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McKinsey Center for Future Mobility

Mastering new mobility

Perspectives on navigating an uncertain future

Executive summary

The European automotive industry finds itself in a changing market that is showing signs of slowing down. This challenging situation results in even higher cost pressure due to large, necessary investments in new technologies and solutions.

Despite the current challenges, new business models based on advancing technology and changing customer demand open up significant long-term potential for all market players – as industry revenues are expected to almost double by 2030.

Scaling up e-mobility is the most urgent task for the industry: OEMs are expected to launch around 300 new battery electric vehicles (BEVs) by 2025 to meet European CO₂ fleet regulations – however, current estimates show an additional two million electric vehicles need to be sold in Europe to avoid CO₂ penalties in 2021.

OEMs are signing an increasing number of partnerships to share high investment costs. Their main goals are to ramp up e-mobility with other players and enhance their capabilities and technological base by cooperating with new market entrants such as tech companies.

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Introduction

For several years now, the European automotive industry has found itself in the midst of a disruption. While the business model of producing and selling cars with combustion engines has been very stable for decades, automakers now face technological challenges such as ACES (autonomous, connected, electric, and shared mobility), demand that's shifting towards Asia, changing business models (vehicle sharing instead of ownership), and increasing instability caused by geopolitical and trade tensions.

How can automakers cope with these challenges and master the new mobility world? By examining the current economic cycle, emerging technologies such as e-mobility, and the changing competitive landscape that's moving from value chains to ecosystems, this publication aims to give a set of perspectives on how to navigate this future that's more uncertain than ever.



Speed bumps ahead

After billing record years regarding both revenues and profits, the automotive industry is now facing an economic headwind. Margins are eroding, and many players issued profit warnings for 2018 and 2019. Many of the challenges facing the traditional value chain are short term, but others will require a long-term focus.

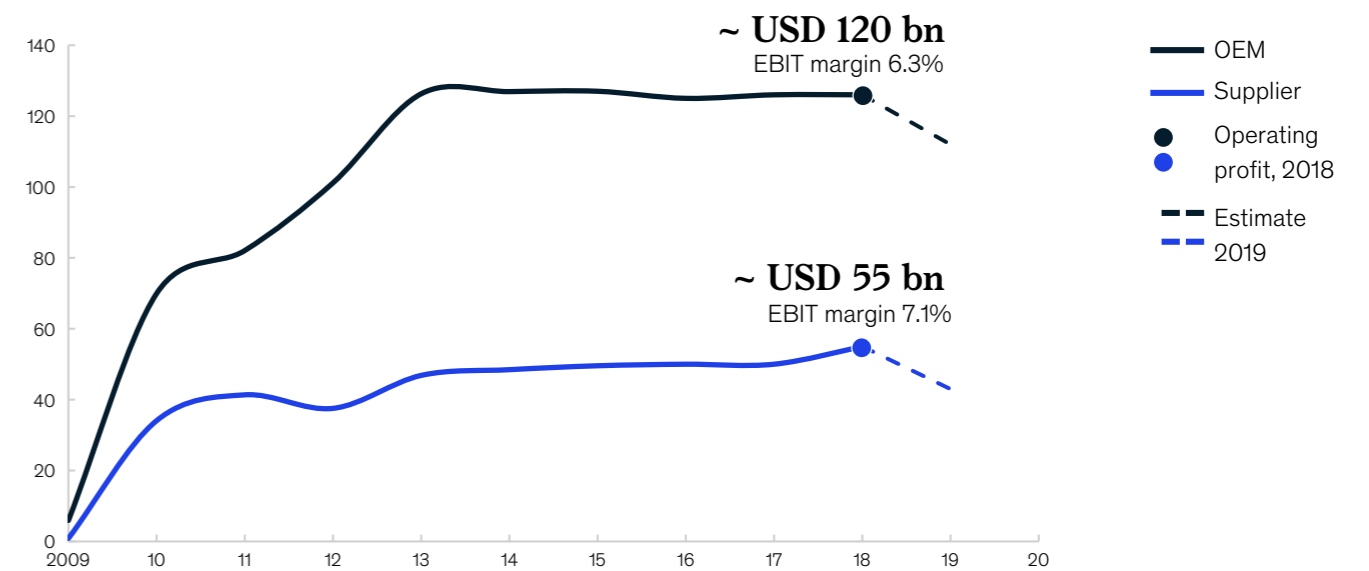
In the short term, geopolitical and macroeconomic risks certainly play an important role. Tensions in the international trade system and factors such as Brexit signal a high degree of uncertainty for the industry. At the same time, long-time boom markets such as China are showing the first signs of saturation. In Europe, the looming CO₂ penalties plus the cost for meeting stricter WLTP¹ standards challenge automakers, accompanied by more traditional factors such as intensifying competition, and new market entrants.

