivitamin.” You hit “OK” and Scarlett Johansson purrs,

“Good morning, Steve. I see you haven’t been sleeping so well. Why don’t you let me drive?”

6:30 a.m.: As the car backs out of the driveway and heads toward your office, your calendar and to-do list appear on the dashboard screen. Two notices are flashing: “Primary care visit tomorrow at 8:00 a.m. Please complete prescreening.” and “Activate home security?” You answer “yes” to activate your home alarm system and set your smart grid on “energy save” and then deal with your medical tests.

It’s here: the era of ubiquitous connectivity, the moment when you, your car, and your life are one. It will change your basic notions about mobility and revolutionize the way you think about and use your car. Because that car, like every other device you use, is part of an interconnected ecosystem that monitors and adapts to your schedule, your evolving priorities, your relationships, and even your health. Everything (including you) is networked, monitored. That car isn’t just a mode of transportation: It’s the control center for your mobile life.

But enough about you.

In this white paper, KPMG LLP (KPMG) set out to better understand how the automotive industry will reshape itself to deliver these transformative mobility experiences. Not since the first automotive revolution has there been such massive innovation and displacement of the status quo. New players will surge forth, some old players will reinvent themselves, and others will be left behind.

Looking for answers

In the course of our research, we sought to answer the following questions:

- What are the economic forces that will shape demand for mobility—and what kind of mobility will that be?
- Who’s going to capture consumers’ hearts and minds and own the customer experience throughout the life cycle? OEMs? Software companies? Upstart niche players?
- How will explosive growth in new technologies and customization options reshape the automotive ecosystem?
- How will the pace of innovation impact product life cycles and investments—and where should you place your bets?
- What types of organizational structures—from skill sets to business processes—will be required to win in the marketplace?
- Given the magnitude of change in the industry, winners and losers are inevitable. How do you make sure your company comes out on top?



Photo courtesy of Philadelphia Auto Show/Automobile Dealers Association of Greater Philadelphia



Mobility economics

Economic trend #1: Everybody wants a car

All over the developed world, people seem to love, or at least lust after, cars. Cars are among our most expensive possessions—our most conspicuous pieces of personal iconography, indicators of style, wealth, political identity, and status. (James Bond had his Aston Martins, Smokey and the Bandit drove a Pontiac Trans Am, Magnum PI drove a bright red Ferrari. Then the Prius hit the market and quickly became the standard icon for granola eaters everywhere.)

It all started in 1912, when Henry Ford dropped the price of the Model T. Over the next 100 years, the auto industry soared. In the first decade of mass production, the number of registered vehicles in the United States went from approximately 500,000 to 8 million—a 16-fold increase—as cars were priced within reach of a burgeoning middle class.

The same pattern repeated itself throughout the developed world (with significant variation from country to country, according to a recent RAND Corporation analysis¹): As GDP per capita increased, people went shopping for cars. Global annual light vehicle sales in 1965 were around 25 million;² by 2017, sales should exceed over 100 million per year.

In fact, a recent report from the Carnegie Endowment for Peace uses the purchase of a car as a proxy for measuring the size of the middle class in developing nations: “Whereas in advanced countries, even households classified as poor own cars, in developing countries, car ownership is almost synonymous with at least middle-class status. It separates those with the ability to purchase nonessentials from the wider population.”³

If the correlation between per capita GDP and vehicle purchase predominates, the industry could continue along the same trajectory for another 50 years. China has a rapidly growing middle class, eager for mobility. Over the past 15 years,

as the Chinese economy soared, so did auto sales—from almost nothing to 23 million in 2013, making China the largest automotive market in the world. Still, penetration is low—with only 86 cars per 1,000 people today (compared to 918 per 1,000 in the United States, 614 per 1,000 in Germany, and 542 per 1,000 in Japan). Market penetration in India is even lower: a mere 30 vehicles per 1,000 people.

According to LMC Automotive, annual light vehicle sales in China and India alone will top 50 million by 2030. Moreover, there could be substantial room for growth in these numbers. Although unlikely, if China and India were to achieve even 50 percent of U.S. ownership rates by 2050, that would increase projected sales by 80 million vehicles a year.

Indonesia, Vietnam, and many of the fast-growing sub-Saharan African countries may also emerge as ripe automotive markets. Recent projections show that seven of the world’s fastest growing economies during the 2010s will be in sub-Saharan Africa.⁴ Current passenger vehicle density in most sub-Saharan countries is extremely low—as few as 2 vehicles per 1,000 people in Rwanda and Liberia, for example.⁵

And demand in many middle-income countries is exploding: In Jakarta, for example, “The number of cars is growing ten times faster than the roads available for them to roll on.”⁶

In short, the market fundamentals seem to be in place for decades of continued growth for the automotive industry. With seven billion people on the planet and only one billion cars, how can you not be bullish?

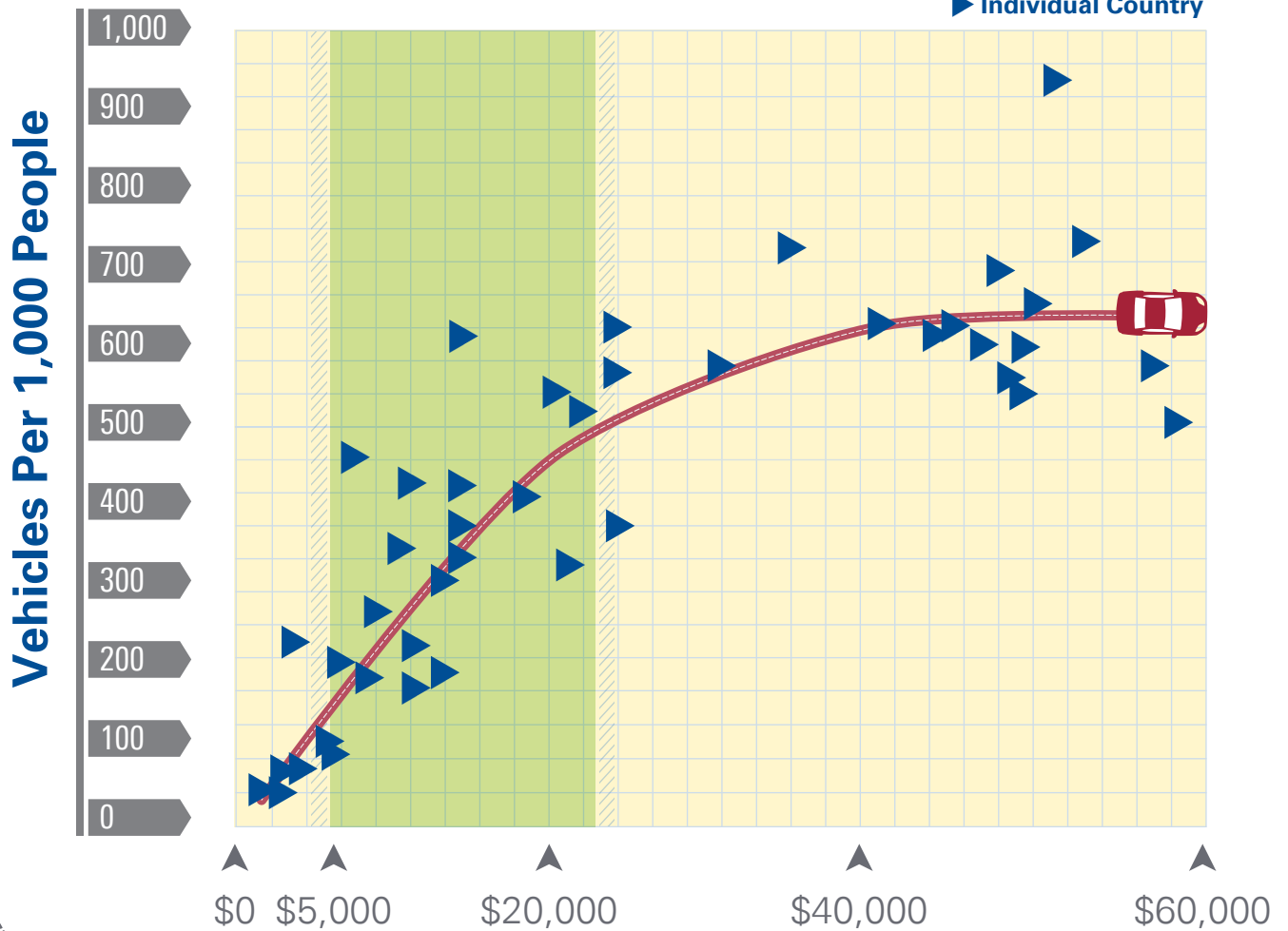
Well, there’s just one thing.



THE AFFORDABILITY SWEET SPOT

When incomes hit \$5k–\$20k, car ownership soars

► Individual Country



2013 GDP Per Capita (Real 2011 Dollars)

Notes: Analysis performed on sample of 46 geographically and economically diverse countries representing 90 percent of world GDP. The best fit curve was created using a third order polynomial fit.

