McKinsey&Company

MCKINSEY CENTER FOR FUTURE MOBILITY

ARTIFICIAL INTELLIGENCE – AUTOMOTIVE'S NEW VALUE-CREATING ENGINE

January 2018

MCKINSEY CENTER FOR FUTURE MOBILITY

ARTIFICIAL INTELLIGENCE – AUTOMOTIVE'S NEW VALUE-CREATING ENGINE

CONTENTS

INTRODUCTION AND KEY INSIGHTS

For more than two years now, the automotive industry has been intensively discussing four disruptive and mutually reinforcing major trends – autonomous driving, connectivity, electrification, and shared mobility. These ACES trends are expected to fuel growth within the market for mobility, change the rules of the mobility sector, and lead to a shift from traditional to disruptive technologies and innovative business models.

Artificial intelligence (AI) is a key technology for all four ACES trends. Autonomous driving, for example, relies inherently on AI because it is the only technology that enables the reliable, real-time recognition of objects around the vehicle. For the other three trends, AI creates numerous opportunities to reduce costs, improve operations, and generate new revenue streams. For shared mobility services, AI can, for example, help to optimize pricing by predicting and matching supply and demand. It can also be used to improve maintenance scheduling and fleet management. These improvements through AI will play an important role for automotive firms because they enable them to finance and cope with the changes ahead of them.

One expected key result from the ACES trends is a marked shift in the industry's value pools. This change will primarily affect large automotive original equipment manufacturers (OEMs) and their business models, but the impact will be felt throughout the industry and beyond. The products and services made possible by the ACES trends will not only impact the business of all incumbent and traditional industry players, but will also open the market up to new entrants. Many companies that were previously focused on other industries, e.g., technology players, are heavily investing in the ACES trends and the underlying key technologies. As a result, a new ecosystem of players is emerging. New players will be important partners for traditional automotive companies. While automotive OEMs can use new players' technology expertise to unlock value potential from AI, new players will have opportunities to claim their share of the automotive and mobility markets. To master the ACES trends, OEMs need to invest substantially into each of the four ACES – not just in their development, but also in their integration.

Against this backdrop, this article – which is a continuation of our work[1] on AI in the automotive sector and the insights of which are based on a multipronged methodological approach (see text box 1) – first maps the AI-enabled value opportunities for automotive OEMs along the three application areas of process, driver/vehicle features, and mobility services (Chapter 1). The second chapter breaks down and quantifies these opportunities in terms of process-, driver/vehicle- and mobility-services-related opportunities. Finally, the third chapter outlines the strategic actions that OEMs should take to fully capture the AI-enabled value opportunities in both the short and long term.

1 Cross-reference "Smart moves required – the road towards artificial intelligence in mobility" (McKinsey, September 2017) and "Smartening up with Artificial Intelligence (AI) – What's in it for Germany and its Industrial Sector?" (McKinsey, April 2017).

Our analyses yielded the following key insights, which will be explained in more detail in the course of the report (for details on our sources and methodology see text box 1 and the appendix):

- In the short to medium term, there is a substantial industry-wide AI-enabled value opportunity, which by 2025 will reach a total accumulated value potential of around USD 215 billion for automotive OEMs worldwide. This corresponds to the value of nine EBIT percentage points for the whole automotive industry, or to an additional average productivity increase of approximately 1.3 percent per year[2] – a significant value to boost the industry's regular ~2 percent annual productivity aspiration. Most of this value is derived from the optimization of core processes along the value chain.

- Even in the short term, AI can lead to efficiencies and cost savings across the entire value chain and can create additional revenues from vehicle sales and aftermarket sales. Most of the value is generated through four core processes. In procurement, supply chain management, and manufacturing, efficiencies lead to cost savings of USD 51 billion, USD 22 billion, and USD 61 billion respectively. In marketing and sales, AI-based efficiencies both reduce cost and generate revenue, leading to a total value potential of USD 31 billion for this process.