In the longer term, automakers need to invest in new technologies such as autonomous driving, connectivity, electrification, and shared mobility – while also mastering advanced manufacturing and materials.

On top of that, the needs and objectives of regulators (nine European countries have discussed restricting internal combustion engines by 2030) and certain customer groups (those who favor mobility services over car ownership) are harder to meet.

The automotive profit pool was at record levels over the last six years – but there is potential risk of a “perfect storm” ahead

Global automotive supplier and OEM¹ EBIT development, outside-in, USD billions



Challenges to the traditional value chain

Short term

Geopolitical and macroeconomic risks

Trade wars, Brexit, market saturation, customs duties

CO₂ penalties/WLTP

CO₂ fleet penalties, necessary EV ramp-up cost of new WLTP standards

Classic automotive drivers

Segment shifts, aftermarket, competitive intensity, new market entrants

Mid- to long term

Investment in new technologies

ACES trends, advanced manufacturing, advanced materials

Regulation

ICE² ban, increasingly tighter CO₂ regulations, city access restrictions

Changing customer needs

From car ownership to mobility services, digital branding

¹ Includes top 21 OEMs and top 75 suppliers

² Internal combustion engine

Source: McKinsey

¹ Worldwide Harmonized Light Vehicle Test Procedure

Challenges create opportunities

The challenges are significant on many levels. Economy-wise, trade tensions could reduce world GDP by about 0.5 percent. Within the automotive industry, making electric vehicles (EVs) profitable remains difficult: only higher-priced premium vehicles deliver positive contribution margins. At the same time, a single automaker would need to invest at least USD 70 billion over next 10 years in ACES trends to build a strong position in all trends.

If EV ramp-up fails, OEMs could end up paying EUR 15 billion in penalties to the European Union in 2021: EUR 1.5 billion for each gram of CO₂ short of the target. This is a strong driver to push EV uptake now.

While the challenges are significant, they in turn provide great opportunities for players to conquer new markets and further reduce costs

Challenges to the existing business model

Geopolitical and macroeconomic risks

-0.5% pt

world GDP reduction from trade wars (25% tariffs on all bilateral trade)

Near term EV business case at risk

< 0%

contribution margin on BEVs

Investments in new technologies

> USD 70 bn

investment into ACES required by OEM, calling for "burden sharing"

Challenges to the existing business model that open up opportunities

CO₂ penalties

> EUR 15 bn

penalty payments in Europe in 2021 with EV ramp-up in base case scenario

Changing customer needs

40%

of customers willing to change brands for digital and connected services

Regulation

9 countries

in Europe discussing the ban of ICEs by 2030

New opportunities

Emerging revenue pools

> EUR 2.5 tr

new market volume emerging in service and mobility businesses by 2030

AI opening new horizons for cost efficiency

4 - 19%

bottom-line optimization potential from AI across value chain steps

Asia

> 40%

of 2030 revenue pools in Asia

¹ Includes BEVs and plug-in hybrid electric vehicle (PHEVs)