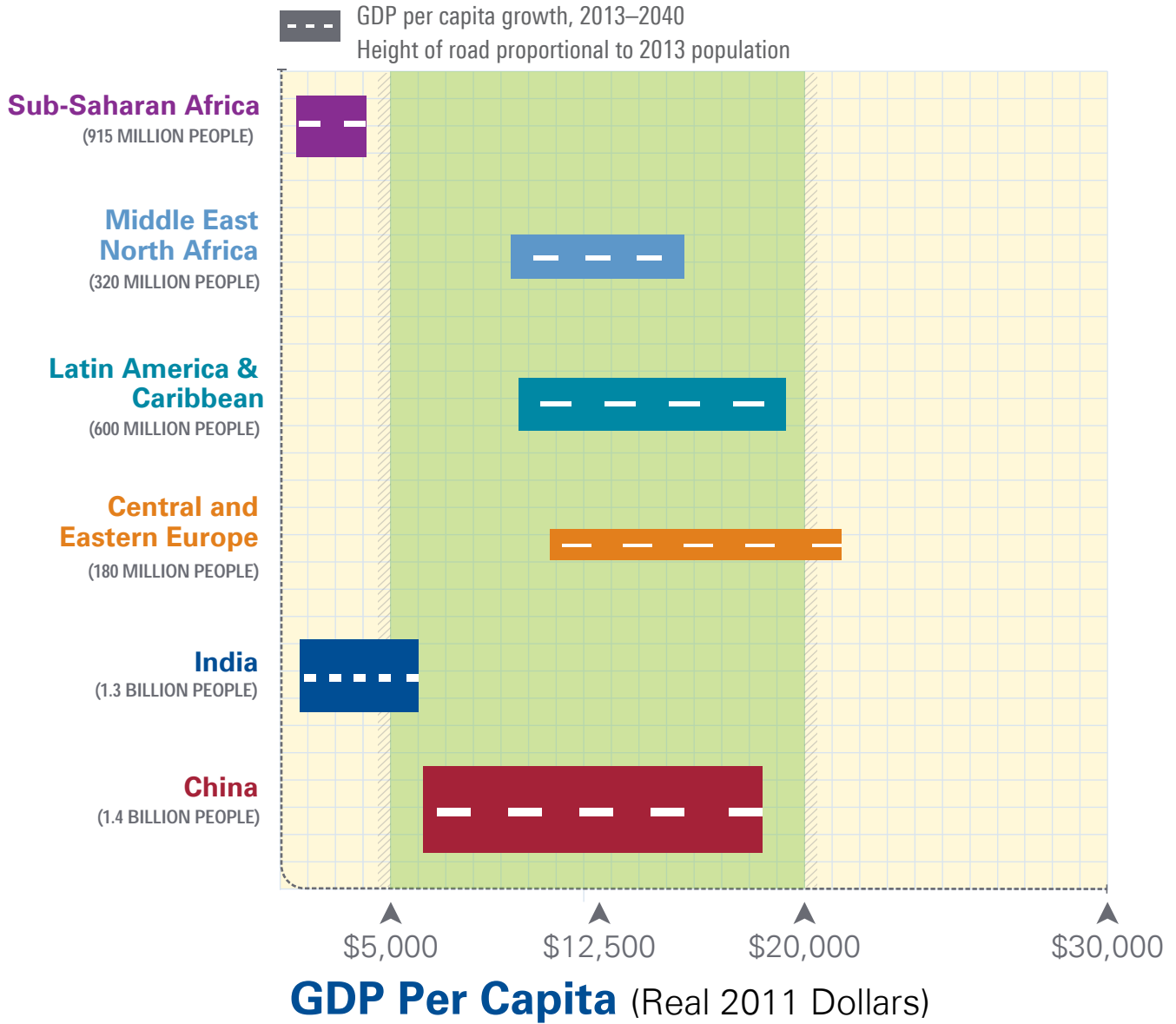
Sources: LMC Automotive and Centennial Group Growth Model⁷





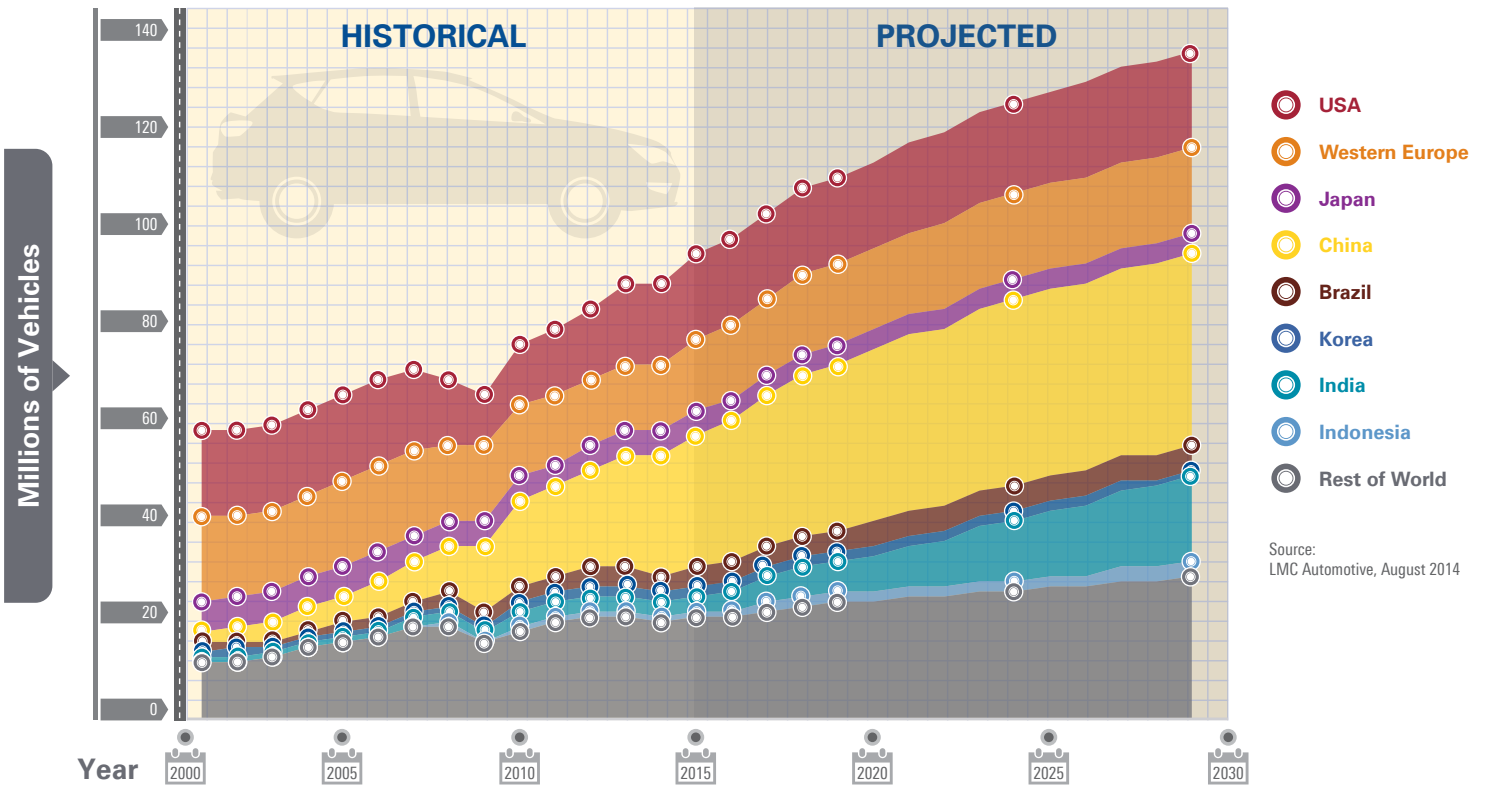
SHIFTING GLOBAL MARKETS

Developing economy growth and the Green Zone (2013–2040)

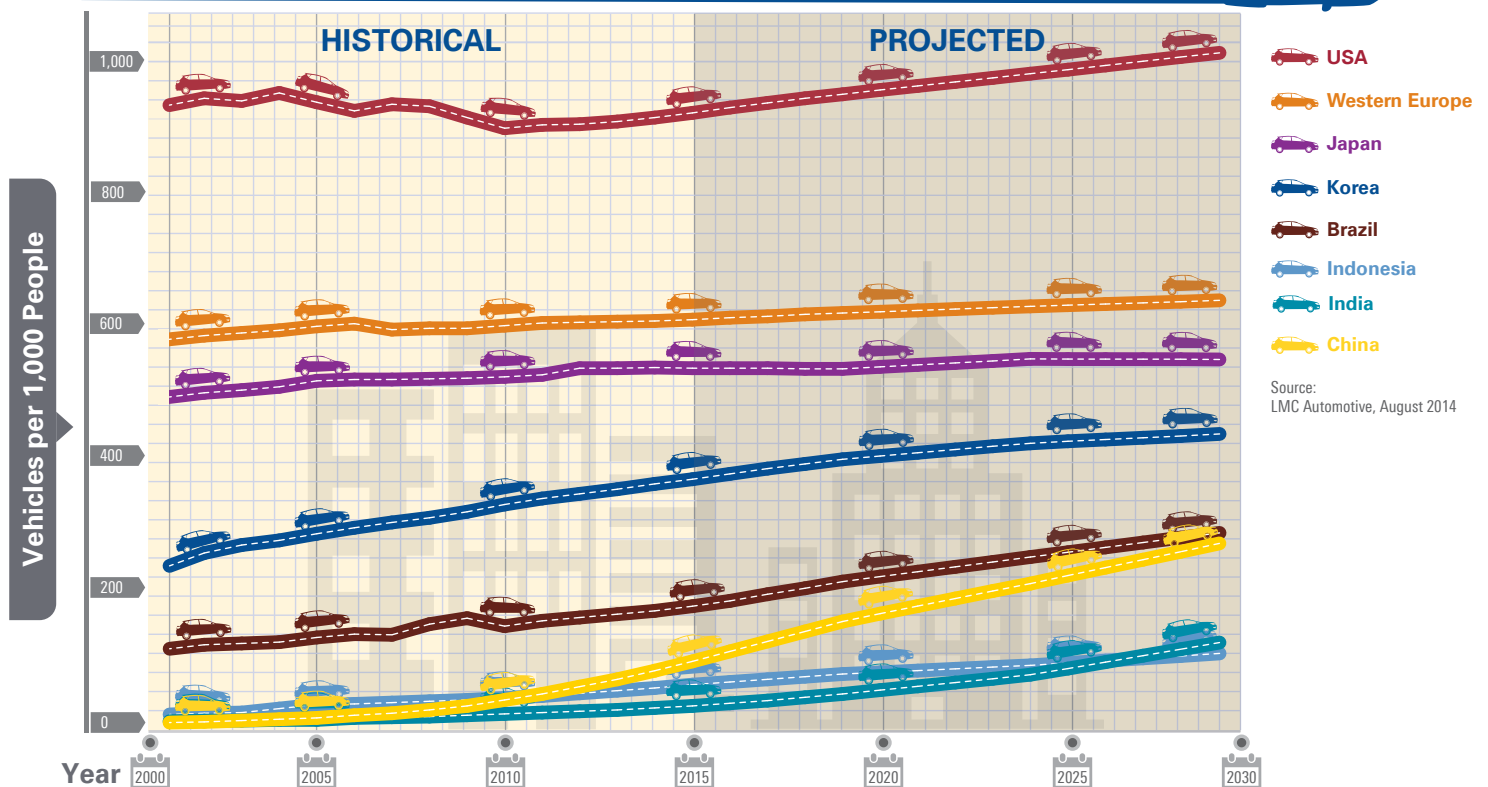


Sources: LMC Automotive and Centennial Group Growth Model⁷

ANNUAL AUTO SALES



VEHICLE OWNERSHIP RATES





Economic trend #2: The rise of mobility alternatives

One could easily make the argument that owning a car is an irrational economic decision. Say you spend \$31,252 (the 2013 average price of a new car in the United States).⁸ That new car loses 11 percent of its value the minute you drive it off the lot.⁹ It then sits idle approximately 95 percent of the time, either in your driveway or in the parking lot at work.¹⁰

So why do it? Because cars are dead-on awesome? Not so much. More likely, the car you own is a mobile locker for your kids' myriad accessories and sporting goods, your mobile office and gym locker, or a giant purse on wheels. And your car provides the one thing you can't imagine living without: the freedom and flexibility to go where you want when you want.

