

MCKINSEY CENTER FOR FUTURE MOBILITY

THE AUTOMOTIVE REVOLUTION IS SPEEDING UP

PERSPECTIVES ON THE EMERGING
PERSONAL MOBILITY LANDSCAPE

October 2017



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INTRODUCTION

What a difference a few years make – the automotive sector is changing, and it's changing fast. Start-up CEOs have risen as superstars of the industry almost overnight. Artificial intelligence is poised to become a base technology for every engineering department. Automotive original equipment manufacturers (OEMs) are exploring other parts of the ecosystem, even taking part in conferences once aimed squarely at the film and music industries. Consumers talk more about systems and technologies embedded in cars than about horsepower. And investors have taken the wheel in shaping the mobility system in certain countries.

Would anyone have envisioned all these shifts happening by 2017?

For more than two years, the industry has been talking about the four disruptive trends changing the rules in the mobility sector: autonomous driving, shared mobility, connectivity, and electrification. Our report from January 2016 integrated the impact of these trends into a single picture for the first time. Today, we can offer a perspective on three questions that are a top priority:

- What is the speed of change?
- What do the new value pools look like?
- What is required to succeed in the future?

Text box 1: How we derive insights for this report

- Established market model based on scenario-tested development of the four disruptive trends and consumer mobility behavior in five city archetypes
- Hundreds of conversations with executives of mobility players and public sector stakeholders across the globe
- Joint projects with various industry associations and academic institutes in North America, Europe, and Asia
- Various big data analyses on specific industry perspectives, e.g., on the investment landscape

In our attempt of answering the above questions, we drafted ten key messages on the emerging personal mobility landscape and how players may navigate the industry's road to 2030. Each of these statements will be explained in more detail in the following three chapters:

Chapter I The four disruptive, technology-driven industry trends are gaining significant momentum

- 1 The pace of transformation in the automotive industry has accelerated dramatically since January 2016.

Chapter II A new personal mobility landscape is emerging and starting to take shape

- 2 Overall growth is expected, but high variance in the prospective growth of disruptive technologies and new business models leads to market scenarios that differ by as much as 40 percent in their projections of 2030 revenue.
- 3 The share of revenue from disruptive business models could increase from about 1 percent in 2016 to up to 25 percent by 2030.
- 4 While about 20 percent of revenue in new vehicle sales could shift to disruptive technologies, traditional products and services may still account for over 60 percent of the total value in new mobility-as-a-service business models.
- 5 The divergence of key technology adoption and global growth rates in national markets and city archetypes requires ever more granular perspectives that put consumers at the center.
- 6 Disruptive developments require us to redefine our view of the industry structure towards a personal mobility landscape focusing on the consumer.

Chapter III Navigating the emerging personal mobility landscape under an uncertain future

- 7 No one player alone can span all relevant core competencies and easily invest a minimum of USD 70 billion to stand out with regard to all four disruptive trends.
- 8 We identified five strategic archetypes significantly differing in required qualifications and breadth of their approach to personal mobility, driving players to make business decisions in accordance with their individual profiles.
- 9 To be able to reach across technologies and business models, players will need to think strategically about which areas to partner in, how to identify the right partners and settings, and which of the 13 partnership structures best suits their needs.
- 10 Players will succeed only if they adapt to the automotive revolution as the fundamental transformation it is and act accordingly – particularly, the strategic balancing of decisions during the transition from old to new could mean the difference between an automaker doubling profit through sustainable long-term transformations or severe declines from missteps and inaction.

I THE FOUR DISRUPTIVE, TECHNOLOGY-DRIVEN INDUSTRY TRENDS ARE GAINING SIGNIFICANT MOMENTUM

1 The pace of transformation in the automotive industry has accelerated dramatically since January 2016.



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All four mutually reinforcing trends – autonomous driving, shared mobility, connectivity, and electrification – show signs of acceleration. Indeed, the entire industry shows signs of increasing momentum (see Text box 2).

Text box 2: Indicators of the revolution's acceleration throughout the industry

Several data points suggest the pace of change is increasing:

- The average disclosed start-up investments per year in new core technologies (such as sensors, sharing solutions, and cybersecurity) increased twelvefold from 2010 to 2016.
- 95 percent of disclosed investments in companies focusing on any of the four disruptive trends come from nonautomotive players – over 50 percent of which are tech players.
- The yearly transaction volume consolidating the supplier industry has grown sevenfold since 2013.
- The complexity of in-vehicle software has doubled since 2006 and is expected to further increase fourfold by 2030, requiring an additional 100,000 software engineers in the United States alone.
- The number of patents filed annually in autonomous technology, to take one of the disruptive trends as an example, has almost doubled since 2012; patents filed by tech players in this area have increased by an average of 25 percent annually.

A few developments illustrate some of these advances:

Autonomous driving. In 2016, only about 1 percent of vehicles sold were equipped with basic partial-autonomous-driving technology. Today, 80 percent of the top ten OEMs have announced plans for highly autonomous technology to be ready for the road by 2025.

Shared mobility. In major regional and local markets, large shared mobility providers dominate, with combined market shares of up to 90 percent. As of this writing, in 2017, at least USD 32 billion had been invested in ridesharing start-ups alone. There is strong growth potential: less than 1 percent of passenger miles traveled today are carried out using shared mobility services, and US customers expect usage of shared mobility to increase by around 80 percent once robo-taxis are available.

Connectivity. Only 12 percent of cars today are equipped with embedded connectivity solutions, and monetization is still weak (less than USD 1.5 billion in revenue). But the importance of cars as part of a connected network for the consumer is growing: the percentage of consumers ready and willing to change car brands for better connectivity has doubled over the past two years. In the premium segment, a majority of OEMs have already installed fully connected infotainment systems in 100 percent of their new vehicles. These systems are used to provide a diverse range of in-vehicle services to drivers and diverse data sets to third parties.

Electrification. Whereas less than 5 percent of vehicles sold in 2016 were equipped with electrified-vehicle (xEV) powertrains, the industry aspires to have over 50 percent of all new models in 2021 equipped with xEV drivetrains. Between now and then, many mass-market OEMs are planning to add ten or more xEV models to their lines as they project they can reach potential sales of 100,000 to 600,000 xEVs in the next five years. Within each trend, individual players are already making headway on key technologies, even though no player seems likely to be able to dominate in all of them (for the foreseeable future). Yet there remain technological and economic challenges for each trend that must be overcome. The speed at which this can be achieved will ultimately define how quickly all trends can gain a real foothold across the industry. Here are two examples:

Battery cost and scale. For producers to reach parity in total cost of ownership and profitability between battery-electrified vehicles and internal-combustion-engine vehicles, the cost of batteries would need to be reduced by 25 to 40 percent. Lithium-ion-battery production will need to increase significantly to meet the demands of millions of new xEVs.

Ability to extract value of shared mobility. Greater proliferation of shared mobility depends, in part, on the ability to broaden the addressable market. Use cases such as commuting would require a much lower price level than a typical ride-hailing offer today. This will require new offers (e.g. for pooling) and new technologies (e.g. autonomous driving).



The automotive revolution is speeding up

II A NEW PERSONAL MOBILITY LANDSCAPE IS EMERGING AND STARTING TO TAKE SHAPE

- 2** Overall growth is expected, but high variance in the prospective growth of disruptive technologies and new business models leads to market scenarios that differ by as much as 40 percent in their projections of 2030 revenue.
- 3** The share of revenue from disruptive business models could increase from about 1 percent in 2016 to up to 25 percent by 2030.
- 4** While about 20 percent of revenue in new vehicle sales could shift to disruptive technologies, traditional products and services may still account for over 60 percent of the total value in new mobility-as-a-service business models.
- 5** The divergence of key technology adoption and global growth rates in national markets and city archetypes requires ever more granular perspectives that put consumers at the center.
- 6** Disruptive developments require us to redefine our view of the industry structure towards a personal mobility landscape focusing on the consumer.