Source: McKinsey

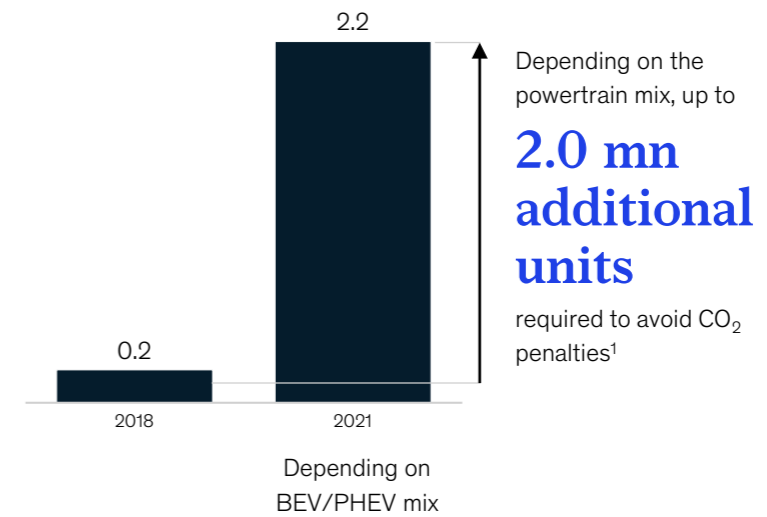
A double-edged sword

Projections for Europe indicate that automakers would need to sell up to 2.2 million EV units in 2021 alone to meet their fleet CO₂ targets. This is a steep ramp-up of EV sales in less than 2 years and equivalent to global EV sales in 2018.

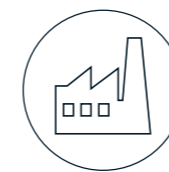
This is a big task not only for the automotive industry, but also for adjacent industries. To power two million new vehicles, Europe would need the equivalent of about four gigafactories for the battery supply – and the additional raw materials. To meet charging demands, 300,000 to 400,000 public charging stations would be required.

European automakers must sell an additional two million electric cars in 2021 to avoid CO₂ penalties

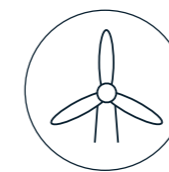
BEV/PHEV sales in Europe, million units



Prerequisites for successfully building up the e-ecosystem



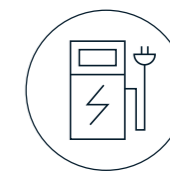
4 gigafactories



~2% additional wind energy capacity (4 GW)



9 kt lithium
31 kt nickel
10 kt cobalt



300,000 - 400,000 public charging stations

1. Assuming a constant overall sales volume of 15.2 mn passenger cars and a stable gasoline/diesel share and ratio until 2021; BEV/PHEV share of 1:1 assumed
Source: EEA; Bernstein; McKinsey

Revving up e-mobility

OEMs are therefore moving quickly: to meet both regulator and customer demand, OEMs are significantly ramping up their BEV portfolios. Incumbent OEMs will bring more than 300 new BEV models to market by 2025.

Advancements in battery technology, economies of scale in EV production, native EV design, and cooperation between OEMs can help bring down costs.

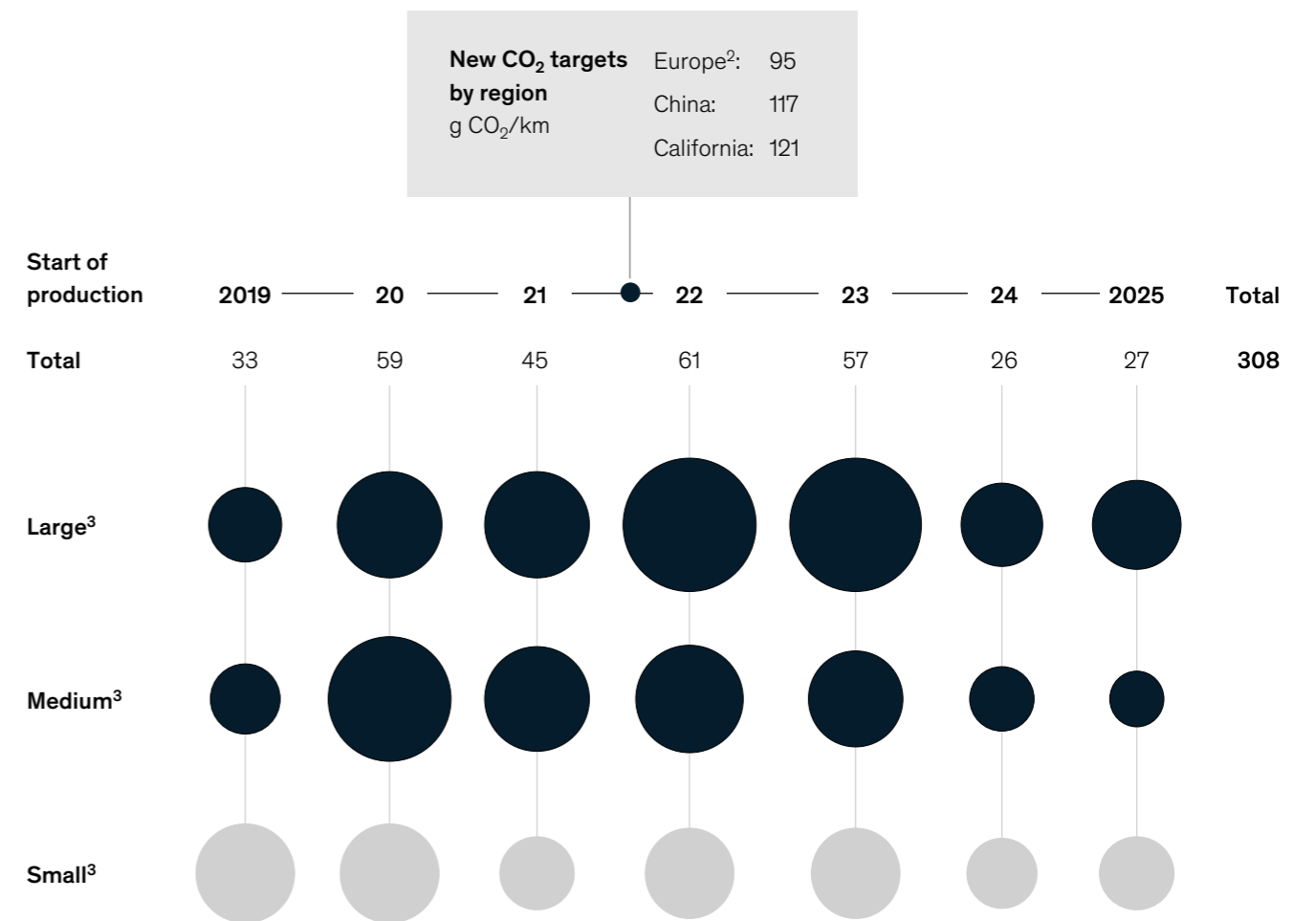
As the business case is more attractive, OEMs are focusing on large and medium-sized cars for the coming years. This is understandable from an economic point of view but will not necessarily help OEMs meet CO₂ targets at scale, as the price point is still too high for many consumers.