- While AI-enabled driver vehicle features and mobility services can generate substantial industry-wide value in the long term, these features and services only create limited value on the industry level in the short term. Nevertheless, generating value from these features and services is important as individual OEMs that outperform competitors with their driver/vehicle features and mobility services can gain substantial market share. These gains in market share by technology leaders are, however, small compared to the risk of losing a significant part of the customer base for OEMs that are falling behind on these features.

- Four key success factors enable OEMs to prepare for the AI transformation and to capture value from AI in the short term: collecting and synchronizing data from different sources; setting up a partner ecosystem; establishing an AI operating system; and building up core AI capabilities and a core AI team to drive the required transformation.

- OEMs need to begin their AI transformations now by implementing pilots to gain knowledge and capture short-term value. They should then establish the AI core to develop an integrated view on AI across the organization. Finally, this will enable OEMs to scale up and roll out an end-to-end AI transformation to systematically capture the full value potential from AI and build up capabilities for their long-term ACES strategies.

2 While this value is generated around the automotive OEMs' business, not all of this value can be exclusively captured by OEMs because other players, including suppliers, system integrators, and tech players, will try to capture some share of the value. Fierce competition between automotive OEMs may also result in some of the value being passed on to customers. In addition, some investments are required for the initial implementation of AI use cases and some (comparably low) costs arise for the operation of machine learning (ML). Nevertheless, we expect that automotive OEMs can capture the largest share of the potential value

Text box 1: How we derived insights – sources and methodology

Our main sources include

- The McKinsey "Auto 2030" market model, which is based on scenario-tested development of the disruptive ACES trends
- More than 100 discussions with AI experts, mobility executives, and functional experts on areas including manufacturing, supply chain management, sales and marketing, and IT
- Relevant market reports on digital disruptions, AI, and automation as well as annual reports from all major automotive OEMs
- More than 15 analyses on specific industry perspectives, e.g., how OEMs are investing their resources and what margins can be achieved

How we derived the value potential

We developed a use-case landscape along the entire value chain and quantified all major use cases by identifying the status quo for a typical OEM as well as the target state for full AI application. Estimating differences in costs or revenues and margins then yielded the value potential (further details on the methodology used are provided in the appendix).

The following is an example for the important overarching manufacturing use case, "in-line quality control", which is relevant for stamping, body shop, paint shop, powertrain, and final assembly (with some variations between these manufacturing steps):

Status quo at a typical OEM

- Quality control is partly carried out by machines, partly manually
- Manual quality control often has a low detection rate for smaller issues
- If a quality issue is detected, a manual intervention is required
- Limited learning can be taken from issues detected as there are multiple interdependent parameters and operators typically do not know how or which parameters to optimize (making changes is too risky)

Target state required for fully capturing the value opportunity

- Continuous in-line quality control for automatic detection and high-accuracy detection of quality issues, for example by recording video, sound, and process parameters
- Improved manufacturing processes based on the incorporation of feedback from the detection of issues affecting quality, and therefore a large reduction in quality issues

Why AI is required:

AI is required for analyzing previously unavailable or indecipherable data (e.g., video or sound which previously could only be interpreted by humans), in order to detect quality issues. AI also has the ability to help detection and analysis mechanisms, improve its own accuracy by continuously learning from the issues detected, and optimize manufacturing processes by incorporating feedback and adjusting the control parameters accordingly.

EXAMPLE QUALITY CONTROL USE CASE

Impact

Reduction of personnel costs, rework, and scrap yielding a total cost reduction of approximately 9 percent in the corresponding parts of the value chain, which corresponds to approximately USD 29 billion.

1. MAPPING THE NEW LANDSCAPE OF VALUE OPPORTUNITIES FOR AUTOMOTIVE OEMS

AI-enabled value opportunities (for details on AI see text box 2 on pages 13,14) for OEMs are emerging within three application areas:

- **Processes** along the OEM value chain and its functions
- **Driver/vehicle features** integrated into the vehicle
- **Mobility services** representing new business models within the mobility market.