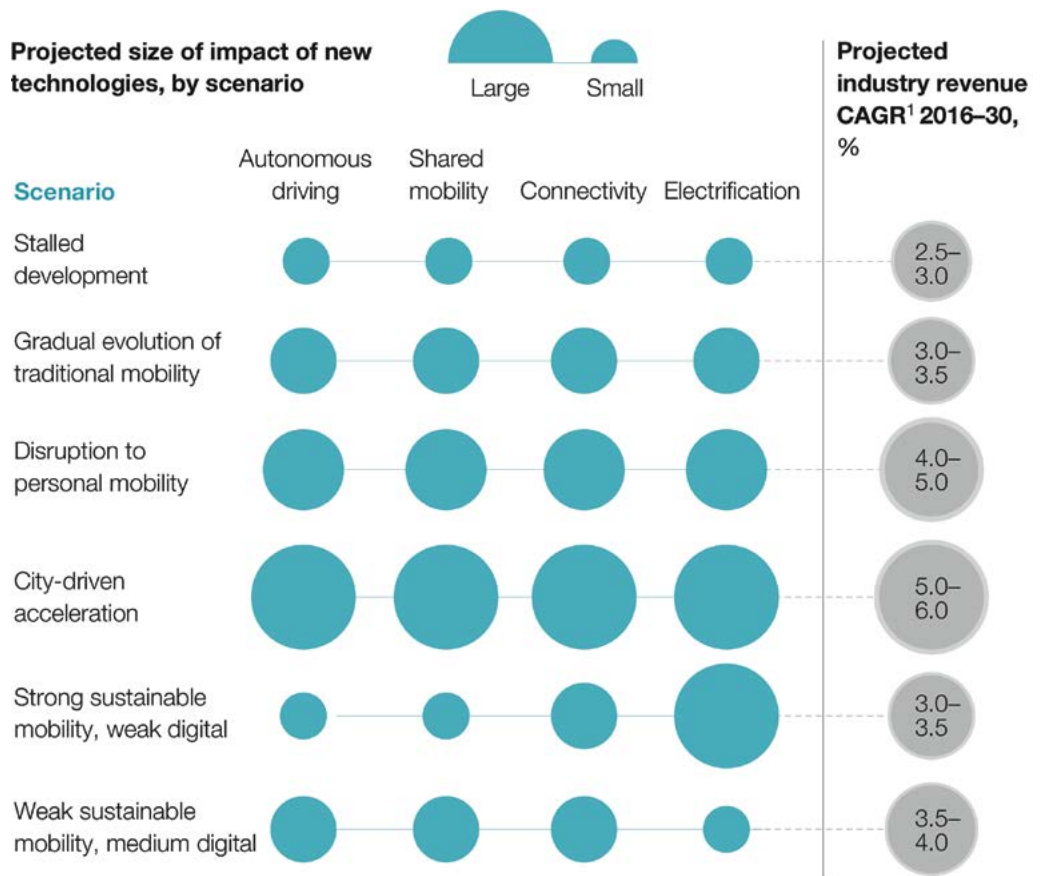
It's clear that personal mobility is evolving. Several scenarios could unfold, depending on a number of variables; the business model and technological focus will shift, market perspectives should become more granular, and understanding customers will be essential.

2 Overall growth is expected, but high variance in the prospective growth of disruptive technologies and new business models leads to market scenarios that differ by as much as 40 percent in their projections of 2030 revenue.

Projecting the various development paths of the four disruptive trends – and their impact on the industry – led us to define six potential mobility scenarios for 2030 (Exhibit 1). Four scenarios were built using the same degree of technology diffusion for all four trends, since we found that all trends are mutually reinforcing and the success or failure of one affects the others. Given that the key drivers of diffusion for electrification (consumer pull, technological readiness, and regulation push) can be independent from those of the other three trends, we added two additional scenarios in which we vary the diffusion trajectory of the trends.

Exhibit 1

6 scenarios with varying technology diffusion show differences in revenue potential of up to 40 percent by 2030.



¹ Compound annual growth rate.

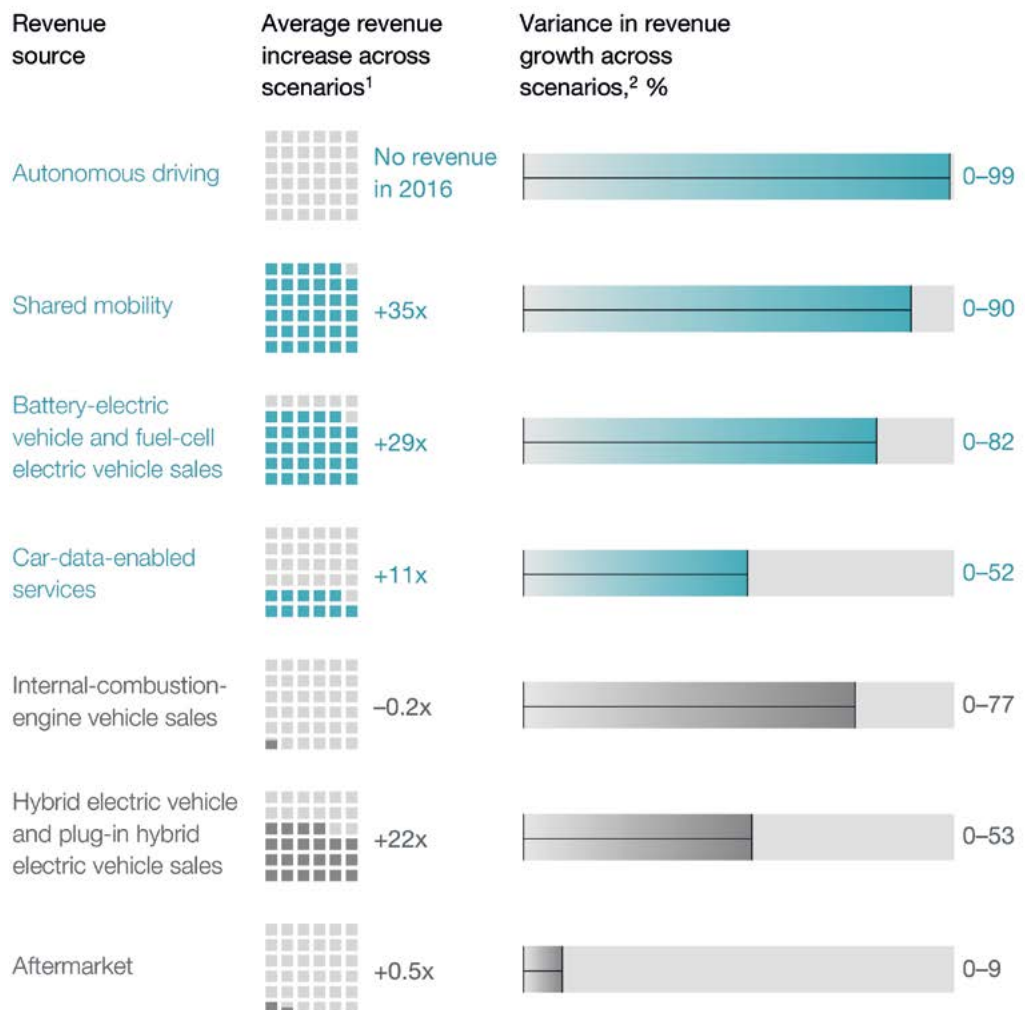
Source: McKinsey Center for Future Mobility

Although the overall industry is expected to continue its path of growth, the range of possibilities for the future is broad. The variation in revenue potential across the six market scenarios could be almost 40 percent. This may be driven strongly by the likelihood and ability of evolving disruptive technologies to unlock new use cases and value within the personal mobility landscape. While more traditional revenue sources could also show some variance in their prospective growth, they will likely prove to be more stable than the revenue sources from disruptive technologies (Exhibit 2).

Exhibit 2

The potential growth of disruptive technologies varies widely by 2030; in comparison, traditional sources seem more stable.

Traditional revenue sources stay relevant in 2030, with more stable growth



¹ Measured as increase of industry revenue in terms of consumer spend from 2016 to 2030.

² Calculated as: 1 – (smallest value/largest value).

Source: McKinsey Center for Future Mobility

Of the outlined scenarios, our research, recent developments, and conversations with players across the personal mobility landscape led us to believe a more disruptive development is most likely. We'll consider the "disruption-to-personal-mobility" scenario the new base case, in which the overall industry could have the potential to grow 4 to 5 percent annually, doubling in size to roughly USD 6.6 trillion by 2030.

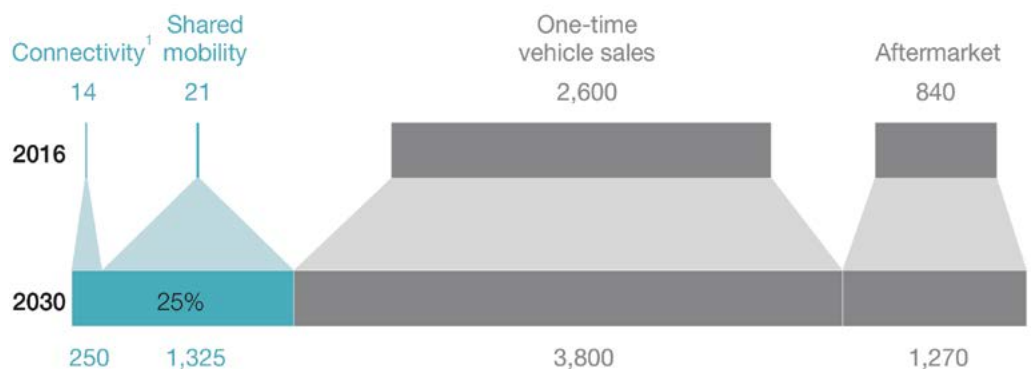
3 The share of revenue from disruptive business models could increase from about 1 percent in 2016 to up to 25 percent by 2030.