€275 bn

invested into EV by automakers so far

Incumbent OEMs will launch around 300 new BEVs by 2025 with a strong focus on medium and large vehicles

Number of BEV launches¹



1. Includes US, European, Japanese, and South Korean OEMs

2. Phase-in from 2020 for 95% of fleet

3. Small = A/B segment, medium = C segment, large = D/E segment

Source: IHS Automotive (July 2019); <https://graphics.reuters.com/AUTOS-INVESTMENT-ELECTRIC/010081ZB3HD/index.html>

Demand is rising

Consumers are already inclined to buy BEVs or PHEVs. China leads the pack, with 86 percent of Chinese consumers considering buying such cars. German consumers are at 64 percent. While American consumers still tend towards traditional vehicles, more than half – 51 percent – now consider EVs when purchasing a new vehicle.

And the EV experience is extremely positive: more than 9 out of 10 current EV owners consider an EV for their next car as well.

However, infrastructure needs to grow in line with growing EV demand. 50 percent of potential BEV buyers are concerned about limited range or access to charging stations. Moreover, the EV supply chain is still shaky – EVs currently have very long delivery times.



Better infrastructure will convert many consumers to EVs

Consideration

64%

BEV/PHEV consideration rate in Germany, 86 % in China, 51% in the US

Infrastructure and range

50%

of potential BEV buyers are concerned about access to charging stations or limited range

Repurchase

> 9 out of 10

current BEV owners consider BEVs for their next car purchase

Supply

~ 770,000

unit backlog

for Tesla models as of 2019

Source: McKinsey Consumer Survey; web search

New powertrain players

Taking a closer look at the powertrain supply chain, one can see it is currently in flux.