Overall, U.S. car ownership is the highest in the world: In 2007, at the peak of the mortgage boom, all but 8.87 percent of households owned or leased at least one vehicle. During the Great Recession, vehicle sales dropped significantly, as did the percentage of no-car households, which rose to a high of 9.29 percent in 2011. However, by the end of 2013, with the economy back on an even keel, car sales rebounded significantly, and the number of American households without a vehicle had declined to 9.09 percent.

Still, household car ownership is much lower within some major cities: In New York, for example, fewer than half of all households own (or lease) a car. And there are some compelling reasons to believe that over the next decade, the number of American households without a car may grow.

New options: They seemed to rise out of the ashes of the Great Recession—the slew of new businesses designed to make mobility fast, flexible, and affordable. Mobility-on-demand services popped up in urban settings, where car ownership can be an expensive hassle. Zipcar was ahead of the game, having launched in Boston in 2000. But a decade later, the idea was going mainstream, as Daimler launched Car2Go in Germany (2008), Austin, Texas (2009),¹¹ and beyond; and Avis acquired Zipcar for \$500 million (2013). Since then, other established companies have launched or acquired competitive services. Car sharing services in the United States have already attracted more than 1.2 million members, who share 17,179 vehicles.¹²

Mobility-on-demand business models vary but fall into a few broad categories:

- Car sharing (peer to peer): GetAround, JustShareIt, and RelayRide
- Membership rental services: Zipcar, Car2Go, Mint, and WeCar
- On-demand services (either driven or, eventually, autonomous): Uber and Lyft
- Niche, special-purpose vehicles (low speed, super compact, super-flashy rentals, etc.)
- Bike sharing: Citibikes, Bixi (Montreal), Akzu Public Bicycle Rental (China), and Bykystations (Dubai)

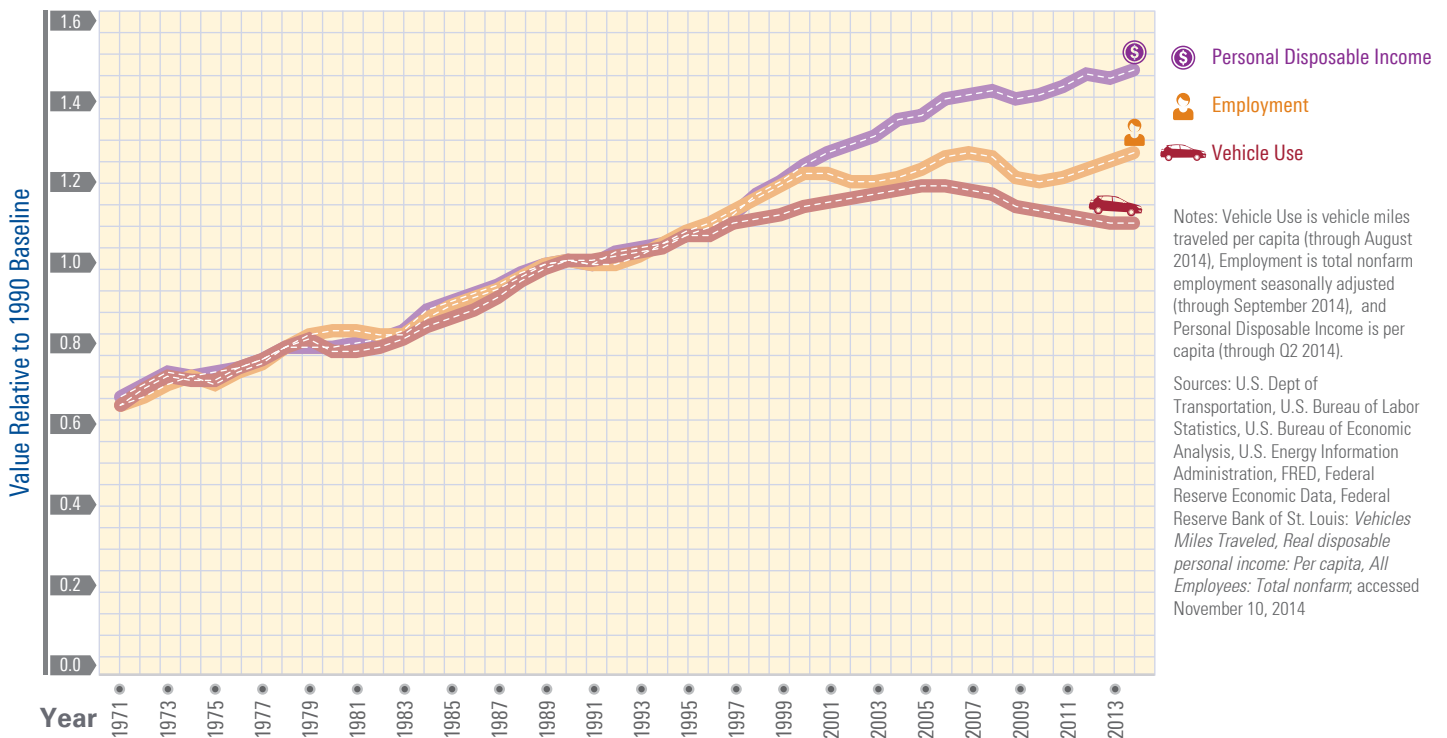
The market for these just-in-time mobility services could be huge, especially with the rise of high-density megacities. Companies such as the newly launched RideScout aim to capitalize on the need for on-the-spot mobility solutions. RideScout aggregates information about the array of mobility solutions available in a particular location, including everything from bike sharing to mass transit to ride sharing and rentals. “We’re all about meeting your transportation needs right now, on the curb—providing you with the information you need to meet your ride preference and current circumstances and then connecting you with that ride,” said Steve Carroll, RideScout’s VP of Strategic Development. “In doing so, we’ve created a marketplace where any ride provider can compete for your business in real time [when] you need to get somewhere.”¹³

Established automotive companies are paying close attention to these new mobility services start-ups. In September 2014, Daimler acquired RideScout, adding to its growing portfolio of on-demand services, including Car2Go, Park2gether, and Moovel.¹⁴

Virtual mobility: Along with new mobility-as-a-service alternatives comes another technology-enabled option: staying home. With a slew of communication and collaboration platforms, companies are finding it easier (and sometimes cheaper) to encourage employees and contractors to work remotely. In fact, there are very few tasks that one can’t conduct online these days—from banking to shopping to medical consultations.

Urbanization: In 1950, 70 percent of the world’s population lived in rural areas. Over the next 64 years, the world’s population began to shift into urban areas. In 2007, for the first time, the balance shifted—with more people living in urban areas. In 2014, the United Nations Department of Economic and Social Affairs issued an update to its World Urbanization Report, noting, “The continuing urbanization and overall growth of the world’s population is projected to add 2.5 billion people to the urban population by 2050, with nearly 90 per cent of the increase concentrated in Asia and Africa. At the same time, the proportion of the world’s population living in urban areas is expected to increase, reaching 66 per cent by 2050.” In urban areas, the cost of vehicle ownership tends to be much higher, and other alternatives, ranging from bikes to mass transit to mobility on demand, can be cheaper and more convenient.

U.S. VEHICLE USE DECOUPLES FROM ECONOMIC GROWTH



Policy shifts: In recent years, many developed countries, including Germany, Australia, and Japan, have implemented policies and fees designed to tamp down on driving.¹⁵ And developing countries may attempt to do the same, leapfrogging the rise of urban congestion and mind-numbing traffic jams. In fact, the RAND Corporation study found that in both the Organization for Economic Development (OECD) countries they studied and all the BRICs except Brazil, policies are shifting away from automobility.¹⁶

The Economist makes a similar point: “Some municipalities in the developing world are already planning for less car use, notably by deploying urban rail systems. The Shanghai metro, mostly built since 2000, ferries eight million people a day and covers 80 percent of the city. Eighteen Indian cities and several Middle Eastern ones are designing urban rail networks.”¹⁷ And South Korea is creating “bicycle highways,” plexiglass-covered bike lanes above existing highways to encourage more people to ride bikes to work.¹⁸

Country-specific factors: While the correlation between per capita GDP and auto sales is undeniable, it is unlikely that any of the developing countries, including China, will reach U.S. levels of market penetration. As the RAND Corporation study puts it: “Income is not destiny. Economic growth is quite helpful in understanding changes in demand for automobility within one country but far less helpful in understanding variation in demand between countries.”¹⁹

RAND’s research identified nine factors that determine the market potential within a developing country:

Indigenous	Exogenous
• Good car infrastructure	• Active population (high demand for mobility)
• Inexpensive fuel	• Existence of domestic oil
• Pro-car policies	• Strength of the domestic car industry
• Lack of alternatives to driving	• Spatial dispersion
	• Favorability of car culture



Different generations, different attitudes and priorities?

What if car obsession went the way of big bands and pogo sticks? What if cars lose their sex appeal? Cultural norms and priorities change. Could single occupancy vehicles become as déclassé as cigarette smoking?

We don't have definitive answers to these questions, but we are quite sure that demographic shifts, urbanization, environmental concerns, the rapid adoption of social media, and the rise of mobility alternatives will likely reshape the demand curve for new vehicles.