However, as there are important application-area-specific differences between the value opportunities, in the course of this study we will primarily differentiate between two types of value opportunities:

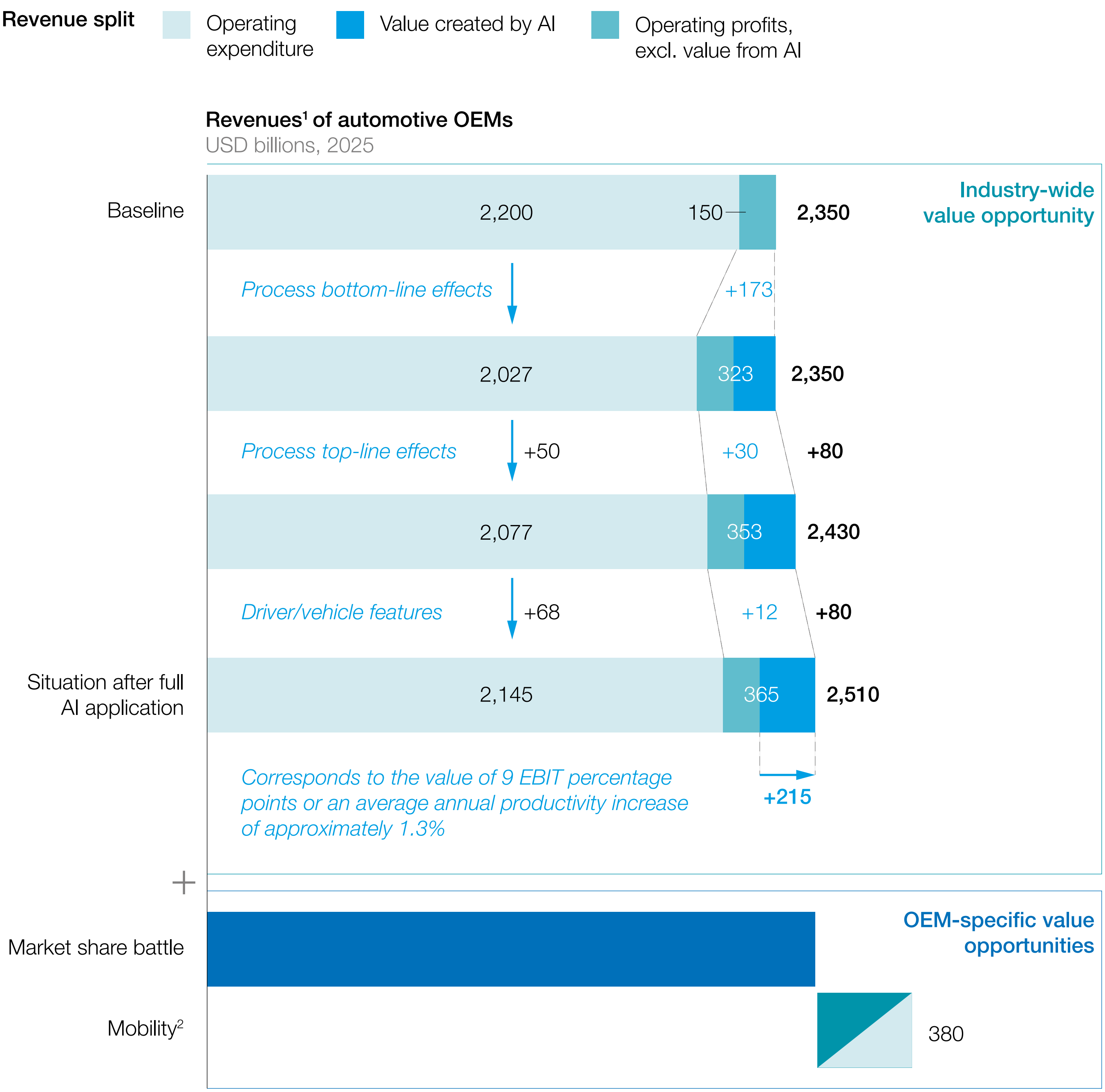
Industry-wide value opportunities. This is an accumulated industry effect that can be achieved by OEMs irrespective of their competitors' performance. In the short to medium term, the lion's share of the value potential in this category comes from processes. AI will enable OEMs to collectively improve their performance, specifically by making improvements in processes and by generating additional sales and revenue from new driver/vehicle features, such as advanced driver assistant systems (ADAS) or autonomous driving (AD).