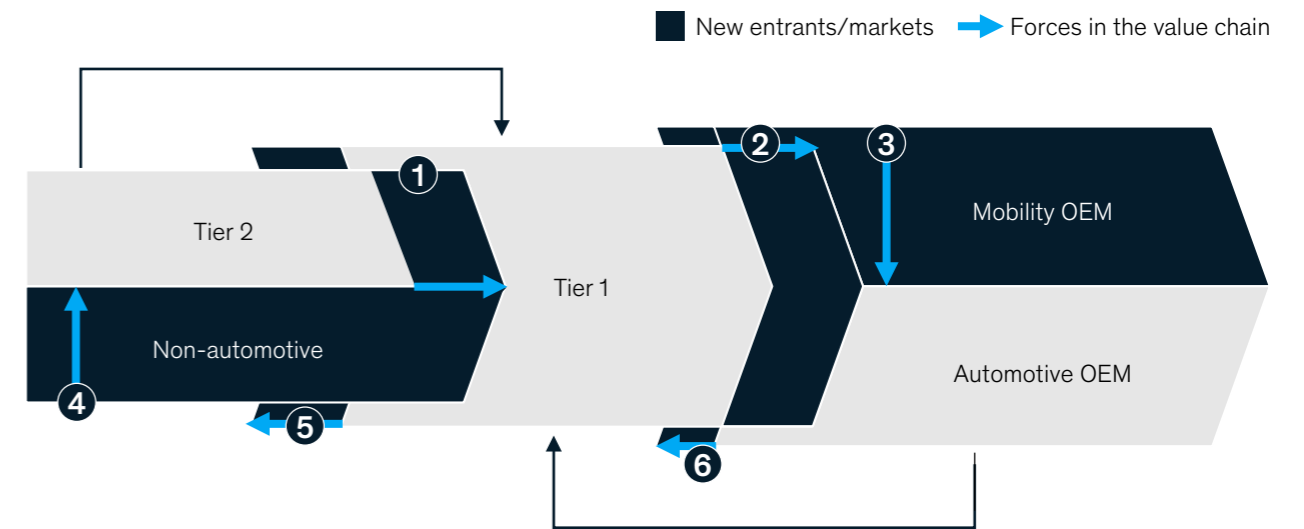
Non-automotive players are entering the market – and they make more than 90 percent of the investments in mobility startups. 15 automotive suppliers offer or develop an e-axle system solution, which is the basis upon which new brands can easily offer their own vehicles.

>15

electric drive suppliers emerging

Disruptions in the e-powertrain value chain create new opportunities for many types of players

E-powertrain landscape



- 1 Non-powertrain tier 2s are entering into direct OEM relationships (e.g., batteries)
- 2 Tier 1s are evolving into tier 0.5s as system and e-chassis suppliers
- 3 New OEMs provide mobility platforms, but non-automotive players have an > 85% market share in mobility solutions
- 4 New players are entering the automotive market (e.g., e-motor and electronic component manufacturers)
- 5 Tier 1s are integrating backward, partly in new areas (e.g., batteries, electronics)
- 6 Automotive OEMs are integrating backward in-house (i.e., e-axles) and face fierce competition

Source: McKinsey

Racing the tech giants

Tech giants are the other major players shaking up the automotive industry, increasing competition in a big way. Backed by large cash reserves and/or high stock market valuations, these companies are trying to redefine how mobility will look in the future.

In light of this, automakers should not neglect their traditional strengths: they should continue focusing on design, sustaining production excellence, and maintaining a big service operations footprint. But they can learn from tech companies and adapt across three dimensions: creating new ecosystems and business models, forging partnerships, and establishing new levers for efficiency gains.¹

The automotive industry must take action along three dimensions to keep up with tech giants

Ecosystems and business models	Shape, don't react	Drive innovation of new solutions even if they harm traditional business models
	Allocate resources	Shift resources to new technologies
Partnerships	Share pain	Turn competitors into partners to share investment burdens and decrease risks
	Team up for gain	Cooperate with technology leaders to explore new opportunities
Efficiency	Explore new technologies	Unlock new frontiers of profitability by actively exploring the potential of artificial intelligence
	Attract new talent	Enhance talent pools to expand data- and technology-driven business models

¹ For further reading: McKinsey "Race 2050 – A Vision for the European Automotive Industry" (January 2019)