Much has been written about the steady decline in car ownership in the United States and millennials'²⁰ relative ambivalence about cars and driving. Fewer young people are getting driver's licenses when they reach legal driving age: that much is clear. Research published by the University of Michigan Transportation Research Institute (UMTRI) shows a marked decline in the percent of millennials with driver's licenses. In 1983, for example, 87 percent of 19-year-olds had licenses; by 2009, "that percentage had dropped to about 75 percent."²¹

Americans are also driving less. According to a report published by Frontier Group, a policy think tank, and the U.S. Federation of Public Interest Research Groups (U.S. PIRG), "From 2001 to 2009, the average annual number of vehicle-miles traveled by young people (16 to 34-year-olds) decreased from 10,300 miles to 7,900 miles per capita—a drop of 23 percent."²²

But the reasons for the decline are still a little murky. First, of course, the available data covers the period of the Great Recession, when spending dropped across the board. The Frontier Group report cites a number of factors: "higher gas prices, new licensing laws, improvements in technology that support alternative transportation, and changes in Generation Y's values and preferences—all factors that are likely to have an impact for years to come."²³

An article in the *New York Times*, "The End of Car Culture," takes a similar position—that these changes in driving habits and car ownership rates could herald a long-term trend. The *Times* quotes Mimi Sheller, a sociology professor from Drexel University, who attributes the cultural change to the rise of social media and carpooling apps, urbanization and urban renewal, and flexible work and telecommuting arrangements. Others suggest that we are moving beyond the traditional "ownership" society, adopting a new way of consuming, which Claire Cain Miller calls "the Netflix economy."²⁴

The Federal Highway Administration (FHA) conducted focus groups to delve more deeply into youth attitudes about driving. They found, as one would expect, that car ownership depends on one's location and finances. "The effects of the economic recession on youth employment prospects, housing expenses and added student loan debt, made living in areas that provided sound transit services and other inexpensive and convenient means of getting around very desirable."²⁵ But the FHA study also noted that "Other than financial reasons; car ownership was viewed by most participants in a positive light."²⁶

The received wisdom is that millennials are radically different from past generations. But are they? The data are still unclear. Behaviors tend to change with age and circumstances. So rather than drawing facile conclusions, watch these trends carefully.

Two-CAR FAMILIES ARE STILL THE NORM IN THE UNITED STATES

The most populous cities in the United States have comparably low rates of multiple-car households



...EXCEPT IN MAJOR CITIES

New York City, NY



13.9%

Los Angeles, CA



47.8%

Chicago, IL



28.7%

Houston, TX



47.1%

Philadelphia, PA



23.4%

Phoenix, AZ



52.1%

San Antonio, TX



51.4%

San Diego, CA



58.0%

Dallas, TX



46.0%

WHAT HAPPENS AS POPULATIONS SHIFT TO URBAN CENTERS?

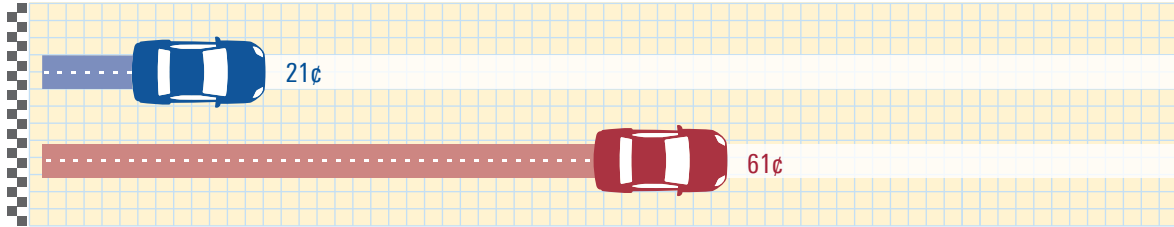
Source: U.S. Census Bureau, 2013 American Community Survey



SHARING CARS BRINGS DOWN COSTS

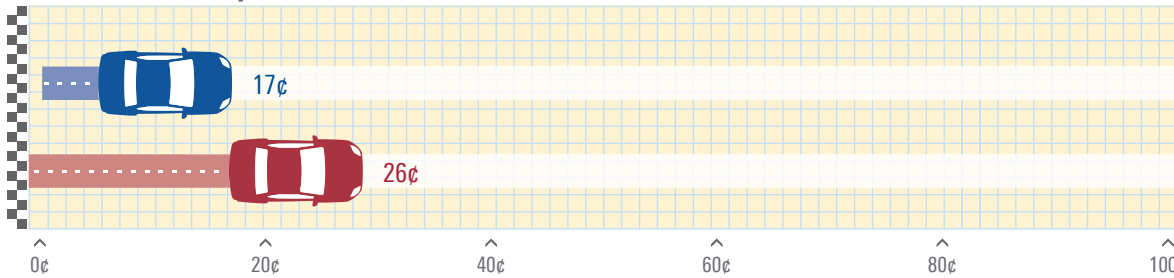
Despite high costs and fast depreciation, high utilization can make shared, high-tech "mobility cars" economically compelling

Today's Car



The "Mobility Car" 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.

Future Mobility Car



Fixed Costs (per mile)

Depreciation, insurance, finance, and registration-related costs

Operating Costs (per mile)

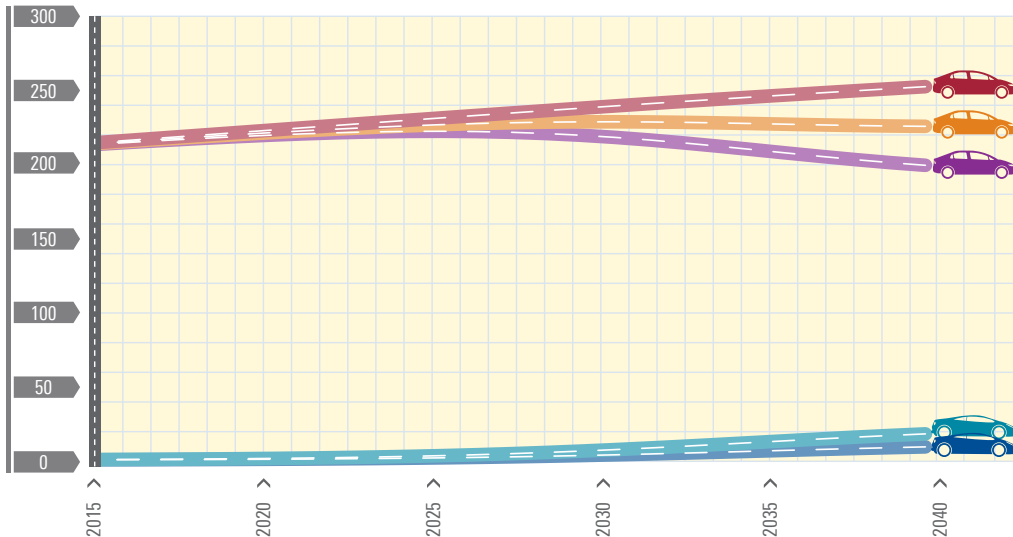
Gas, maintenance, and tires

Sources: AAA, NYC Taxi and Limousine Commission

PROJECTION: THE DECLINE OF THE HOUSEHOLD CAR?



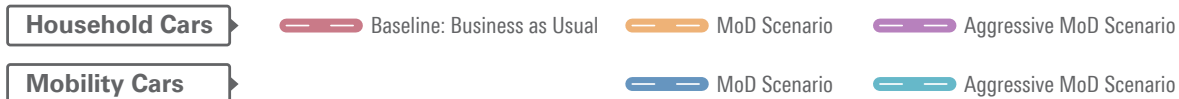
Household owned cars (millions)



Notes: Our model depicts two scenarios in which U.S. households begin to gradually own fewer cars in response to the rise of Mobility on Demand (MoD).

As household-owned cars decline, there is a rise in fleet-like Mobility Cars to supplement transportation needs.

Sources: Federal Reserve Economic Data (FRED), U.S. Census Bureau American Community Survey, Bureau of Economic Analysis



The upshot: A new take on supply and demand

The future won't look like the past: Light vehicle sales will likely soar over the next decade as billions of people enter the middle class. But neither the patterns of ownership nor the vehicles themselves will necessarily look like the vehicles we know today. New technologies and alternatives will emerge, policies may be more or less favorable for private vehicle ownership, and attitudes about land usage and the environment will shape the adoption curve.

New efficiencies: Once a vehicle can be easily shared among households, it gets used more efficiently. Rather than sitting idle 95 percent of the time, it might be idle only 60 percent of the time. In other words, a single vehicle could handle 5 to 8 times as much of our collective need for mobility. It's reasonable to assume that as vehicles are used more efficiently, demand for additional vehicles per capita could shrink. Based on the research we conducted in 2013 for our paper, *Self-Driving Cars: Are We Ready*, we predict that many households will continue to own one vehicle, but the market for privately owned second and third vehicles could take a hit. On the other hand, lower mobility costs might lure new people into the on-demand market.

New buyers: As mobility on demand becomes the norm in urban areas, a larger share of the market will likely be dominated by fleet owners. Once fleet owners gain market share, they will also likely gain pricing power and perhaps a greater say in vehicle design. The cars they buy will have to be built for much higher annual mileage than household-owned

vehicles. The market for premium brands may soften in some cases, as the focus shifts from the car as status symbol to the car as utility. (If you're using a car you don't own, do you really care that it's a super-cool, high-end brand?) However, we think there will still be a robust market for premium vehicles—especially among the newly minted aspirational buyers.

Vehicle turnover will likely be faster, and those vehicles may also require more frequent software and in-vehicle infotainment (IVI) updates, especially if the fleet is to remain competitive. In turn, this will likely bring cars to aftermarket more quickly, and possibly change the funding and business case for developing new platforms and models.

What you need to know

1. There is huge growth potential in emerging markets—but sales in mature markets could be flat or even decline.
2. The rise of mobility alternatives could dramatically change the types of cars sold, pricing power, and profitability.
3. You will need to rethink and recalibrate your economic models.





Owning the customer experience

Challenge ahead: Taming complexity

Ana is a management consultant. Based in New York City, she doesn't own a car. In fact, she's a big advocate for livable cities initiatives, such as congestion pricing and the proliferation of bike lanes. Still, there are occasions when she wants a car—for a weekend in the country or a meeting with a client. For those trips, she uses Zipcar if she wants to drive and Uber or Lyft if she doesn't. When she travels on business and needs a car, she rents from one of the majors.

Elite status notwithstanding, rental cars are a pain, she says. First, you get upgraded to some monstrous gas guzzler. "Doesn't anyone crunch the data?" she asks. "With all the information they have on me, you'd think they'd have pegged me right away as some hybrid-loving lefty."

Second, you have to figure out the car's controls. "Last week I spent 15 minutes looking for the phone charger in the SUV they gave me. Why would they bury the phone charger in a hidden slide-out compartment under the center arm rest?" she says. "I had to ask one of the agents to help me find it."

"Every model I rent has a different user interface. I don't want to spend time trying to map out the inside of each new car I drive. Things like the window controllers: Why were they in the center panel? What was wrong with the door, where they've been in every car for the past 100 years? And why does it take three different screens to pair my phone with the car's audio system? I want it to pair automatically with the car—just the way it detects available Wi-Fi networks."

Of course, Ana's complaints are easy enough to fix with existing technology: Rental agencies could do a better job with customer relationship management (CRM) tools and incentives; app makers could make pairing easier. And they will. As representatives from a Tier One supplier put it, the industry needs standards. "Customers look for the same interface [from vehicle to vehicle]."