OEM-specific value opportunities. The value of AI use cases in this category accrues only to individual OEMs and is based on the OEMs' potential to outperform competitors. For single OEMs, there will be opportunities to outperform competitors in two ways. First, OEMs can focus on gaining market share by, for example, offering a superior digital customer experience. Second, OEMs can target an increase in revenues and/or improvement of margins by participating more actively in the emerging mobility market.

Exhibit 1 illustrates the achievable revenue and the value that is generated along the application areas, with a differentiation between bottom-line and top-line levers for processes in 2025. For the developing mobility market, only the overall revenues were quantified, but not the specific value from AI. Overall, our model predicts a value potential of USD 215 billion in 2025, which is equal to the value of approximately nine EBIT percentage points on an industry level or to an additional average productivity increase of approximately 1.3 percent per year – a significant value to boost the industry's regular ~2 percent annual productivity aspiration.

Exhibit 1

AI-enabled process optimization will drive industry-wide value until 2025, while AI-based driver/vehicle features are levers for individual OEM competitiveness



1 From vehicle and aftermarket sales, excl. other business segments, such as financial services

2 Market size for the entire mobility market, e.g.,including companies that are not automotive OEMs but rather specialized on car rental or ride sharing services

SOURCE: McKinsey

Importantly, the value from processes is mostly accessible in the short to medium term, whereas the industry-wide value from driver/vehicle features and mobility services is limited in the short term but rises significantly in the medium to long term (Exhibit 2).[1]

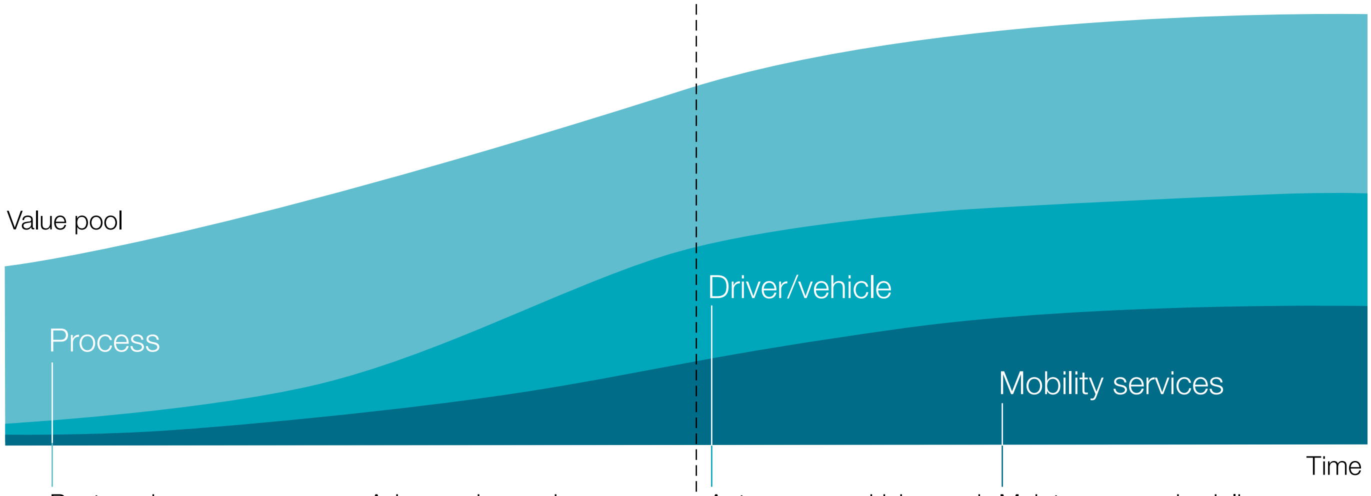
Exhibit 2

Contrary to value from processes, the lion's share of value from driver/vehicle features and shared mobility can only be captured long term

ILLUSTRATIVE

Short to medium term
Savings from process optimization are necessary to invest in driver/vehicle features and mobility services

Long term
Potential from driver/vehicle and shared mobility services is only realized later, while process optimization value can be captured early and only grows slowly