Source: McKinsey

Succeeding in tandem

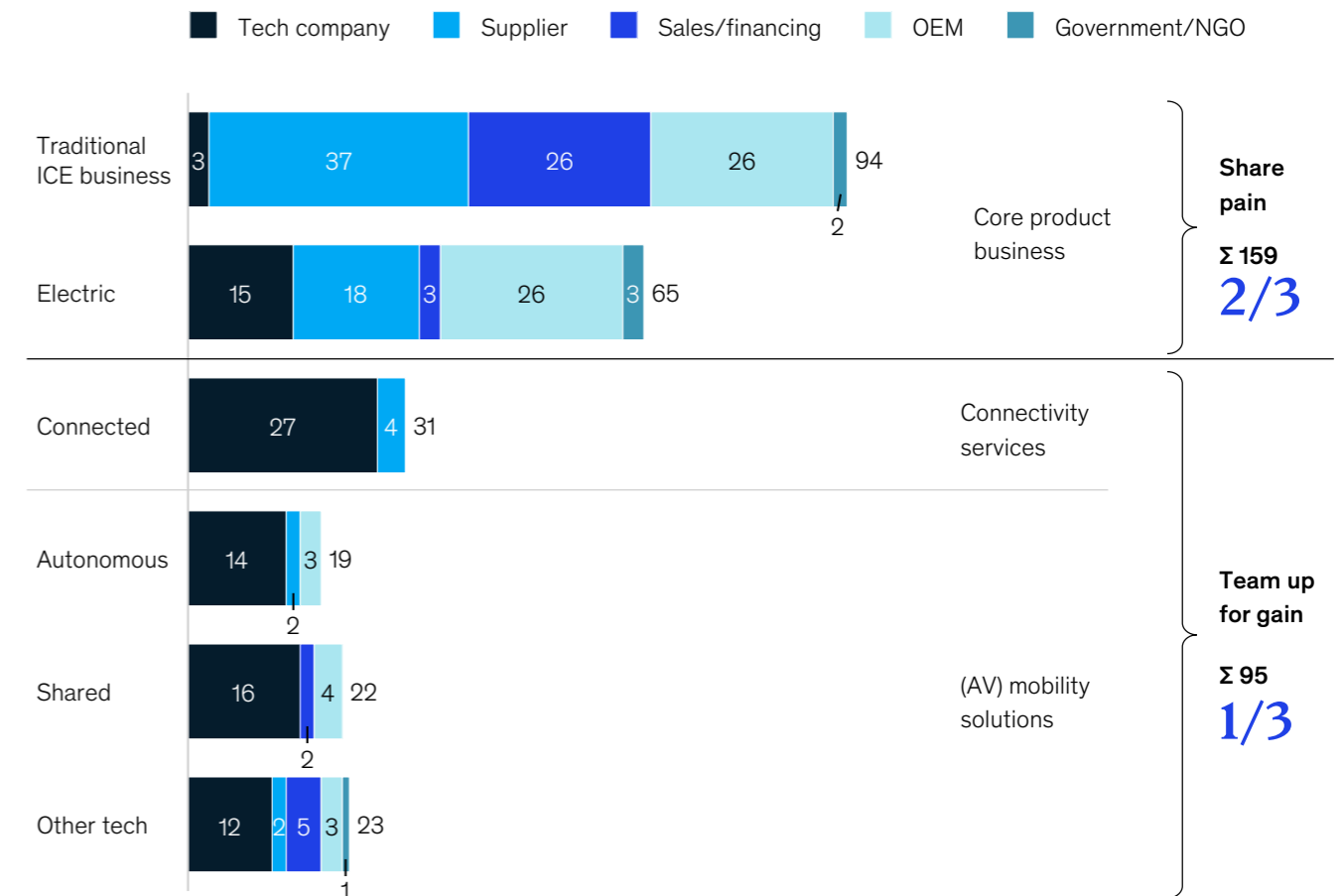
Cooperation within the automotive industry is not new – for decades, OEMs have shared the financial burden in core areas like engine development and production. But given the challenges ahead, cooperation will become an even bigger success factor.

Our analysis shows that the majority of new cooperations in the industry are still in these core, investment-heavy areas; 94 new cooperations have been forged in this space since 2014. But electrification cooperations are on the

rise: 65 have now been forged, and interestingly, 15 of them are between OEMs and tech companies. This figure is even higher for connectivity-related cooperations: 27 out of a total of 31 are between OEMs and tech players, giving them a high share in the autonomous driving and shared mobility markets.

Two thirds of partnerships initiated by OEMs since 2014 have focused on sharing investment burdens

Total new OEM partnerships (since 2014)



Source: McKinsey

From value chains to ecosystems

These cooperations are only the first step into what we call an ecosystem for mobility. As the traditional value chains between suppliers and OEMs begin to dissolve, new entrants, tech companies, and governments/regulators will play bigger roles.