But Ana's story also illustrates a changing attitude towards vehicles: Our cars are becoming one of many nodes within our already mobile, connected lives. And we expect them to play well with our other devices. We want our screens, apps, schedules—and yes, even our vehicles—mapped and customized to our priorities, values, and aesthetic sensibilities. Apple, Amazon, and Google trained us to expect our vendors to understand us. They curate our experiences, suggest items of interest, pique our curiosity. Companies that want to own the automotive future will have to deliver similarly customized experiences.

Audi is all over this idea. In a conversation with the KPMG team, Anupam Malhotra, senior manager of Audi America's Connected Vehicle Program, described the typical rental car experience—and it was exactly Ana's experience. "Typically... there's no preselection available unless you're willing to pay an exorbitant price... [and] no guarantee what kind of equipment is going to be in the car and what you're going to be able to do with it. None of your personalization is in there. And you have to figure out how to use it, because you're not used to the controls."

That's why Audi invested in a partnership with SilverCar, a new rental car company that promises customers a seamless, consistent, personalized experience. The cars are always the same: silver Audi A4s. Users customize their in-vehicle preferences with the MyAudi app. So when they get into their rental car, their personal preferences are already loaded in. For all intents and purposes, they're driving a car that is uniquely theirs. "The stress [is] lower because I [have] this beautiful vehicle with Wi-Fi, navigation, and my personalized information from the cloud," Malhotra adds.

Managing the customer life cycle

The in-vehicle experience is evolving rapidly. But in some ways the customer experience has not kept up with the technology. Compare the experience of buying a car to that of, say, going online and configuring and buying a new laptop. Either way, the customer life cycle follows a fairly standard cycle: awareness, desire, consideration, purchase, use, maintenance, and upgrade. But right from the start, buying your new laptop is infinitely easier: You get your choice of chip, RAM, hard drive type and capacity, screen size, graphics card, and preloaded software. You arrange for delivery—either in-store pickup or direct ship. And when you get your new laptop, all you have to do is log into your existing accounts to access your customized digital life.

It all starts with awareness and desire.

Awareness and desire: Henry Ford made mobility attainable, but it was GM that first mastered the art of creating desire for new cars. GM established the first true automotive design office under the legendary Harley Earl in 1927. Until then, cars were more utilitarian machines, built by engineers. But with the elevation of design, GM began building iconic cars with coordinated colors and chrome, and launching annual model changes, encouraging car owners to trade in yesterday's model for the latest and greatest new version (a strategy hardware manufacturers have been using ever since). According to historians at the Smithsonian, "The strategy was successful and General Motors' sales soared as Ford's plummeted."²⁷

In the 21st century, Steve Jobs emerged as the unrivaled master at creating objects of desire. Few companies have been able to duplicate Apple's phenomenally successful product launches. But what distinguished Apple from any other technology brand was the extent to which the company shaped every aspect of the consumer experience—from the product design to its packaging to the lighting in the sleek retail stores. Everything from presales to purchase to service (at a Genius Bar or via Apple Care) is consistent with the Apple brand.

For OEMs, creating branded experiences is far more difficult—because to a greater and greater extent, OEMs are systems integrators. As vehicles become more and more autonomous, the user experience will be far more tied to the software and the human-machine interface (HMI). And vehicles will have to communicate seamlessly with the rest of the devices in the user's digital ecosystem. Maintaining brand relevance could become a challenge as cars become "hardware" in a software-driven ecosystem. If auto makers are not successful, as we noted in our last white paper, customers may look for cars branded by Apple or Google.²⁸

Already automakers are worried. As *The Economist* put it in a recent article, "Smartphones On Wheels," "Cars will become bundles of different technologies, not only of devices but also of consumer brands, all vying for the driver's attention

in a sometimes uneasy alliance with carmakers."²⁹ Apple's CarPlay and Google's soon-to-be-released Android Auto give OEMs plenty to be concerned about. In fact, according to *The Economist*, Fiat Chrysler CEO, Sergio Marchionne, is "worried that it will cost his company money to 'provide a venue to host other people's parties.'"³⁰

Purchase: These days it's easy to go auto shopping online. Almost every OEM allows potential customers to build their own vehicle. But buying a car in the United States almost always requires a face-to-face interaction with a salesperson at a car dealership. Online car blogs are full of car buyers' horror stories of pressure, greed, and misdirection. And car dealers, sadly, rank lower than members of Congress in a Gallup Survey of most- and least-trusted professions.³¹ It's not that car dealers are necessarily more devious than other merchants, but the dealership model, which initially provided much-needed financing for OEMs in the form of customers' down payments, needs an upgrade.

We're not suggesting that dealers will disappear, although Tesla has already revolutionized the car-buying experience. In an interview with Autotrader.com, Tesla's VP of Sales and Ownership Experience, George Blankenship, explained the Tesla sales approach: "We want to engage with people when they are not thinking about buying a car. Our goal is not to sell a person a car, but to educate them on what electric cars and, particularly, what Tesla electric cars can provide."³²

According to economists Francine Lafontaine and Fiona Scott Morton, "Theory and evidence suggest that the protection... automobile dealers have obtained from local legislatures has been to the detriment not only of manufacturers, but also of consumers, resulting in higher cost of retailing and higher prices for cars, inflexibility of the dealer network, and a lack of innovation in car distribution."³³ It's not just the economics that makes the dealership model problematic; current dealer staffing, skills sets, and incentives are not appropriate for selling these new highly sophisticated mobility devices.

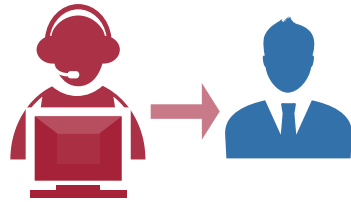
Auto companies will need a local presence for both sales and service. But the sector is already beginning to evolve, as private family-owned dealers look for an exit and large investors like Warren Buffett look to consolidate and modernize the retail side of the automotive business.³⁴

In the future, we expect that the retail experience will be far more streamlined, more data driven—and far more pleasant and personalized. A dealer will already know your history and profile when you walk in the door. He will immediately connect you with the right products, configurations, and add-ons to meet your needs. After you buy a vehicle, your relationship with the dealer will continue, because the integrated systems in your vehicle will automatically schedule maintenance appointments and alert you to product updates and sales you care about.