The new base case could mean that business in the personal mobility landscape may look very different in the future. Value is likely to shift toward new, disruptive business models, with shared mobility and connectivity solutions potentially accounting for up to 25 percent of total automotive revenue in 2030 (Exhibit 3).

Exhibit 3

The share of revenue from **disruptive business models** could increase from around 1 percent to about 25 percent by 2030.

Automotive revenue based on consumer spending in 2016 and 2030, "disruption to personal mobility" scenario, \$ billion



¹ Revenue only for data-enabled services, not reflecting cost-saving potential.

Source: McKinsey Center for Future Mobility

Of course, there's no guarantee this scenario will emerge. Reaching four milestone statistics is crucial to it becoming reality:

- 100 percent vehicle connectivity and the commercial introduction of robo-taxis covering up to 5 percent of passenger miles traveled by 2030
- 90 percent adoption rate of smartphone ridesharing apps by 2030
- Tenfold growth in reliance on shared mobility, accounting for about 15 to 20 percent of vehicle miles traveled in dense cities by 2030
- 50 percent of vehicles sold have cost-efficient electrified powertrains in 2030.

If this scenario comes to pass, new business models on shared mobility and car-data-enabled services will require players to build on different technology and competencies as well as new types of partnerships to unlock value and serve increasingly diverse customer needs.

One example of how multiple players are starting to partner on new business models can be observed in the development of in-car delivery solutions. While same-day delivery still seems like a novelty to many, automotive, e-commerce, and logistics players are already working on solutions that use data from fully connected vehicles to have packages delivered to car trunks, regardless of where the driver is.

4 While about 20 percent of revenue in new vehicle sales could shift to disruptive technologies, traditional products and services may still account for over 60 percent of the total value in new mobility-as-a-service business models.

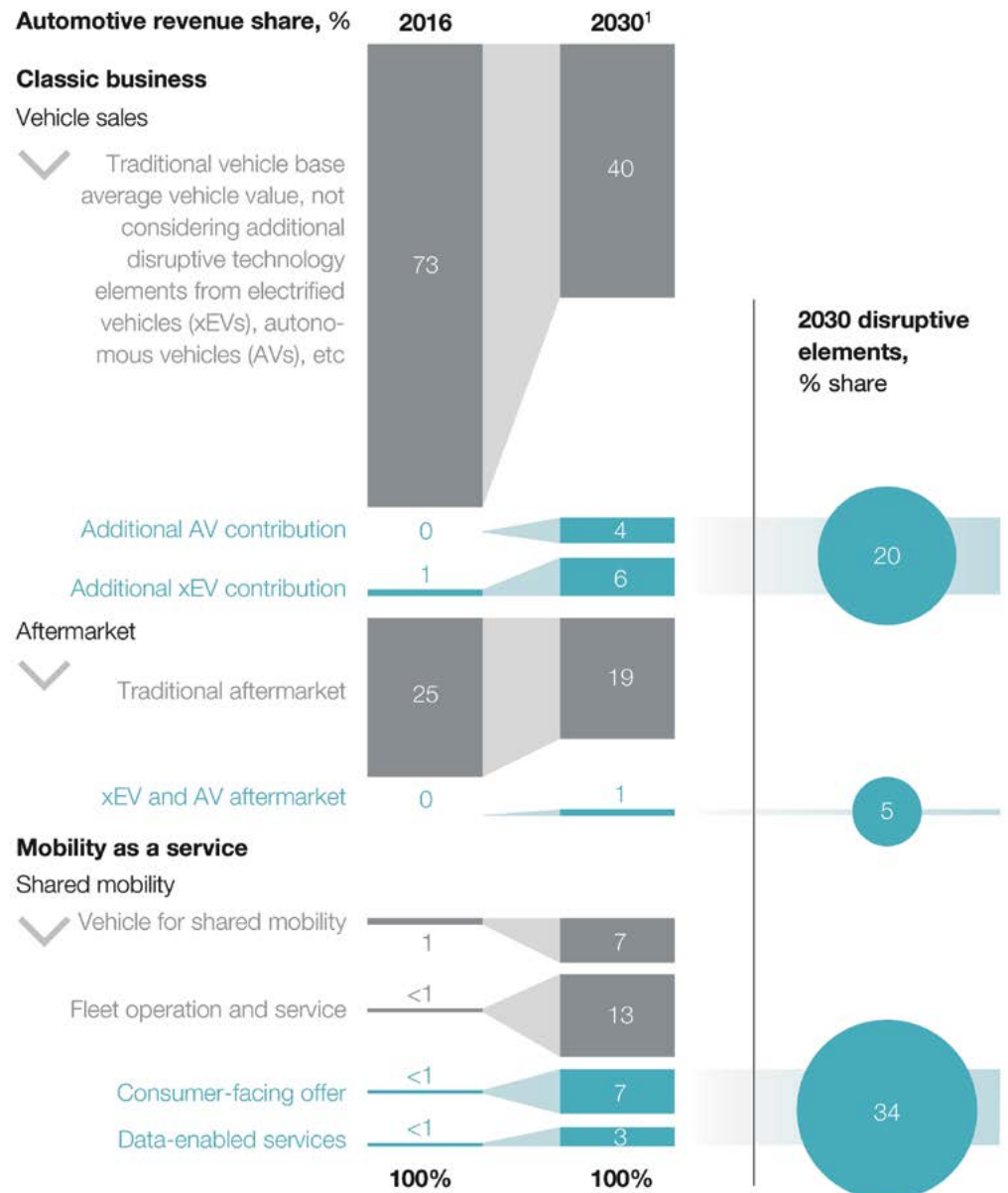
The growing importance of new business models is accompanied by a shift in technological focus, which is required both in classic vehicle sales and aftermarket as well as in new, disruptive business models. Emerging technologies in the fields of electronics and software stand in contrast with more traditional areas, which are likely to remain a relevant share of the overall value pool.

Considering our base case, by 2030, about 20 percent of value generated from classic vehicle sales might shift toward new technologies, such as xEV powertrains or autonomous-vehicle software and components. But more than 60 percent of revenue from disruptive business models could still be carried by traditional elements, such as the shared vehicle itself or fleet operations (Exhibit 4).

This development will push players to bridge two worlds to serve their customers. Although incumbent players could face a major transition as the personal mobility landscape evolves through 2030, they should look for areas in new business models where they can use their advantages in more classic industry capabilities. Similarly, despite the challenges of a transition, there may also be an opportunity to reduce the intensity of capital expenditure in the industry – an effect that may also increase the industry's overall attractiveness for the financial market.

Exhibit 4

Disruptive elements will account for more value in vehicle sales, but most recurring revenue will still be from traditional elements.



¹ Assumptions based on “disruption to personal mobility” scenario.

Source: McKinsey Center for Future Mobility

5 The divergence of key technology adoption and global growth rates in national markets and city archetypes requires ever more granular perspectives that put consumers at the center.

“The customer is king” is not a new law to live by. Yet in the new personal mobility landscape, it can make changes in market structures more prominent and may require industry players to take an ever-more granular perspective on how to best serve their customers. This is not a surprising development; other industries, such as telecommunications, have already gone through a similar shift. Two factors are primarily responsible for the need for a granular market approach: different growth rates and different speeds of trend adoption.

First, growing regions are likely to become even more important. Most significantly, China could experience growth in sales volume of more than 50 percent by 2030. With an expected 8 percent compound annual growth rate, it would grow to represent about a quarter of the industry’s revenue by then. Similarly, dense, developed metropolitan areas could increase their market share by 50 percent as well, accounting for 20 percent of industry revenue.

Second, we are on track to see an increasing divergence in the adoption of key technologies in all markets. Again, China’s consumers seem to remain front-runners, with 90 percent of our recent survey respondents willing to switch brands for better autonomous-driving functionalities – compared with 56 percent of consumers in the United States and 49 percent in Germany. The regulatory drive toward electrification may also play out differently in different cities, even within the same country.

And it’s worth noting that consumers in dense cities will require mobility services that differ from those for people in small towns or rural areas.

With diverse sets of customers across the globe taking center stage in defining the future of mobility, the development of the four technology-driven disruptive trends has the potential to vary significantly by market. This requires industry players to act at an extremely granular level.

6 Disruptive developments require us to redefine our view of the industry structure towards a personal mobility landscape focusing on the consumer.