Process:

- Postpurchase cross- and upselling
- Predictive maintenance in manufacturing
- Automated prefilling of invoices
- In-line quality control
- Automated documentation of product data across its lifecycle
- Virtual prototyping and testing
- Advanced spend intelligence
- Programmatic advertising
- Predictive service recommendations
- Automated guided vehicles and indoor navigation
- Next-product-to-buy prediction in sales
- Data-driven design-to-value

Driver/vehicle:

- Autonomous driving and ADAS features
- Personalized offers based on unique customer ID
- Voice control in vehicle
- Next-generation navigation

Mobility services:

- Maintenance scheduling and advanced fleet management for shared vehicles
- Optimization of vehicle pick-up and drop-off locations
- Dynamic pricing to best determine price for each ride
- Customer-ride allocation
- Robo-taxi routing based on traffic flow predictions

SOURCE: McKinsey

Despite the two different time horizons for capturing the respective value opportunities, it is important that OEMs begin to invest in driver/vehicle features related to AI, e.g., autonomous driving or connectivity features, and build up competencies to leverage AI applications for the successful operation of mobility services. In addition, capturing value along the processes is crucial for OEMs to finance the significant investments that are required over the next five to ten years to generate value from driver/vehicle features and mobility services in the long run.

1 It is currently difficult to precisely forecast the value that will be generated from driver/vehicle features and mobility services in the long term, but we expect this value to increase substantially.

Text box 2: The nomenclature of artificial intelligence (AI)

For the purpose of establishing a shared understanding, we are defining various AI-related terms as they are used in this report. Most of the technology we are looking at in this report is based on machine learning.

Artificial intelligence (AI) is intelligence exhibited by machines and systems, with machines mimicking functions typically associated with human cognition. There are three levels of AI:

- The lowest level is **narrow AI,** the current state-of-the-art with existing software that automates a traditionally human activity and often outperforms humans in efficiency and endurance in one specialized area, e.g., playing board games, predicting sales, or forecasting the weather. Autonomous driving is also a case of narrow AI, albeit one with significantly higher complexity than all currently available applications.
- **General AI/human-level AI** describes the capacity of machines to understand their environment and reason and act accordingly, just as a human would in all activities across all dimensions, including scientific creativity, general knowledge, and social skills.
- **Super AI,** the highest level of AI, is reached when AI becomes much smarter than the best human brains in practically every field. Super AI systems can make deductions about unknown environments. There is much uncertainty and debate about whether and how this state could be reached, and what its implications would be.

Machine learning (ML) describes automated learning of implicit properties of, or underlying rules for data. It is a major component for implementing AI since its output is used as the basis for recommendations, decisions, and feedback mechanisms with regards to a previously unknown situation. ML is an approach to creating AI. As most AI systems today are ML-based, the terms are often used interchangeably – particularly in a business context. ML involves training algorithms on sample input data to optimize its performance on a specific task so that the machine gains a new capability.

The trained ML algorithm then uses its learning experience to better make predictions based on previously unseen data (such as recognizing a certain type of animal on an image). ML systems are mainly trained using three methods:

- **Supervised learning.** The AI system is provided with example input data that is similar to the data that the AI system should learn to predict. The data provided is labeled, i.e., the desired output is included in the data.

- **Unsupervised learning.** The input data does not contain labels, and the AI system needs to find its own metrics and categorizations based on recognizing structure in the data.

- **Reinforcement learning.** The AI system selects actions to maximize payoff based on a reward function – i.e., machines and software agents automatically determine the ideal behavior within a specific context, using trial and error to maximize their performance.

Deep learning is a branch of AI. It mainly deals with neural networks that consist of many layers, hence the name "deep." In the last years, deep neural networks have been the most successful AI approach in many areas. Deep neural networks can be applied to all three types of learning mentioned above. They work well for many pattern recognition tasks without alterations to the algorithms, as long as enough training data is available. Thanks to these properties, deep neural networks can be applied to a broad range of tasks from visual object recognition to complex simulation of product characteristics.