BREAKING DOWN BARRIERS TO THE CUSTOMER



Awareness • Desire • Consideration • Purchase



Research and Information Gathering



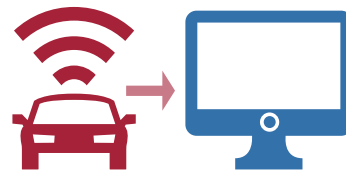
Dealer Visit and Purchase



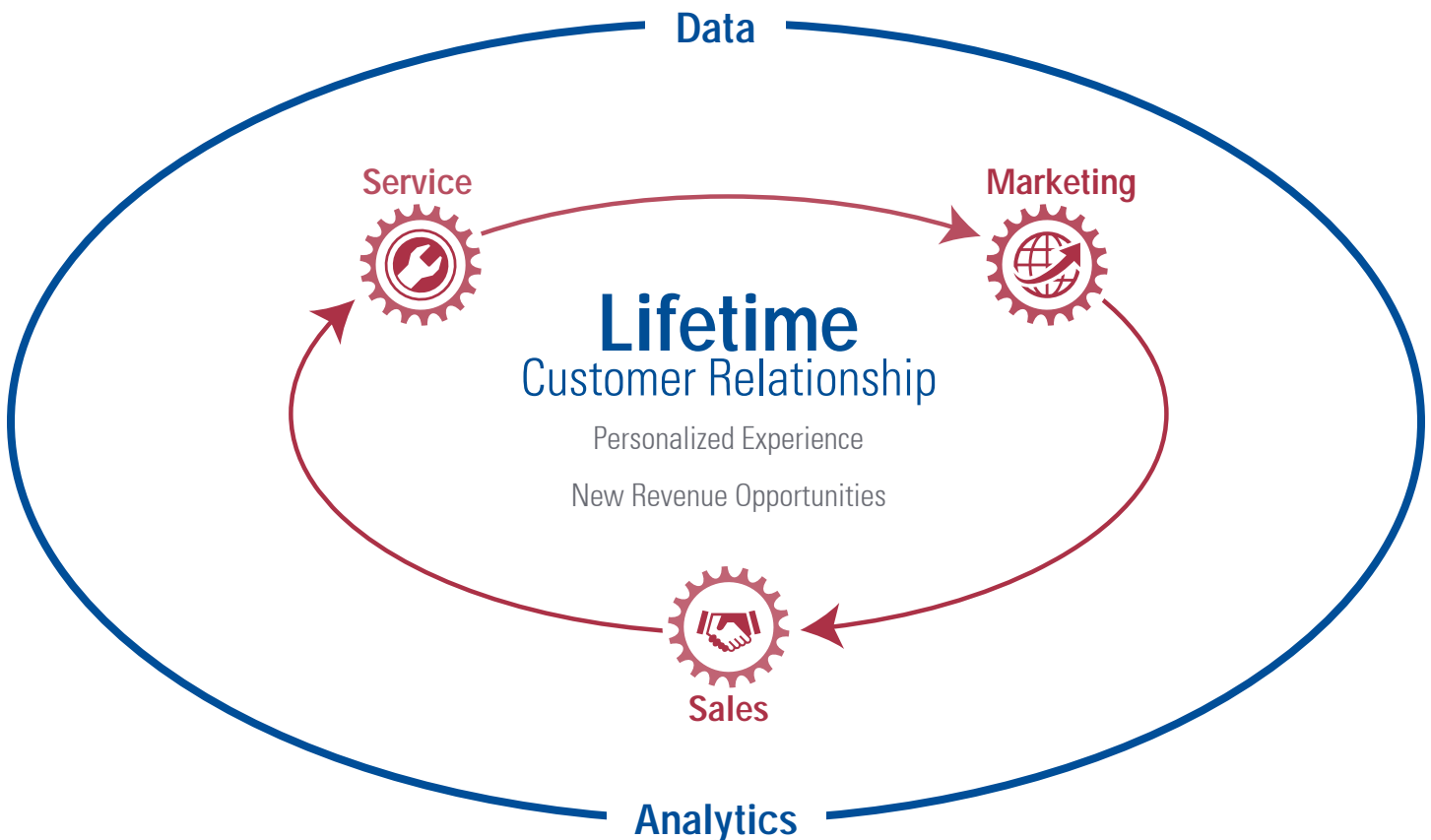
Use • Maintenance • Upgrade



Maintenance and Service



Telematics and Connectivity

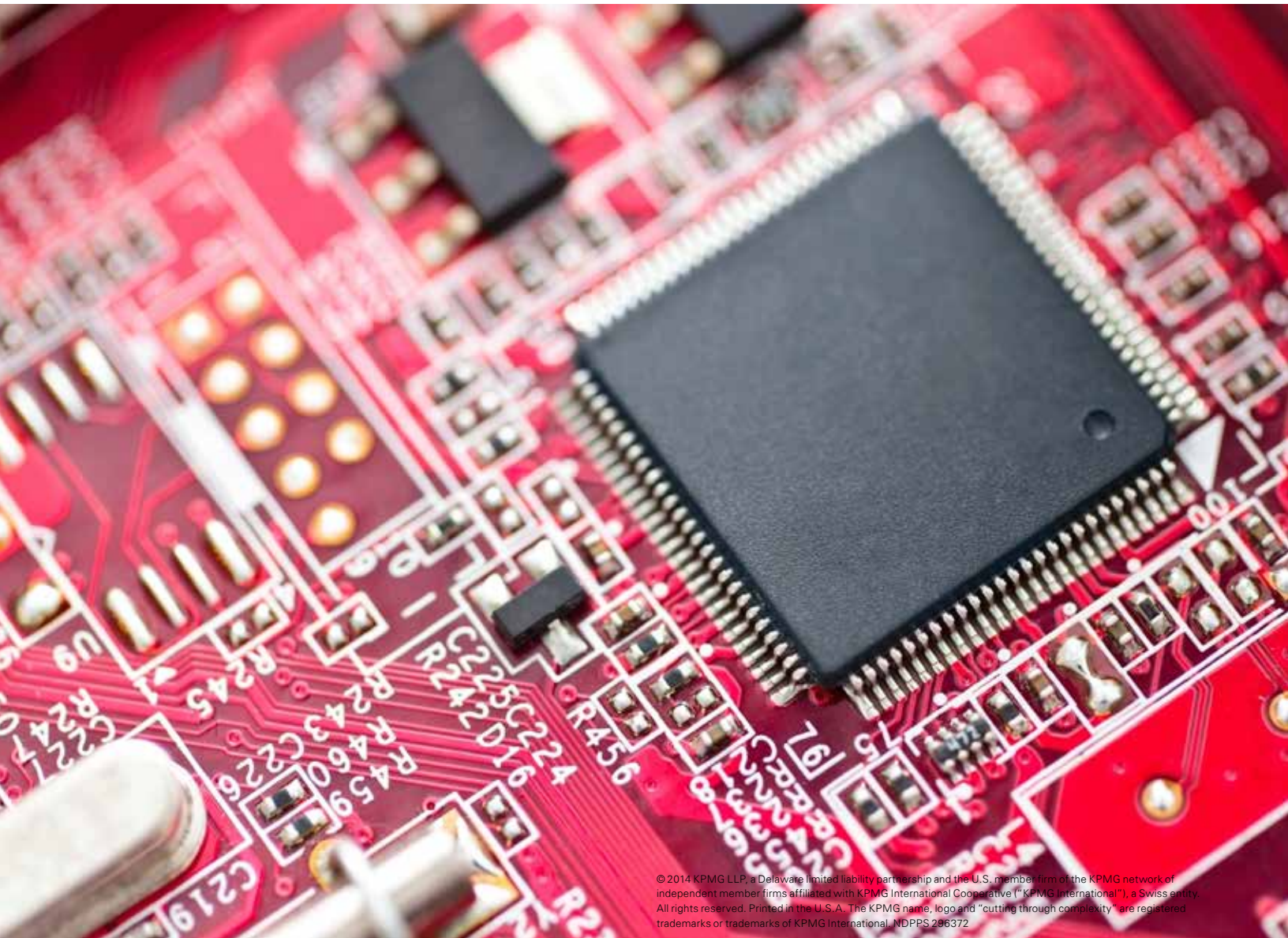


Maintenance and upgrade: As the car becomes “the ultimate mobility device,” customers will need service delivered by teams of well-trained experts—the kind you’d find through Geek Squad or Apple Genius Bars. As car models come out ever more frequently, keeping abreast of all options and developments will require constant updates, assisted by well-developed OEM Web tools. When Apple or Android comes out with a new operation system, everything connected to the user’s mobile device will have to get upgraded too.

Dealers will need to integrate expertise and a level of personalized service that matches consumers’ expectations. But in the near future, it won’t take a visit to a dealer to fix a bug or upgrade vehicle software. Tesla is already providing “over-the-air” updates. Other vehicle manufacturers will, no doubt, follow suit, because upgrades and bug fixes are incredibly expensive. “Toyota just got hit with a recall for a software update for the chargers in the Prius. 1.9 million vehicles need to go back to the dealer for a software update,” notes Intel’s Elliot Garbus, who heads up the company’s Internet of Things and Automotive Solutions groups, adding that recalls requiring a dealer visit cost anywhere between \$200 and \$400 per vehicle.³⁵

Processing power, not horsepower: In the future, will car buyers focus more on processing power than on horsepower? Intel Corporation predicts that connected cars will need to process “approximately 1 [gigabyte] of data each second” just to operate safety-critical functions.³⁶

The connected vehicle provides an ideal channel for OEMs and other suppliers to build better relationships with customers—and to offer increasingly personalized products and services. Connected cars with robust infotainment systems will have billions of bits of data about users. They will know your driving habits, the kinds of roads you take, how many passengers you carry—and even the type of music you listen to. As cars become more autonomous and users are able to conduct more activities from their cars, the data streams will become even more valuable.



The Human Machine Interface (HMI)

The Human Machine Interface is the nexus of the customer experience. The car—whether you own it or rent it—is just another item in your growing array of mobility devices. And the complexity involved in something as seemingly simple as pairing your phone with the car’s sound system is evidence that the industry will have to evolve—especially if cars of the future are going to take a greater role in our connected lives.

How those connections are made, and how seamlessly the car and driver can hand off control is a major challenge ahead. But well before we get to autonomous vehicles, the HMI is proving to be a major headache for OEMs. They are already struggling to deliver the seamless infotainment and connectivity consumers expect—and it’s hurting their brand reputations.

Consumer Reports’ 2014 survey on new car reliability indicates tremendous frustration with in-vehicle infotainment systems. In its press release about the survey, the editors observed, “Just as a brain surgeon isn’t the best person to do a heart transplant, it turns out automakers aren’t the ideal source for sophisticated, cutting-edge infotainment electronics.”³⁷ In an interview with the *Wall Street Journal*, Jake Fisher, director of automotive testing at the magazine said, “Consumer Reports tries to filter out complaints about the design or usability of infotainment systems in this year’s report...however, usability problems do lead to less favorable ratings to some cars.”³⁸

Runaway complexity is, by far, the toughest challenge for makers of connected devices, from laptops to smartphones to vehicles. We are drowning in complexity. Most device owners understand and use only a fraction of the features on their smartphones.³⁹ Or, as the authors of the book *Trillions* note, “Computing complexity is already far beyond the ability of most normal people to manage, and we’ve scarcely gotten started.”⁴⁰

Why? Because we are entering the awkward in-between state, when the car can operate the throttle, brake, and steering, making it seem reasonable for a human in the driver’s seat to get involved in other activities (opening juice boxes for kids, texting, updating Facebook profiles—whatever). Except that humans have to quickly take back control on occasions.

That’s one of the reasons some car makers believe they need to maintain control over the devices drivers can use while in the car. “An in-car system can pause movies, turn off e-mail and hide reading materials when it’s time to drive. If the driver doesn’t respond, it might sound alarms and blink lights, eventually turning on the hazards and slowing to a complete stop.”⁴¹

Former administrator of the National Highway Traffic Safety Administration (NHTSA), David Strickland, and Chan Lieu, former director of government affairs at NHTSA, discussed the agency’s preference for limiting the use of “nomadic devices” within the vehicle. OEMs are responsible for the safety of the vehicle—including the center stack, they said. And because of the liability issues, “anything on the center stack will be highly curated.”⁴²

But the argument for nomadic devices is compelling. First, users want what they want. And we think a significant number of users will want seamless, uninterrupted experiences—a harmonization of their connected lives and devices. Second, connecting to these always-on, data-rich devices could have significant value for whoever owns the car’s data stream (more on that later).

“Consumers will push the manufacturers for more choices,” Lieu agreed, “but those choices will be highly vetted and will be within the software development kit (SDK).” Strickland added that Google’s decision to move to Level 4 (fully automated) vehicles, from Level 3 (vehicles that can operate autonomously at the driver’s discretion) was designed to allow people to use nomadic devices and do whatever they want. “Google is taking the rider out of the loop,” he said.

Most OEMs and Tier One suppliers we spoke with think the war on nomadic devices has already been lost. “Everyone today [who’s] driving a vehicle is bringing their own device,” said one Tier One team we interviewed. “The question will be whether we can adapt [and] work on the interface technology. The [OEMs] who can do that most seamlessly, unobtrusively, and intuitively will be the winners.”

What you need to know

1. Customers will expect ubiquitous connectivity and seamless integration with their nomadic devices. Get it right!
2. Make the HMI elegant and easy to use.
3. Use data and predictive analytics to manage the customer relationship throughout the life cycle, from awareness to purchase to vehicle maintenance and upgrade.



The new world order

Twenty-year-old upstarts

Gina is 20, a junior in the EECS (Electrical Engineering and Computer Science) program at MIT, and a self-described “bot geek.” She’s been building robots since she was four years old, first using cardboard, rubber bands, and the wheels from old rollerblades to build strange mobile creatures, and later graduating to Lego Mindstorms. For her 10th birthday, she asked for a servo motor and a soldering iron. By high school, she had graduated to electric cars, when her AP physics class competed for the Automotive X Prize.

These days, Gina is working on nanophotonic phased arrays and solutions for mobility at the bottom of the pyramid. “Think about the billions of people who don’t own cars,” she says. “As they begin to enter the middle class, let’s give them something better than the internal combustion engine.” The challenge is a combination of engineering, design, branding, and production. “It has to be cool—like the iPhone used to be,” she says. “It has to be something people covet—something that says ‘you’ve arrived’—and it has to be something we can produce for less than \$15,000.”