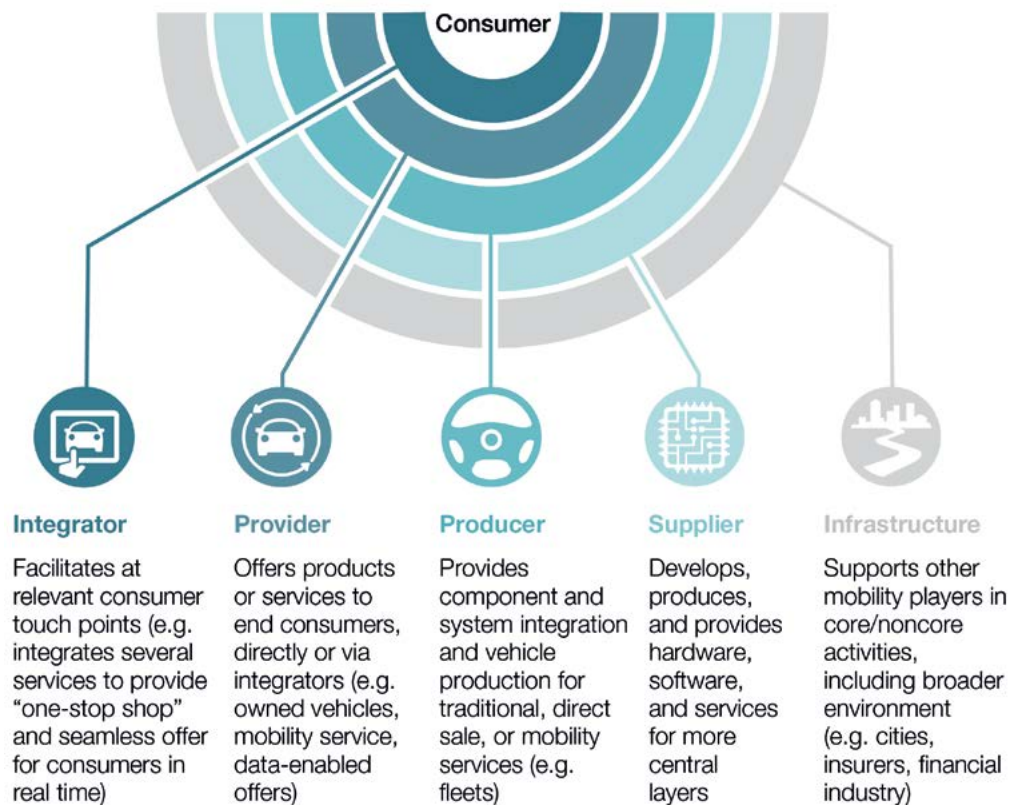
The increasing momentum of all disruptive trends, the shifts in value pools and corresponding capabilities, and the growing need for more granular perspectives on consumers requires we rethink our view of the automotive industry. The new personal mobility landscape that is emerging is much broader than the traditional automotive industry; it is extending to include, among many others, tech players and new entrants from other industries such as software and utilities. Whether incumbents or challengers, all players will find themselves part of an increasingly diverse playing field (Exhibit 5).

In this emerging landscape, players should not define themselves as belonging to one layer, quadrant, or technology type. Instead, they may be active in different business models, engage multiple technologies, and play more than one role across layers, depending on what their capacity to deliver value to their customers allows. A classic OEM, for example, could grow from its traditional core of building vehicles for ownership toward developing provider capabilities. Furthermore, it could participate in new mobility services for end consumers in

Exhibit 5

Technological focus and business-model orientation shape the layers of the personal-mobility landscape to emerge by 2030.

5 layers of emerging mobility landscape



Source: McKinsey Center for Future Mobility

order to capture value that is generated in new areas of the landscape and that increasingly gravitates toward its center.

Those closest to the center may tend to be more focused on how they serve the mobility end consumer. Their business models are likely to be more targeted than those of players operating mainly on the outer layers of the landscape. Actors in the supplier or infrastructure space, on the other hand, have a broader audience and likely cater to both other industry players and the end customer, regardless of whether they are active in the mobility-as-a-service space or in traditional vehicle sales. A tire manufacturer may sell the same product to manufacturers, car owners, and mobility fleet operators, for example.

On the other hand, these outer-layer roles may tend to be more focused on specific technologies or solutions in order to deliver the best offer to their broader market.

Roles close to the end consumer, however, will probably have to provide a combination of technologies.

Fleet operators, for instance, may choose to offer a range of premium products and services (including the newest electric and autonomous technologies).

Such changes mean that players will have to think actively about positioning themselves. A snapshot of these changes emerges when we consider the likely shifts in value discussed above, and thus the respective revenue opportunities, between today and 2030 in the new personal mobility landscape (Exhibit 6). To illustrate this, we will refer to the revenue potential of our base case – USD 6.6 trillion by 2030 – and will not consider broader opportunities, such as those in the infrastructure layer.

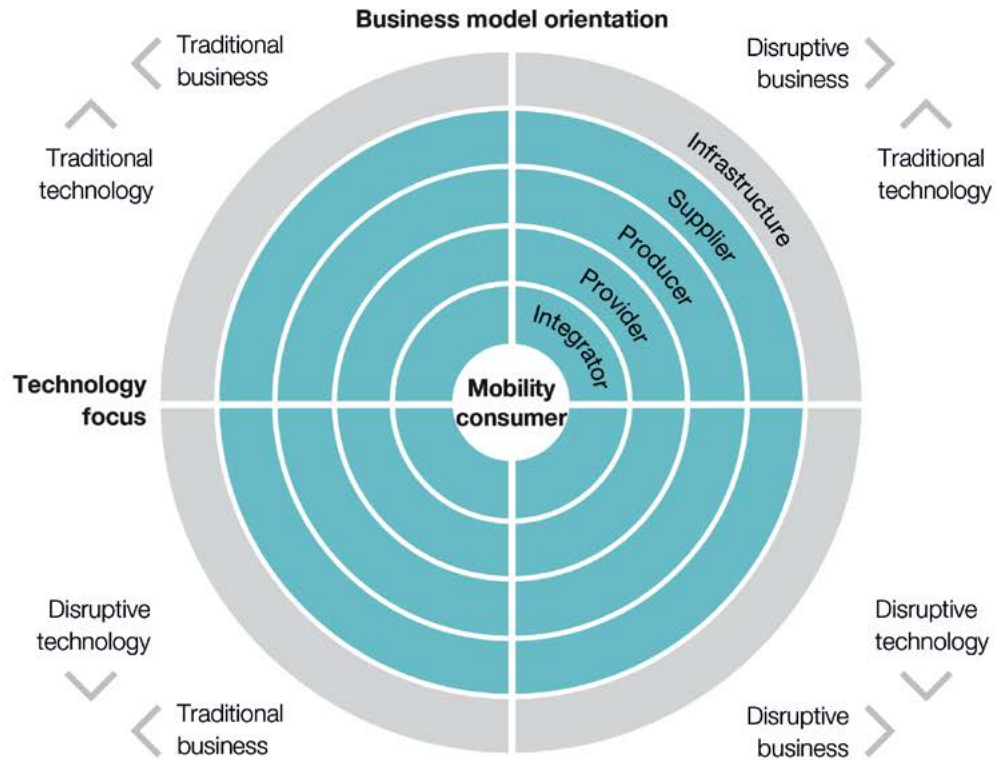
Today, the market is consolidated and focused on providing the traditional, privately owned vehicles that the majority of consumers use for their personal transportation needs.

In the future, the mobility landscape may be highly disrupted and require many new layers of offers, given the potential for value shifts and additional value being created through new powertrains, autonomous-driving technology, in-vehicle connected services, and shared mobility.

The biggest beneficiary of this disruption is likely to be the end consumer, as personal mobility continues to improve with these new offers. Mobility as a service may fundamentally change the consumer's relationship to the car. Just like the mobile phone, changes in mobility will open up the possibility for new services and completely new forms of value creation in daily life. This new way of looking at the personal mobility landscape allows us to map developments and identify new opportunities as players seek to meet the needs of the mobility consumer of the future and capture a fair share of the market.

Exhibit 6

The revenue composition of the mobility market will shift from traditional to disruptive from 2016 to 2030.



Mobility consumer scenario, \$ trillion

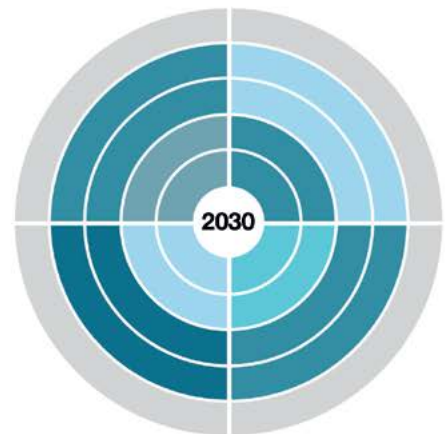


Status quo



2016 total \$3.5T

"Disruption to personal mobility" scenario



2030 total up to \$6.6T

Source: McKinsey Center for Future Mobility

III NAVIGATING THE EMERGING PERSONAL MOBILITY LANDSCAPE UNDER AN UNCERTAIN FUTURE

- 7** No one player alone can span all relevant core competencies and easily invest a minimum of USD 70 billion to stand out with regard to all four disruptive trends.
- 8** We identified five strategic archetypes significantly differing in required qualifications and breadth of their approach to personal mobility, driving players to make business decisions in accordance with their individual profiles.
- 9** To be able to reach across technologies and business models, players will need to think strategically about which areas to partner in, how to identify the right partners and settings, and which of the 13 partnership structures best suits their needs.
- 10** Players will succeed only if they adapt to the automotive revolution as the fundamental transformation it is and act accordingly – particularly, the strategic balancing of decisions during the transition from old to new could mean the difference between an automaker doubling profit through sustainable long-term transformations or severe declines from missteps and inaction.