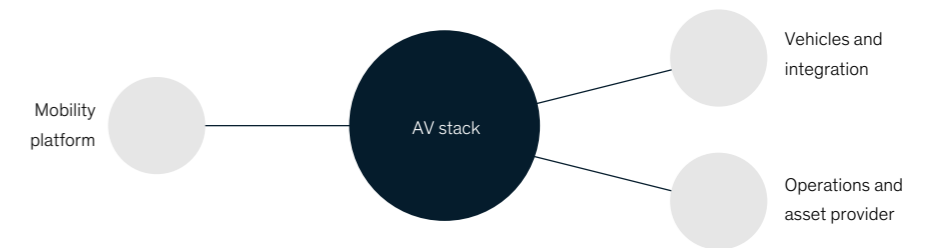
In the long run, it is expected that a handful of global ecosystems based on different players will emerge. These could take the forms of a tech-centric ecosystem focused on the AV stack, an OEM ecosystem, an investor-orchestrated ecosystem, and an open-platform ecosystem.

Several ecosystem archetypes are emerging to dominate the market

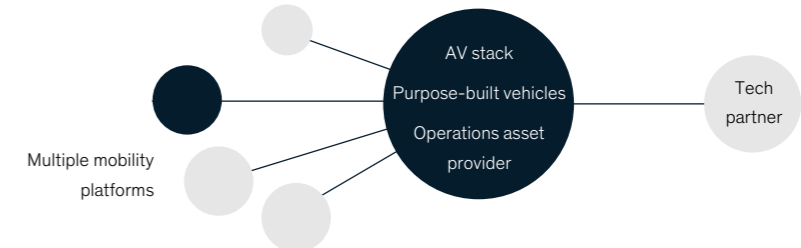
Potential ecosystems

● Leading player in ecosystem

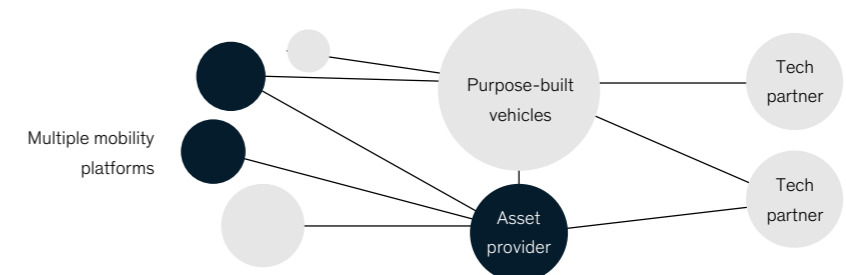
Tech-led ecosystem



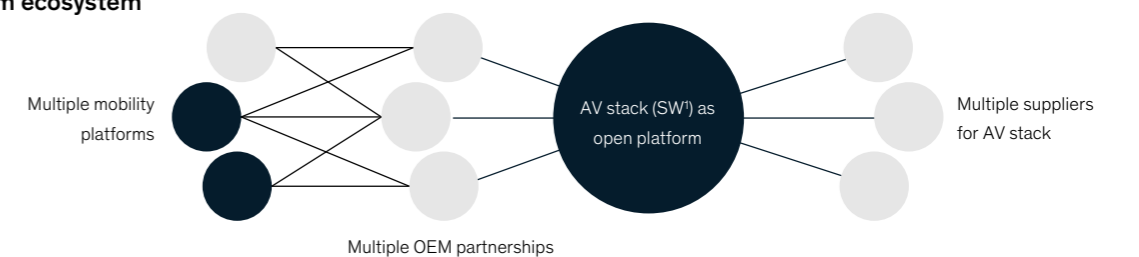
OEM ecosystem



Investor-orchestrated ecosystem



Open-platform ecosystem



1. Software
Source: McKinsey

Boosting EBIT with AI and analytics

Technology is not only central to developing these ecosystems, but also one lever to optimizing efficiency and profitability in the future. Artificial intelligence is a prime example of an essential technology for the automotive industry beyond traditional levers.

Since many companies work on the edge of traditional cost optimization – 63 percent of executives say they have reached limits, e.g., for lean manufacturing – artificial intelligence and industry 4.0 promise to deliver additional cost optimization potential.

There are numerous use case along the value chain.

For instance, OEE¹: today, most solutions fail to accurately measure OEE due to unavailable or heterogeneous data. With AI, data sources can be linked and harmonized – allowing automated, real-time reports that address further efficiency potential.