2. AI-ENABLED APPLICATIONS PROVIDE SUBSTANTIAL NEW VALUE OPPORTUNITIES FOR AUTOMOTIVE OEMS

2.1 Industry-wide value opportunities: applying AI to processes

Our quantification of the effect of these value opportunities on automotive OEMs shows that most value from AI technologies – i.e., approximately USD 203 billion[1] – will be found in processes along the value chain in 2025 (Exhibit 3):

- Along the automotive OEM's value chain, the largest opportunities for OEMs are around levers that impact the cost of goods sold. The largest absolute cost-reduction effects are thus found in manufacturing (15 percent improvement), procurement (4 percent improvement), and supply chain management (16 percent improvement).

- Sales and marketing also provides interesting value opportunities, partially due to a bottom-line effect through cost reduction (13 percent improvement), e.g., by using the marketing spend in a more efficient way, but mainly driven by top-line impact from additional revenue (0.9 percent increase in total revenue). This top-line impact on sales and marketing focuses on reducing the rebates that are given to customers and improving the upselling of vehicle features. Rebates can be reduced by applying ML to better understand customers' priorities and adjusting vehicle production, as well as the vehicle-to-dealer-allocation, accordingly.

To better understand exactly where and how these value opportunities are generated, we analyzed the seven main process areas within the OEM's value chain: R&D, procurement, supply chain management, manufacturing, sales and marketing, aftersales and services, and support functions, including HR, finance, and IT.

For each of these seven main areas, AI-enabled applications can create value in two different ways (Exhibit 4):

- **Data-based insight generation:** AI enables the analysis of previously unavailable or indecipherable data in order to generate new insights. These new insights are then leveraged to make processes more cost- or time-efficient. For example, predictive maintenance use cases monitor images, sounds, and vibrations from machines to predict when maintenance is required in such a way that the maintenance timing and execution can be optimized.

- **AI-based process automation:** AI facilitates the automation of tasks that could not previously be automated. This does not create new insights, but does reduce the need for manual labor in certain processes. For many use cases, the automation involves data that was not previously available, or was only available in a nondigital format, e.g., in paper reports. An important example of AI-based automation is the virtualization of product tests occurring during R&D processes, e.g., crash test simulations that limit the need for costly, real-life crash tests.

1 Our quantification focuses on automotive OEMs and excludes the additional value that ML can generate for external parties, such as suppliers.