In this chapter, we take a deeper look at the emerging personal mobility landscape to identify themes related to how industry players might actually approach developing opportunities.

Successfully growing or transitioning into the new mobility industry will require more than simply defining or reorienting a fixed strategy. Strong navigators will learn how to choose based on probabilities. At the same time, they will remain agile and not fixate on a single road forward. As such, mobility players should take four actions, which we will discuss in more detail:

- Define their strategic posture and select differentiating capabilities to build
- Choose their individual strategic setup
- Pursue optimal partnerships
- Actively manage the transition from traditional to disruptive models.

7 No one player alone can span all relevant core competencies and easily invest a minimum of USD 70 billion to stand out with regard to all four disruptive trends.

The future of the mobility industry is characterized by uncertainty. As such, there will likely be several ways forward due to the impact of regulations, technological disruptions, and divergence of consumer needs, for example – each unfolding at a different pace. Players thus need to think about which developments they consider more probable than others and how well they are positioned to follow those paths toward successful outcomes.

In doing so, identifying relevant technology and business model competencies that will allow for differentiation is an important step and should be taken early on in order to define a suitable strategic posture. On the technology side, mastering software capabilities or creating advanced skills in electrification may become key areas for successful differentiation. Similarly, in considering where to focus concerning business model competencies, it could be critical to choose competencies using a customer-centric perspective.

Moreover, trends in the space will also require players to develop a robust organization that enables capabilities around digitization, automation, and innovation, for instance, to the point that they are able to compete along their newly chosen core competencies.

Taking a closer look, we find 25 competencies in the areas of technology and business models, which can be clustered into front-end and back-end competencies, as well as five organizational enablers (Exhibit 7). Companies must master them all to successfully differentiate and serve consumers across all four disruptive trends (autonomous driving, shared mobility, connectivity, and electrification). And most differ from what traditional players have become used to refining for decades, such as a skill set around optimizing the development of internal combustion engines (ICEs).

Beyond building such a multitude of competencies, achieving at least a defensible position in-house for each of the four technology-driven trends would require an established automotive manufacturer to commit to investments totaling more than USD 70 billion.

Exhibit 7

Differentiating core competencies in technology and business models are enabled by organizational structures and processes.

	Technology A software and electrification game	Business models The consumer at the center	Organizational enablers Digitizing structures and processes
Front end	<ul style="list-style-type: none"> • Connectivity solutions • User interface • Product design • Component integration • Infrastructure development (eg, electric-vehicle charging, smart parking) 	<ul style="list-style-type: none"> • HMI¹ and infotainment • Battery technology • Electric powertrain • Driving software 	<ul style="list-style-type: none"> • End-to-end digitization • Automation of processes (eg, operations 4.0 such as predictive and automated maintenance of machines) • Two-speed organization (serving old and new world at the same time) • Digital and open innovation and experimentation
Back end	<ul style="list-style-type: none"> • Sensor technology • Cybersecurity • Data storage and processing • Vehicle-to-vehicle-to-infrastructure communication 	<ul style="list-style-type: none"> • High-accuracy maps • Machine learning 	<ul style="list-style-type: none"> • Integrated (digital and physical) customer experience • Connectivity-based services (eg, smart parking, in-vehicle entertainment) • Financing (eg, loans, leasing) • Aftersales (incl. maintenance) • Online commerce (eg, vehicle sales) • Digital marketing and branding • Digital processing of front-end offers (eg, mobility platform operation) • Fleet operation • Infrastructure operation • Consumer intelligence • Ecosystem management (eg, managing stakeholders, partners, vendors, and consumers)

¹Human-machine interface.

Source: McKinsey Center for Future Mobility

This conservative estimate is based on the probable number of attractive products a player would need to offer to compete in a given space and the necessary enablers required in bringing those products to market.

Our analysis found that the bulk of the cost of disruption will fall to players supporting traditional automotive business models that need to deploy significant capital to develop technologies while bringing new products and vehicle models to market. As such, building new xEV platforms, converting existing ICE platforms, and rolling out semi- to fully autonomous technology to a sufficient number of models (as a share of the fleet of a typical mass-market OEM) may cost at least USD 55 billion over the next 15 years.

There is a lower cost to entry for new mobility business models, such as building a shared mobility service in a specific region or developing a connectivity platform for in-vehicle services and advertising. To compete in just one of these two verticals, a company should be prepared to spend roughly USD 5 billion to USD 10 billion in the same time frame.

This is a high level of investment. And, as our estimates represent the likely overall cost of entry, further funds may be necessary to achieve a leading position in any one of the trends, as competitors will probably make similar moves simultaneously.

No single player is apt to “do it all,” so incumbents and new entrants alike will have to define their strategic posture clearly – i.e., where they want to shape, follow, wait, or even exit the mobility industry. Defining this stance includes prioritizing core competencies and the areas

of the mobility landscape they may occupy, identifying partnerships that will widen their reach, and mapping the path to their envisioned end state as a successful mobility player.

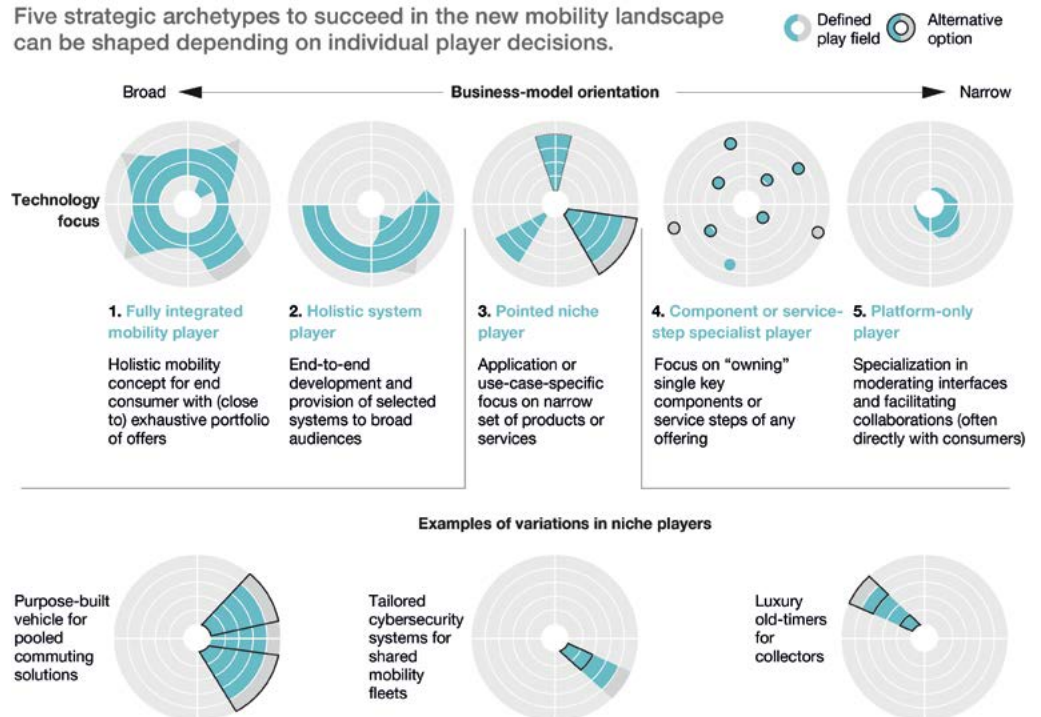
8 We identified five strategic archetypes significantly differing in required qualifications and breadth of their approach to personal mobility, driving players to make business decisions in accordance with their individual profiles.

To build up the new mobility landscape, all segments in all five layers will have to be fully served (Exhibit 5). Individual players will have an ever-growing number of ways to compile their offers and define their mobility strategy in line with their aspirations.

Looking at the potential breadth of any actor’s portfolio, we see five strategic archetypes evolving. Each archetype looks quite different in its coverage of the personal mobility landscape. Even within each of the archetypes, different subtypes can evolve, depending on where players decide to focus and how they fine-tune their approach (Exhibit 8).