Her latest project is a solar charging, very light weight, self-driving, modular electric car. Taking a page from the PC clone business of the late 20th century, Gina and her colleagues plan to bypass OEMs altogether. “Drivetrains are just commodities—at least at the low end of the mobility market,” she says. “Any electronics company could make them.” It’s all about the software, the operating system, and the sensors.

Is Gina a threat to the status quo? Absolutely.

Well, except that we made her up. Gina is an amalgamation of a few young whiz kids we’ve researched and interviewed. But make no mistake: the Ginas of the world are coming. They’re the students from University of New South Wales in Australia, who built the Sunswift eVe, a solar-electric car, which can travel over 300 miles at an average 62 mph on a single battery charge.⁴³ Or Ionut Budisteanu, the 19-year-old Romanian student and winner of the Intel Science and Engineering Fair for his \$4,000 kit that turns a regular car into an autonomous vehicle.⁴⁴

They’re the ones starting innovative new companies like Cruise and VocalZoom. They’re bringing new ideas, new technologies, and new perspectives on urban planning and transportation policy. If their ideas are good, they will find funding. And although it may be several years before any of them truly threaten the automotive status quo, collectively, they are a growing force in the new automotive world order.

OEMs dethroned?

For almost 100 years, the OEMs have been kings of the huge, mature \$4 trillion automotive industry.⁴⁵ They exerted near-complete control over the design and content of the car. Their choices defined the roles their suppliers would take and, to a great extent, exactly what their suppliers would design.

Product specs were created by OEMs and passed down through the ranks of suppliers. Parts were designed and built according to specifications and passed back up the chain of tiered suppliers, eventually reaching the OEMs, who assembled the parts into cars.

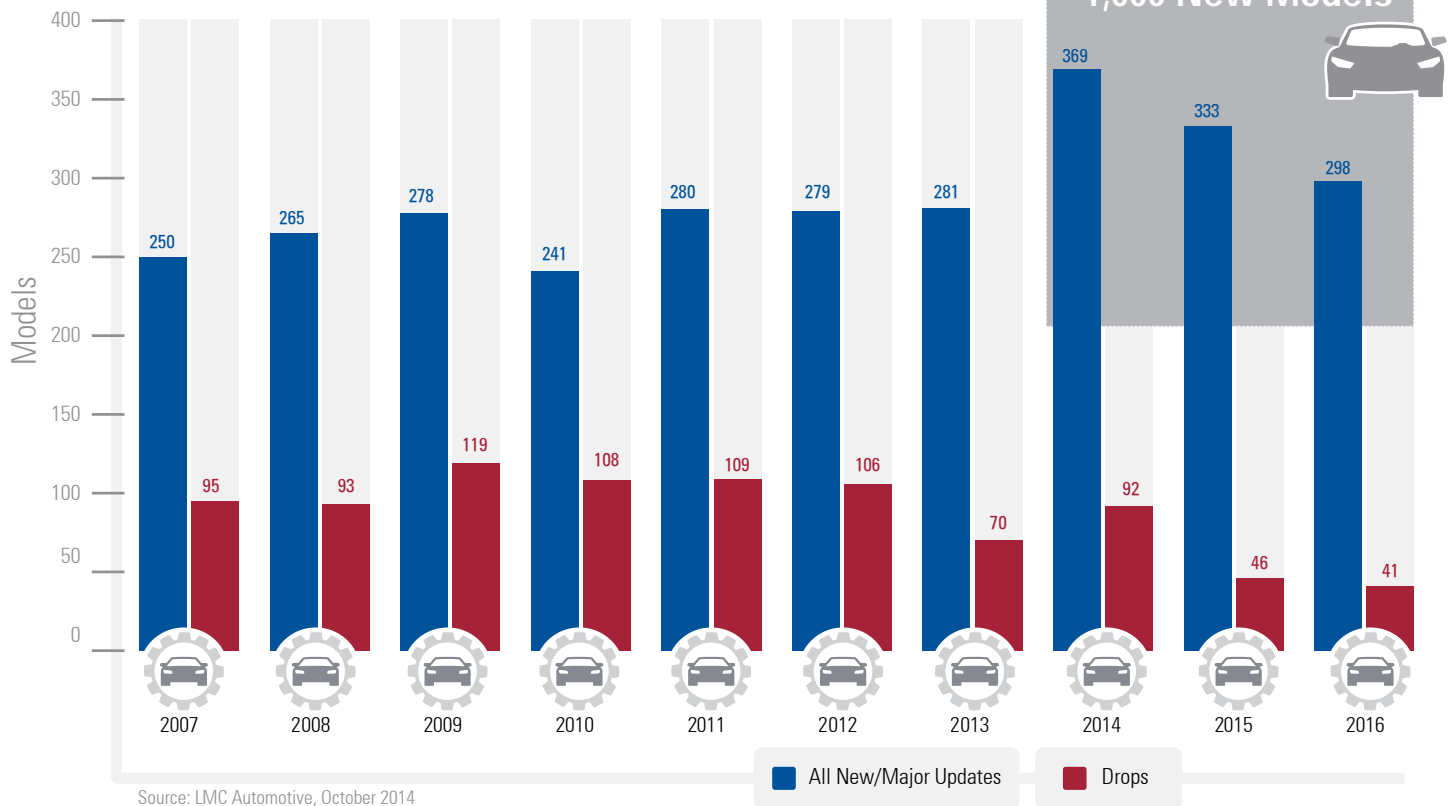
The paradigm doesn’t work anymore. The hierarchies are unstable; new players are rising up, and R&D costs are high. As a senior leader at a Tier One supplier put it: “We can’t manage [the rapid pace of technological change] alone anymore. Even within our group there will be so many costly changes, there have to be partnerships to share the investment.”

How do companies find and nurture those partnerships? Before the Great Recession, OEMs had teams of supplier development engineers, who conducted on-site assessments to ensure that suppliers had the technology and the capacity to provide the necessary parts and components at scale. The supplier development teams are largely gone now—and the technology they’d be assessing often falls outside the normal automotive engineer’s domain. But the need to assess, develop, and collaborate closely with suppliers is more important than ever before.

Some OEMs have launched their own venture capital funds to find and develop the next generation of suppliers. The structure of the relationships vary: Some OEMs are acquiring start-ups, launching joint ventures, or pairing them with more experienced suppliers. But regardless of the legal or financial structure of the relationships, OEMs and Tier One suppliers know they must become experts at managing the innovation and collaboration process, which means:

- Enabling faster, more transparent communication and information management between and among the OEM and all of its suppliers and subsuppliers
- Developing a robust, integrated Supplier Relationship Management program to enable real-time development and collaboration, performance monitoring, and risk management
- Implementing gated, innovation platforms
- De-coupling new technology incubation time lines from product launch time lines.

GLOBAL NEW MODEL LAUNCHES 2007–2016



The amped up pace of change

Perhaps the greatest challenge OEMs face today is in trying to keep pace with the speed of innovation in consumer technology. Melding the two worlds—consumer electronics, with its rapid new product launch cadences and willingness to accept iterative software releases, and automotive engineering, with its mass customization, millions of product configurations, and critical safety, durability, and reliability requirements—is not an easy prospect.

Today an average midsize vehicle has approximately 40 to 50 individual microprocessor-driven systems, which require approximately 20+ million lines of code; a larger, high-end luxury vehicle might have as many as 100 million lines of code.⁴⁶ A Boeing 787, on the other hand, has less than 15 million lines of code.

Each completely new vehicle launch is a huge bet: Launches can cost anywhere from half a billion to \$1.5 billion, depending on the complexity and the level of change. And these days, automotive companies are making more of those bets than ever before. OEMs have announced plans to launch 1,000 new vehicles between 2014 and 2016 (see above) and will offer them in far more configurations than ever before. Why? A growing global market for vehicles and intense competition to meet consumers' demand for the latest, greatest new technologies and personalized driving experiences.

Given the complexity, cost, and cadence of product launches, it's not surprising that OEMs have suffered through some embarrassing and costly public failures. Late launches and recalls captured headlines too often in 2013. According to the NHTSA, 2013 saw a dramatic rise in U.S. vehicle recalls: a total of 21.9 million cars, up 9 percent from the previous year.⁴⁷ But by the end of October 2014, the number of recalls in a single year had more than doubled, hitting an all-time high of 56+ million vehicles.⁴⁸

Recalls may be an inevitable consequence of the profound changes affecting the automotive industry. Ask anyone on the new tech side of the automotive ecosystem and you'll hear the same refrain: "OEMs are trained to connect a bunch of black boxes." As Tal Bakish, CEO and founder of VocalZoom put it, "The OEM groups that [assess our technology] are engineers who are familiar with the [current] state of the art. When you have issues related to the evolution of the technology, they don't know how to analyze the problems. They are meeting the technology for the first time, while you have investigated it for years."⁴⁹

Of course, OEMs see things differently. They know that they will get the blame for any kind of product failure, whether it be mechanical, technical—or a sync problem with your iPhone. As one OEM executive put it, “When we release an entertainment system with Bluetooth in a \$50,000 car, it has to connect to 100 different phones. And if it doesn’t work, [consumers] call us. They don’t call [the phone manufacturer] about the [lousy] phone. They call us about our [lousy] system.”

New skill sets, core competencies, and road maps

Implicit in all these discussions about integration of black boxes and the mashup of automotive and consumer technologies is a rapid evolution in the types of hard and soft skills required to produce new vehicles.