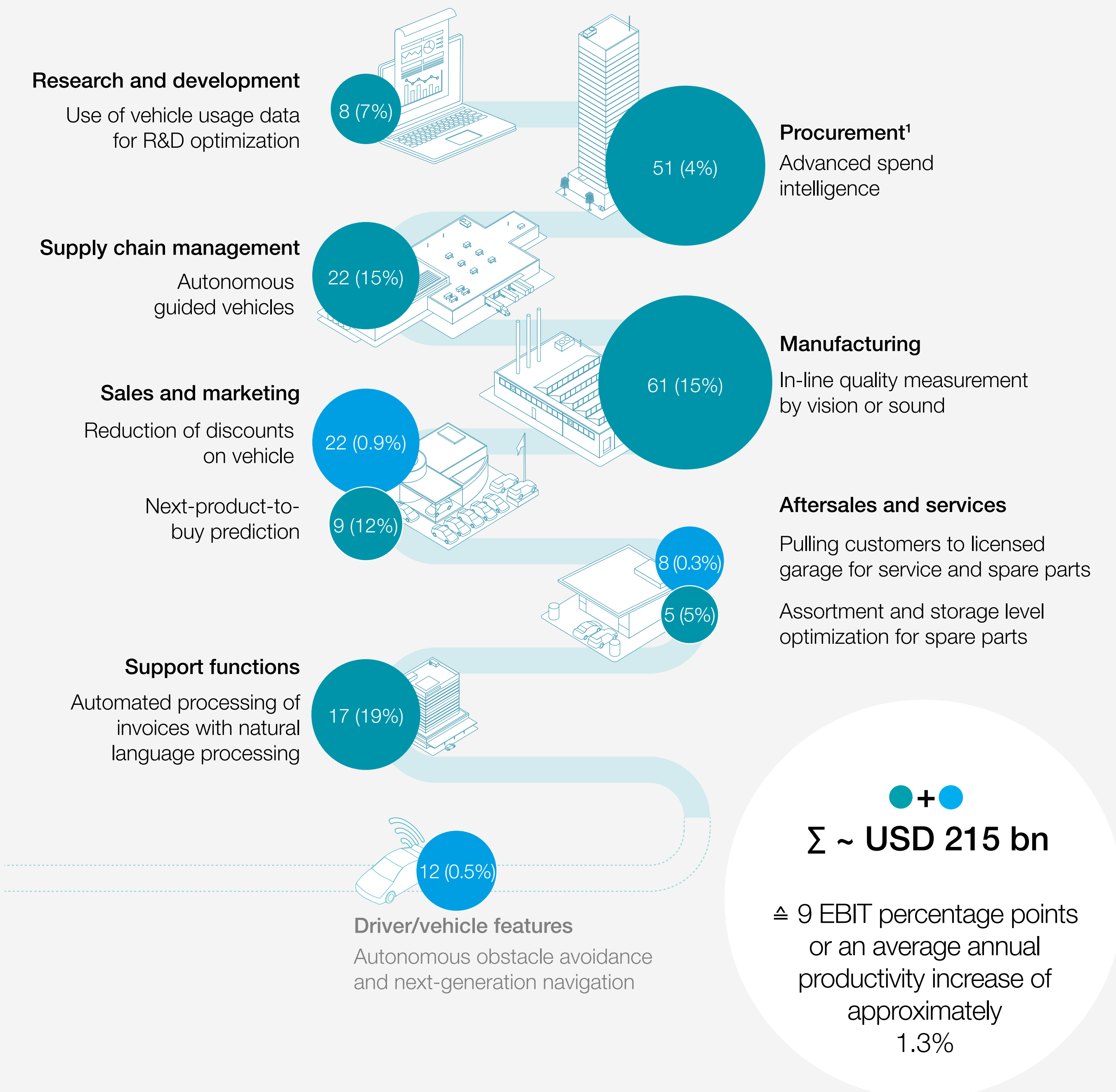
Exhibit 3

Breakdown of automotive OEMs' value pools along the value chain in 2025

Value potential from bottom-line effects
USD billions (as share of costs in corresponding part of the value chain)

Value potential from top-line effects
USD billions (as share of total revenue)

Part of the value chain
Example for optimization through AI



1 Includes direct and indirect spend

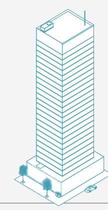
SOURCE: McKinsey

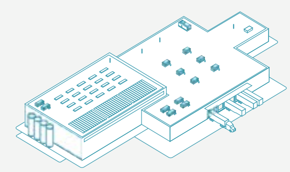
For our quantification, we collected more than 120 use cases for the application of AI along the entire value chain. Exhibit 4 shows how and where value is generated for a selection of major use cases.

Exhibit 4

By facilitating the generation of new insights and automation of processes, AI enables OEMs to capture new value opportunities at each stage of the value chain

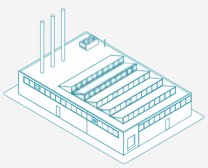
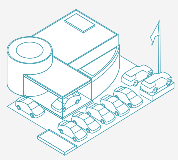
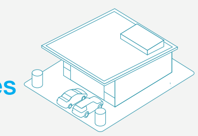
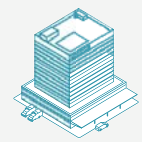
Value potential from bottom-line effects in percent of costs in the corresponding part of the value chain
Value potential from top-line effects in percent of total revenue