Exhibit 8

Five strategic archetypes to succeed in the new mobility landscape can be shaped depending on individual player decisions.



Source: McKinsey Center for Future Mobility

To succeed within each archetype, players must carefully select and master a minimal set of technology and business model competencies, as we outlined in Exhibit 2. For example, a "pointed-niche" player may decide to bet on one trend (e.g. autonomous-driving technology), and therefore, depending on the planned focus, will need to cover all software-based front-end and back-end technology competencies.

This player might need to build advanced machine-learning capabilities, double down on driving software, and create the relevant set of business model competencies such as the effective processing of front-end offers.

To offer a complete and differentiated portfolio within a selected archetype, a company – such as the autonomous-driving niche player – will need to have a minimum profile of qualifications. Five characteristics should be considered in selecting the most suitable strategic archetype:

- **Financial strength**, i.e., the minimum available funds and the ability to invest effectively in accordance with the selected strategy over the course of five to ten years
- **Customer access**, i.e., the level to which one has wide access to the relevant base (e.g. serving a broad range of different customers across segments, needs and wants, demographics, and geographies) or deep access to build relevant knowledge and serve effectively (e.g. understanding a specific customer type down to daily routines, individual wants, and needs)
- **Talent access**, i.e., the opportunity to widely (across a broad range of disciplines) or deeply (through specific knowledge in a selected field) recruit and retain relevant talent – such as software engineers or designers – given the employer’s attractiveness
- **Organizational agility**, i.e., the ability to quickly adapt significant parts of the organization to a rapidly changing company focus (by adopting structures, processes, or employee skills to new market requirements, e.g.)
- **Ecosystem embeddedness**, i.e., the extent to which one is or can be networked with relevant partners and vendors in a targeted field or the broader mobility landscape.

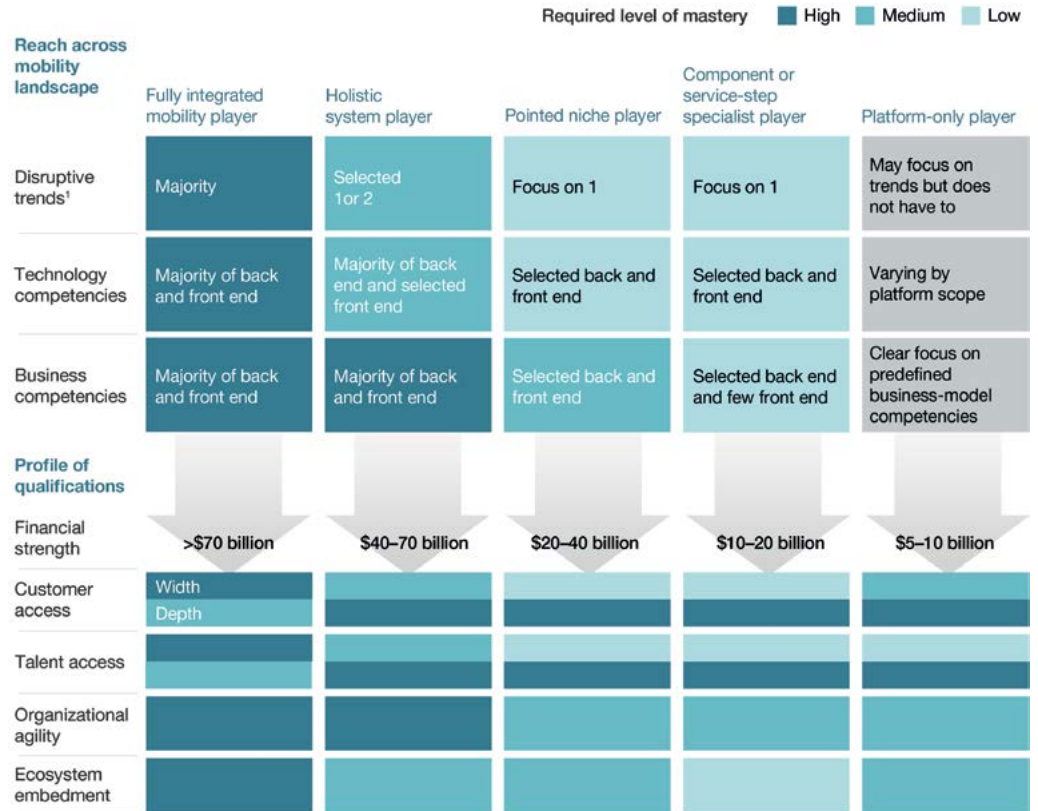
Accordingly, each strategic archetype demands excellence across a unique combination of various competencies as well as specific qualifications (Exhibit 9). Players looking to be successful in a given archetype will need to build their capabilities with respect to their current individual portfolio of skills and assets.

Companies that understand their profile and the archetype requirements can quickly grasp when a specific strategy could be met or exceeded, or in which circumstances under-delivering might become a risk. Identifying individual nuances can clarify appropriate archetypes and then help players fine-tune their strategy once a choice has been made.

Imagine, for example, a company that aspires to become the standard provider for holistic autonomous-driving technology kits. The company has the necessary expertise in software, is well networked to also cover required hardware components, and has a strong employer and consumer brand. While this sounds promising for a holistic systems-player strategy, the company is also financially well-equipped and could therefore consider becoming an even broader player in the industry, potentially moving into the domain of a fully integrated mobility player instead of focusing on a single system.

Exhibit 9

Strategic archetypes vary in their coverage of competencies and trends; this drives the requirement for different profiles of qualifications.



¹Autonomous driving, shared mobility, connectivity, and electrification.

Source: McKinsey Center for Future Mobility

It is then up to the company to evaluate its strategic posture and preferred way of moving forward in the new mobility landscape.

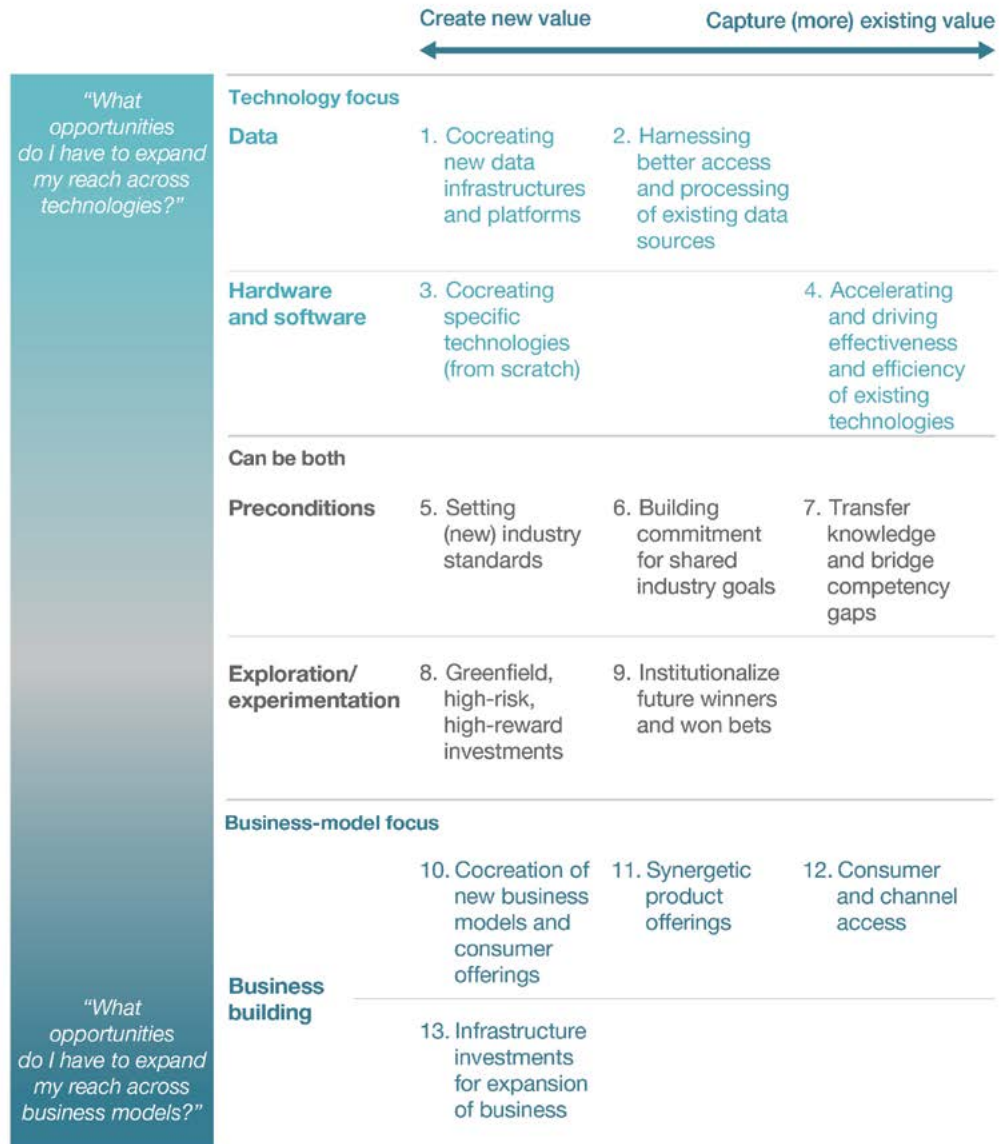
9 To be able to reach across technologies and business models, players will need to think strategically about which areas to partner in, how to identify the right partners and settings, and which of the 13 partnership structures best suits their needs.