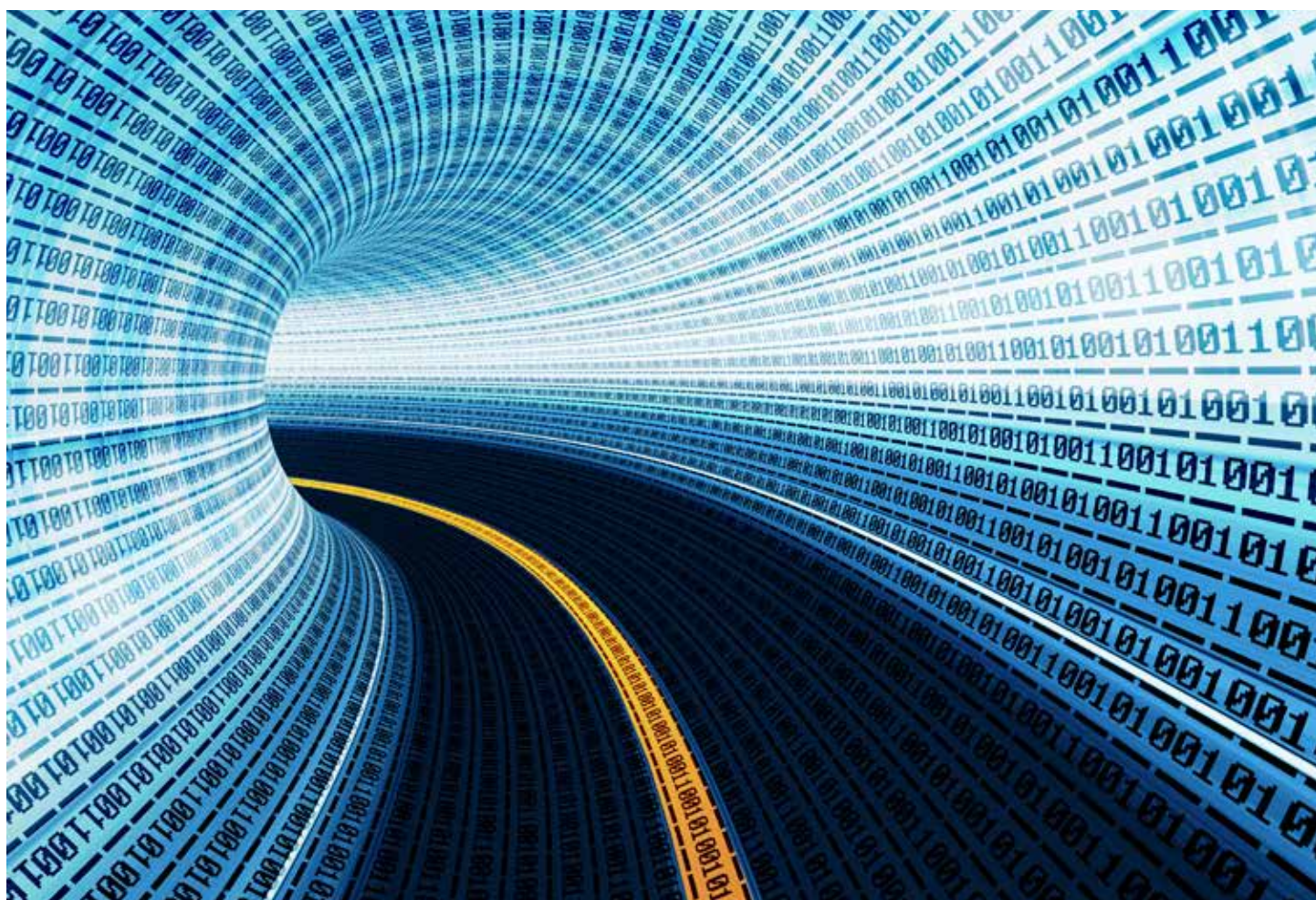
OEMs know the world is changing around them. Getting all those increasingly complex black boxes to work together is no mean feat, and OEMs are struggling to gain the requisite skill sets. Their core competencies—making engines and auto bodies, designing and marketing cars—may no longer dominate the future of mobility. Some OEMs have been hiring big software teams; others are managing through joint ventures and other structured alliances. But invariably, they are coping with culture clashes—between engineers and computer scientists, between baby boomers and millennials.

Old established companies—including OEMs and some of their Tier One suppliers—are also battling the inevitable ossification that comes with old, established hierarchical organizations. They know they have to break down their silos. They know they have to get much better at communicating, encouraging debate, and leveraging new ideas. And they know it all has to happen faster—with more agile, streamlined processes.

But agile software development processes may not be appropriate for bringing safety-critical machinery to market. And OEMs know whatever they produce has to deliver the perfect combination of aesthetics, technologies, automotive grade performance, and branded experience to precisely the right target audience, in the right geography, at the right time, and the right price.

The challenge is in learning how to innovate quickly and safely. For large organizations, that may mean creating and empowering smaller, more nimble teams and developing a higher tolerance for risk (within well-defined parameters). Innovation invariably comes with risks; the key is to fail fast and fail cheaply.

In many cases, though, OEMs have an added challenge: they’re still rebuilding their workforces after having shed more than 470,000 jobs during the Great Recession (2008–2009). Many of those jobs were staffed by highly experienced people, who left the industry and are not likely to return. And while many industry jobs are now available, qualified candidates are in short supply.



The evolving automotive ecosystem

How will new cars come to market without the OEM as king and owner of the customer relationship? After a great deal of discussion with OEMs, suppliers, innovators, and investors, KPMG has come up with the following model

The Evolving Automotive Ecosystem – The Players



At the center of our model are two major forces in a kind of competition: traditional OEMs and would-be tech displacers. The upstarts—companies like Google, Tesla, and other smaller start-ups—see the car as software-driven machinery. They expect to bring increasingly sophisticated artificial intelligence to new vehicles and envision a future in which vehicles are environmentally sustainable and crash-proof—with or without the need for steering wheels, gas pedals, and brakes.

Around the perimeter are a host of new, increasingly powerful forces: universities, venture capitalists, established mobility and technology companies, high-tech start-ups, and regulators. Among these new players, communication and collaboration will likely be direct, peer-to-peer. Not hierarchical. And the interplay of ideas and innovations will likely no longer be controlled by the OEMs.

This is the moment of greatest risk and greatest opportunity. Bets placed within this evolving ecosystem will have profound ramifications for the industry and for the shape of vehicles to come.

What you need to know

1. A car's value and differentiation will reside in its software and electronics—and how well they work together. Your most difficult task will be taming complexity.
2. Take a broad view: Think like a venture capitalist and cultivate relationships with new tech innovators inside and outside the industry
3. Get used to the perils of innovation. Great upside but plenty of risk. Accept and learn from failures.

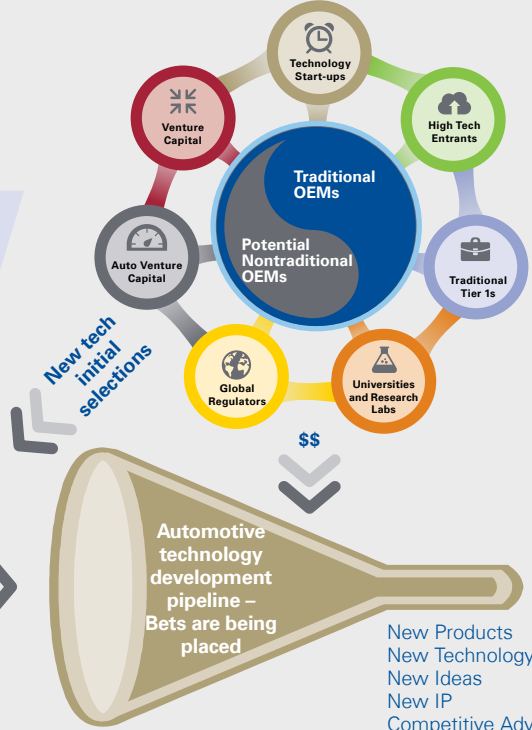
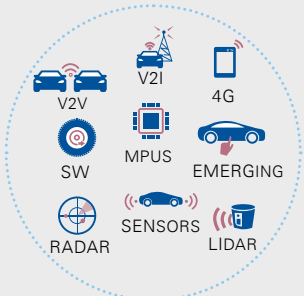
The Evolving Automotive Ecosystem – The Products

How should technologies be selected?

Who are alliance, M&A, and JV potential partners?

How can organizations gain the right set of competencies?

Who are the customers, what will they want, and what will they pay for?



Vehicle Development Cycle



Intelligent Vehicles

New Products
New Technology
New Ideas
New IP
Competitive Advantage?

Time



Connecting the dots

It's an exhilarating time to be part of the automotive industry. Creativity and innovation abound, new entrepreneurs and investors are rushing in—and demand for “automobility” solutions is soaring. While it seems likely that growth in light vehicle sales will slow in mature markets (the United States, Western Europe, and Japan, for example), demand will likely soar in other markets, as billions of people climb out of poverty and into the middle class.

Vehicles will likely become more autonomous, more connected, and safer; and, as they do, they will leave their human occupants free to perform other activities in the car. That means all kinds of new possibilities for in-vehicle services. Those new connected vehicles will also generate petabytes of valuable data and create opportunities for brand-new business models—from infotainment to education to healthcare and beyond.

But the transformation of the automotive industry will not be painless. Competition will be more intense than ever, the bets automakers have to make will be bigger, faster, riskier, and fraught with complexity. There will be winners and losers.

Winners will be those who anticipate the market and deliver compelling, customized user experiences.

Losers will be those who move too slowly and/or fail to grasp the significance of shifting customer behaviors and preferences—both in delivering the right kinds of vehicles and customer experiences, and in mastering the development, launch, and production processes.

They will be swallowed up by complexity, cumbersome processes, and their own complacency. And they will not have the economic or reputational resiliency to recover from catastrophic launch failures and product recalls.

How can you ensure that your company stays relevant and capitalizes on emerging opportunities? After interviewing dozens of leaders from OEMs, Tier One suppliers, academics, start-ups, and established technology companies, we have come to a few conclusions:



Find new partners and dance: The structure of the automotive industry will likely change rapidly. Designing and producing new vehicles have become far too complex and expensive for any likely one company to manage all on its own. The companies that thrive in the future will likely be those that are nimble, future oriented—and prepared to invest in new technologies, new talent, and new strategic alliances.

Become data masters: Know your customers better than they know themselves. Use that data to curate every aspect of the customer experience from when they first learn about the car to the dealership experience and throughout the customer life cycle. Having data scientists on staff will likely be the rule, not the exception. Ultimately, you will need to use that data to create mobility solutions that capture consumers' attention, address their personal mobility needs, and make their lives better, more fun, and more productive.

Update your economic models: Predicting demand was hard enough in the old days, when you did a major new product launch approximately every five years. Now, with the intensity of competition, the rapid cadence of new launches, and the mashup of consumer and automotive technology, you may need new economic models for predicting demand, capital expenditures, and vehicle profitability.

Tame complexity: It's all about the center stack, the seamless connectivity with nomadic devices, the elegance of the Human Machine Interface. The companies that create the best, most easily customized user experiences will likely be victors in the age of personalized mobility. These will be hard-won victories. Identifying or developing the right technologies (saying "no" when necessary), integrating those technologies into automotive grade systems—and getting them to market quickly with no defects, no recalls—that's a tall order.

Create adaptable organizations: It will take a combination of new hard and soft skills to build the cars and the companies of the future. For many older, established companies, that means culture change, bringing in new talent, and rethinking every aspect of process and people management. Melding the rigor and discipline it takes to build zero-defect automotive grade machines in factories throughout the world with the free-wheeling culture of the most innovative high tech companies will be a challenge. But the winning companies will make it happen.



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