Another example: while OEMs usually spend 10 to 20 percent of their revenues on incentives, it might be one of today's most undermanaged expense categories. AI offers the potential to significantly reduce customer rebates and vehicle time in stock. By predicting demand, OEMs can optimize build-to-stock vehicle configurations, and vehicle distribution, as well as offer targeted rebates and promotions.

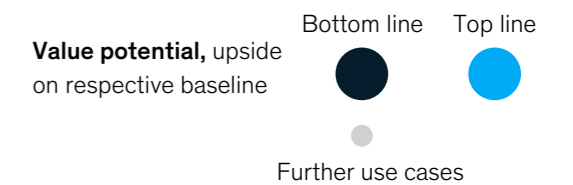
¹ Overall equipment effectiveness

9% pt

industry-wide, AI-enabled EBIT potential for automotive OEMs

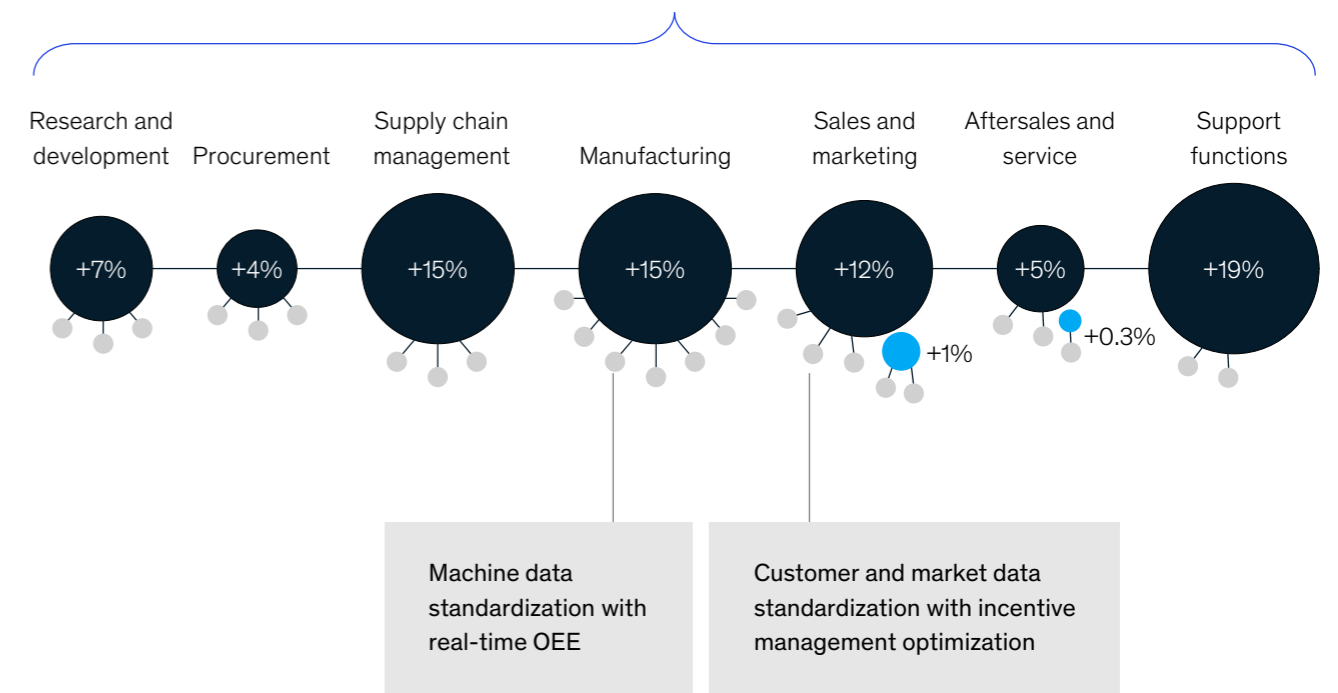
AI use cases offer potential along the full automotive value chain

AI use cases examples



~ USD 215 bn

global value potential from AI for OEMs through to 2025 (equivalent to 9 EBIT % pts)



Source: McKinsey

Conclusion

The road ahead for the automotive industry is certainly not straight and smooth; in fact, it is uncharted, windy, and bumpy. But one thing is clear: mobility has always been and will remain an important constant in human societies.

Therefore, if traditional OEMs and suppliers manage to turn the short-term challenges and long-term disruptions to their business models into opportunities, they will be able to continue growing successfully – and make healthy profits to boot.

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