Besides gaining clarity on where and how they want to position themselves, players need to think about how they can extend their reach in the mobility landscape and build relevant partnerships for future success. We have identified 13 types of partnerships, each of which offers a specific approach to help manage a player’s reach across technologies and business models, and to create and capture additional value (Exhibit 10).

Partnerships, by nature, are unlikely to be a fixed construct. They may vary by area of the mobility landscape, as well as by the core competencies they are best suited to cover.

Exhibit 10

13 partnership types can help individual players manage their reach and create or capture value in the new mobility landscape.



Source: McKinsey Center for Future Mobility

For example, dedicated partnerships for setting new standards in the industry may, generally speaking, be well suited to cover technology and business model topics but should ideally be oriented towards disruptive offers, such as how to think about and handle the deployment of robo-taxis, once available.

By contrast, partnerships on synergetic product offers primarily focus on expanding business based on existing technologies and thus can be optimally used for a gradual transition into more disruptive business models.

At the same time, as new partnerships grow more mature, they will probably include more elements of capturing existing value, even if they originally set out with the goal of creating entirely new value pools. Consider a newly established platform for sharing data on autonomous-vehicle (AV) behavior: while at the beginning such a partnership may be focused on opening up new opportunities for its contributors, it may shift towards securing the created – and potentially other existing – value pools.

Selecting where to partner, the most suitable type of partnership, and the right structure will not be straightforward as the industry becomes more complex and diverse. Players will presumably face an increasing number of potential partners across all layers of the mobility landscape and from a large set of industries that are all looking to serve the mobility end consumer.

Not surprisingly, we already observe many new offers stemming from rather unconventional partnerships in the mobility space. Take, for instance, competitors collaborating on high-definition maps or new players from different industries such as retail and fashion building on opportunities from fully connected vehicles and car-data-enabled services (for more, see Text box 3).

Text box 3: Example partnership models around Lyft

Lyft leverages more than ten partnerships to gain reach across technologies and business models.

To accelerate AV technology, Lyft taps into a broad network of partners. As part of its approach, the company established an open AV platform allowing its partners (automakers GM and Jaguar Land Rover, start-ups Drive.ai and nuTonomy, and Google's self-driving division Waymo) to test their autonomous fleets on its ride-hailing platform, granting access to its network of riders. Furthermore, Lyft is working with partners like nuTonomy on enhancing the end-to-end passenger experience for AVs. Lyft recently announced it would also develop its own autonomous-driving software and hardware components and have its partners integrate this technology into vehicles.

On the business-building side, collaborations are numerous. Most notably, Lyft partners with Chinese Didi and Grab as platform players in separate markets offering its customers a seamless ride-sharing experience beyond the United States, in Asia. Several partnerships exist with insurance and travel companies to provide “last-mile transportation” where offerings are synergetic – for instance, from the train station home or to the doctor's office. Additionally, Lyft partners with fast-food providers and the American Automobile Association (AAA) to boost ride sharing as an alternative to the conventional car rental business.

As advances in mobility continue, we expect more and rather diverse partnerships to evolve. For example, multiple industry players have already started discussing the need for AV

remote-control centers, which would serve to help navigate highly autonomous cars in unexpected or emergency situations. Such centers could play a crucial role in getting autonomous technology off the ground and achieving an initial, critical level of adoption, for example, through providing consumers and safety authorities with a sense of security, knowing there is a defined fallback mechanism to start with. A variety of stakeholders, including regulators, fleet operators, and AV-system providers, may be interested in controlling these centers in the future.

On a less concrete level, we could include making electric vehicles serve as mobile power banks for businesses and private households, leveraging AVs for more attractive storage or even real estate deals, or basing entire interior design businesses on equipping purpose-built vehicles of all kinds. However, such partnerships are structured, the future is likely to bring interesting collaborations to benefit the industry and end consumers.

10 Players will succeed only if they adapt to the automotive revolution as the fundamental transformation it is and act accordingly – particularly, the strategic balancing of decisions during the transition from old to new could mean the difference between an automaker doubling profit through sustainable long-term transformations or severe declines from missteps and inaction.

Beyond looking at how to choose the right strategy and partnerships, we also need to acknowledge the automotive revolution as a fundamental transformation of the industry. In our perspective, players should approach it as such – and the rules of transformational change still apply (see Text box 4).

Text box 4: Key considerations for a successful transformation

Thriving in the emerging mobility landscape requires not just fundamental change but also strategic change. Industry players who make five deliberate decisions stand the best chance of a successful transformation that results in sustainable profitability:

- Set the right overarching goals, including the right organizational aspirations for the future.
- Determine and tackle the technical, managerial, and behavioral gaps between today's state and the future vision (including a clear plan for capital expenditure and investment).
- Develop a portfolio of clear initiatives to grow into new performance spaces, and structure the implementation of initiatives in ways that attract and motivate the right talent.
- Design a rollout plan, and account for broad ownership and thoughtful stakeholder management throughout the transition.
- Set mechanisms for continuous improvement and innovation, as well as for developing and enabling leaders to keep driving the required changes.

This may sound like any other transformation, but for the automotive revolution, it will be particularly crucial to draw attention to the business case element of the upcoming transition. Financial decisions will have to be made in light of the need to serve two worlds: the traditional automotive business, which will still make up a sizable portion of the industry by 2030, and the disruptive, technology-driven trends, which will grow to take over the mobility industry. Defining the right balance across when, where, and how to invest in one field or divest from another will be of utmost importance.

The impact can be immense, and players in the new mobility ecosystem have very different starting positions based on their current roles and competencies. To quantify the potential evolution of profitability and investment, we ran a war-game simulation that modeled the potential decisions of various players hundreds of times and assessed the effect of competitive dynamics on profitability (Exhibit 11). Through this analysis, we identified three core components of decision making that seem to help determine success:

- **Investment focus.** This entails weighing the trade-offs and taking a considered approach on whether to be balanced across exposure to disruptive trends or to focus more on narrow competencies.
- **Investment timing.** The second component involves managing long lead times for technology development and market entry while staggering high-cost investments and deciding whether to front-run industry developments or take a fast-follower approach.
- **Agile organizations.** Major events, such as regulatory decisions or the entrance of one or two large players into a market, can disrupt a company's long-term investment strategy while reducing market share and creating downward pressure on margins. Agile organizations must first anticipate and second react to this risk, specifically when significant amounts of capital and corporate focus are committed to one space.

Looking at average performance and top performers across numerous simulations, we also see how fundamental dynamics for different player types inform various strategies:

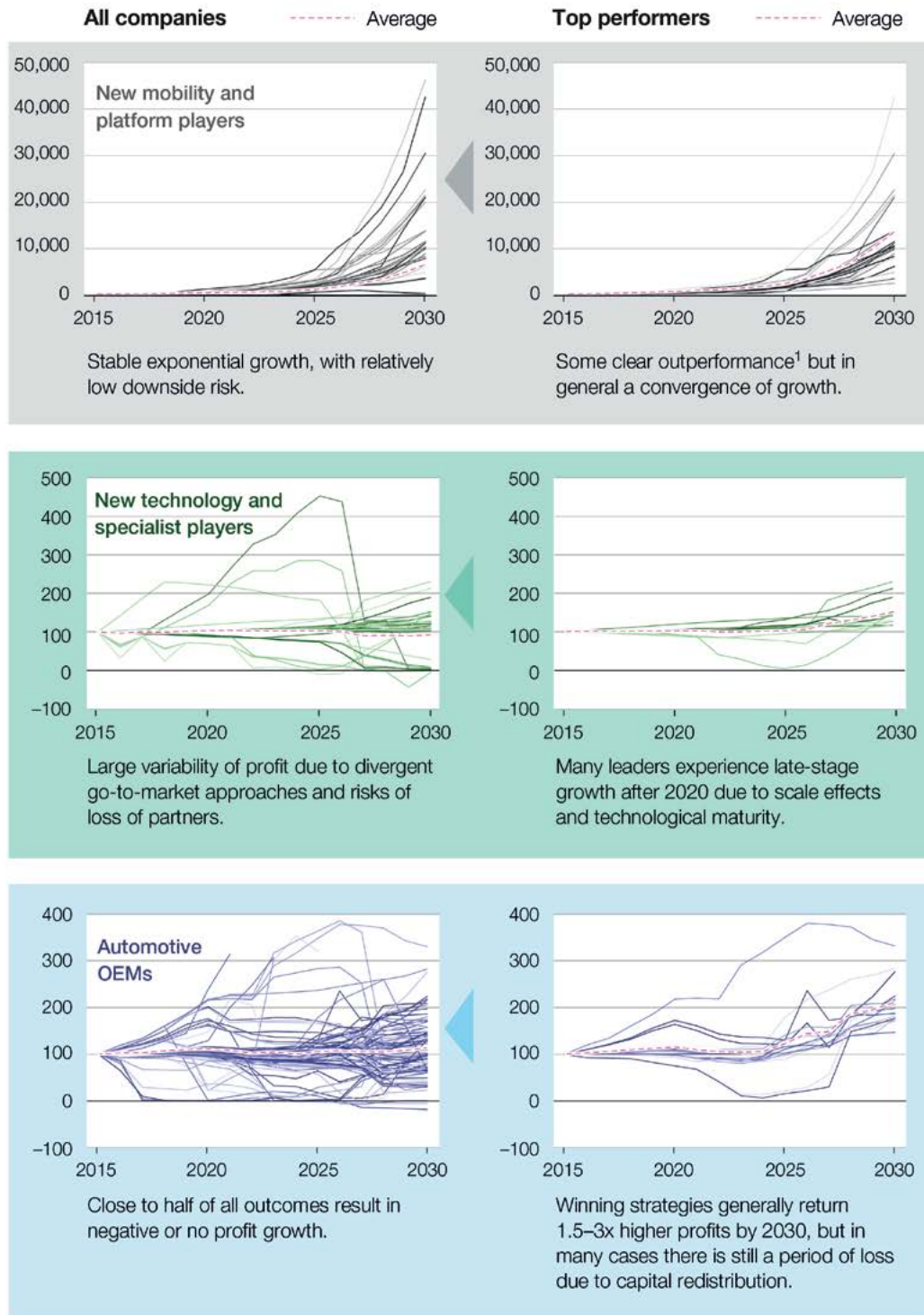
New mobility and platform players. New mobility players start from a position of tight profits and constrained cash flow, but with organizations that are potentially quite agile. These players could see massive expansion of their current profits, achieving growth of a hundred times or more. However, they must carefully position themselves to respond aggressively to potential new entrants and changing regulation that could dethrone them.

New technology and specialist players. Large technology players and specialized companies focused on bringing one or two disruptive technologies to market have the luxury of timing and targeting their go-to-market strategy while working with numerous players to scale technologies and profits across large volumes. For these players, a variety of approaches proved successful: whether manufacturing lithium-ion batteries, developing connectivity platforms, creating in-vehicle-services ecosystems, or even rolling out a shared mobility fleet, all generated strong returns in competitive environments. With access to large amounts of capital – giving them the ability to decide when to enter, if at all – the key obstacle these players needed to overcome was the ability to identify sufficient OEM partners and the best business models.

Exhibit 11

Our war-game simulation reveals multiple paths to future profits.

Simulation of profits across scenarios, normalized to 2015



¹Due to varying competitive intensity, size of 2015 business, and emergence of autonomous vehicles.

In our testing, only 30 percent of the simulated companies were able to both enter the automotive market and generate long-term profits.

Automotive OEMs. Automotive manufacturers faced a more varied path to long-term profits. High levels of fixed capital, long product cycles, and the need to transition to new technologies in the face of an uncertain future mean shareholders of some companies may need to prepare for an intense phase of capital redistribution and pressure on profitability. In our simulations, we still saw various decisions leading to success, but close to half of all simulated strategies resulted in negative or neutral profit growth.

Many large OEMs diversified their bets across a range of powertrain and autonomous systems, keeping core intellectual property and investments in-house and staggering their investments to minimize risk and spread costs. However, in some successful paths, OEMs achieved an even more radical transformation of their businesses, divesting tens of billions of dollars of capital from their core ICE business as they shifted large portions of the portfolio to xEVs and advanced AV while rolling out their own mobility platforms.

Smaller OEMs, including emerging-market players and niche-market specialists, were forced to sharpen their focus if they were to succeed. In some instances this meant falling back on producing the core vehicle, while strategically sourcing high-volume disruptive technologies (such as partially autonomous-driving systems and hybrid propulsion) to grow their market share at the cost of a substantial profit give-back to the system suppliers. Other OEMs created outside growth by focusing on one disruptive technology, such as battery electric vehicles or fully autonomous vehicles, building a brand and being first to market at the expense of all other potentially addressable segments.

Our simulations revealed a wide variation in the ability to grow profit across types of players and strategies as the industry goes through a wide-reaching disruption and transformation.

Many of these outcomes themselves were critically sensitive not only to the actions of others and the evolution of overall industry structure but also to exogenous shocks. In the war game, a battery manufacturer could achieve substantial returns by investing in a multibillion-dollar battery manufacturing facility and supplying to one or two mass-market OEMs. This investment would fail without ongoing and increasing regulatory support for xEVs; alternatively, it could generate 30 percent greater returns through improved battery chemistry. Similarly, the success of fully autonomous vehicles represents a paradigm shift for shared mobility players' revenues and profits, but technology failure or regulation delaying the rollout could keep that business on a more conservative long-term path and lead to negative returns for players heavily invested in the technology.

The level of uncertainty facing many of these major investments is significant. While our analysis suggests the existence of winning paths, the road to the future is uncharted. But the four key actions we explored here could help players navigate in the emerging mobility landscape. Staying flexible while at the same time learning to operate based on probabilities will continue to increase in importance.

NAVIGATE THE FUTURE ... TODAY!

The MobilityMania war game simulates the future automotive world in a highly dynamic, interactive model and translates the insights into players' reality.

As the pace of technological change in the industry accelerates, we believe the question is no longer whether the disruption will occur. Rather, it is how quickly and to what extent players will have to reimagine their businesses to serve the mobility consumer of the future. The new landscape will require new technologies, competencies, and partners, while still relying on traditional businesses and products as part of the solution.

The size and potential impact of the automotive revolution requires more than gut feeling to drive the right decisions for a successful mobility strategy. Only a good understanding of the potential outcomes and a data-driven mindset can enable actors to adjust to the full impact of the disruption on their business. Solutions like our MobilityMania war game (for more, see below and right) seek not to forecast the future but to simulate a range of possible scenarios and understand how they could affect the profitability of a variety of players. They also allow companies to test their strategies in the face of an uncertain future and enable key decision makers to approach impending changes with an industry-wide perspective.

We hope this report encourages organizations to think about probable futures, decisions, strategic alternatives, the moves of other players, and the importance of a future-oriented vision. The next 15 years will usher in a new mobility landscape, with large shifts in the deployment of capital and the capture of profits. Navigating what is ahead will require businesses to approach the market with a long-term vision and to clearly communicate with shareholders and partners about the road ahead.

Players choosing actions on an iPad interface and negotiating on mutual cooperations



The MobilityMania war game allows to experience the disruptive future of the mobility industry hands-on

- 1 Put yourself in the shoes of competitors and new players
- 2 Probe investments in key technologies and negotiate on strategic partnerships
- 3 Compete with other players on market shares and profits by developing the dominant strategy
- 4 Pressure test strategies in a highly agile market with an unknown future
- 5 Experience disruptions by other players, governments, and customers
- 6 Gain insights on market dynamics and success factors for reality



CONTRIBUTORS

Authors

Kersten Heineke, Partner, Frankfurt

Timo Möller, Senior Expert, Cologne

Asutosh Padhi, Senior Partner, Chicago

Andreas Tschiesner, Senior Partner, Munich

The authors are members of the McKinsey Center for Future Mobility.

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Editing and layout

Torea Frey, Manager, Digital Publishing, Seattle

Jörg Hanebrink, Senior Communication Specialist, Düsseldorf

Richard Johnson, Senior Editor, Data Visualization, Washington, D.C.

Johanna Löffler, Senior Media Designer, Berlin

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Contacts

Kersten Heineke is a Partner in McKinsey's Frankfurt office.
kersten_heineke@mckinsey.com

Timo Möller is Head of the McKinsey Center for Future Mobility
timo_moeller@mckinsey.com

Asutosh Padhi is a Senior Partner in McKinsey's Chicago office.
asutosh_padhi@mckinsey.com

Andreas Tschiesner is a Senior Partner in McKinsey's Munich office.
andreas_tschiesner@mckinsey.com

Media contact

Martin Hatstrup-Silberberg
Senior Communication Specialist
Düsseldorf
+49 (211) 136-4516
martin_hatstrup-silberberg@mckinsey.com

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