	Research and development	**Procurement**	**Supply chain management**
Value potential	7%	4%	15%
Data-based insight generation	R&D prioritization and performance improvement, e.g., using outcome prediction for experiments Data-driven design-to-value to improve product to customer fit Wear and tear analytics Optimization of product features to production process	Advanced spend intelligence/ analytics-based spend optimization Supplier performance scorecard Procurement organizational performance scorecards Cleansheet analysis for parts and index-based parametrization	Closed-loop planning, e.g., integrated pricing and inventory mgmt. across channels, incl. planning forecasts SC simulation and risk management Automation of warehousing based on real-time information Improved utilization of transport capacity based on real-time information
Value potential	3%	4%	7%
AI-based process automation	Automated documentation of product data across product life cycle Automated data transfer between different systems Virtual prototyping and testing Digital project life cycle model	Procure-to-pay work flow processes, e.g., by linking procurement to back-office finance Comparative document analysis to convert documents into text and perform analysis Automated compliance management	Automated guided vehicles and indoor navigation Automatic order placement and mgmt., esp. where algorithm can handle special situations
Value potential	4%	< 1%	8%

SOURCE: McKinsey

Manufac-turing 15%	Sales and marketing 12% | 0.9%	Aftersales and services 5% | 0.3%	Support functions 19%
AI-based predictive maintenance of assets through monitoring of parameters In-line digital quality mgmt, e.g., visual control for real-time process optimization	End-to-end predictive analytics for sales, e.g., build-to-stock Postpurchase cross- and upselling Programmatic/personalized marketing Cross-channel customer relationship management AI-supported lead mgmt, e.g., by providing guidance for managing customer interactions	Early recall detection and software updates Predictive service recommendations, incl. pulling customers to own/ licensed garage Assortment and storage level optimization for spare parts Remote maintenance for problems and breakdowns	Analytics of financial data and reports to enhance decisions Credit risk optimization by computation of customer risk score AI-based prediction of IT problems to minimize downtime
6%	9%	2%	3%
Advanced process control for real-time optimization Autonomous guided vehicles for intralogistics Visual quality control for final product or incoming parts	Automation of order process, from configuration to order processing and communication of delivery date Automatic placement of advertisements across channels	Automated order regis-tration, handling, and payment Optimized document mgmt. and automated processing AI-based visual inspection for 1st assessment of service effort	Automated prefilling of invoices Automation of accounts payable Automated claims mgmt Automated billing via scans or pictures
9%	3%	3%	16%

2.2 OEM level competitive advantages: customer-centric services

In contrast to process improvements, customer-centric services (driver/vehicle features and mobility services) will have a limited, short-term value impact on an industry-wide level. These services will, however, play an important role in individual OEMs' short-term ability to outperform competitors and gain market share as well as to participate in the newly developing mobility market (Exhibit 5).

Two sources provide value opportunities for customer-centric services:

- **Digital user experience and driver/vehicle features.** OEMs can increase their market share with a superior digital user interface and driver/vehicle features. The gain in market share that is typically achievable corresponds to a revenue increase of around 5 to 7 percent, depending on the type of OEM. A larger effect, however, is the potential revenue risk for OEMs that are falling behind in their digital user experience and driver/vehicle features. Depending on the type of OEM, around 60 to 70 percent of consumers state they are willing to switch their brand for better AD functionalities, and around 35 to 45 percent of consumers are willing to switch their OEM for better connectivity features (Exhibit 5).[2]

- **The emerging mobility market** presents another interesting revenue opportunity for OEMs (approximately USD 380 billion in 2025). Some OEMs will actively participate and seek to secure a large share of the new market, while others will stay focused on traditional vehicle revenue. Even though this is a large revenue opportunity, OEMs' ability to generate profits will depend largely on the operating model and the scale of their offers. ML needs to be leveraged here, e.g., to optimize shared vehicle fleet operations, but a broader shared mobility ecosystem needs to be developed by the OEMs to capture that value.

While it is clear that driver/vehicle features and shared mobility services will lead to a disruption of the automotive industry, it is difficult to predict when and how this disruption will take place. However, it is certain that in the long term, the success of automotive OEMs will depend on their ability to provide cutting-edge driver/vehicle features and to successfully operate in the shared mobility market. A retrospective look at other technological disruptions provides a perspective on the potential scope of such disruptions. For example, during the digital disruption of the travel industry between 2000 and 2014, the number of travel agencies in the United States was cut in half, whereas online hotel revenue increased more than ten times.[3] Irrespectively of when and how the disruption of the automobile sector takes place, all OEMs need to prepare by building up the required capabilities and making the right investments now.

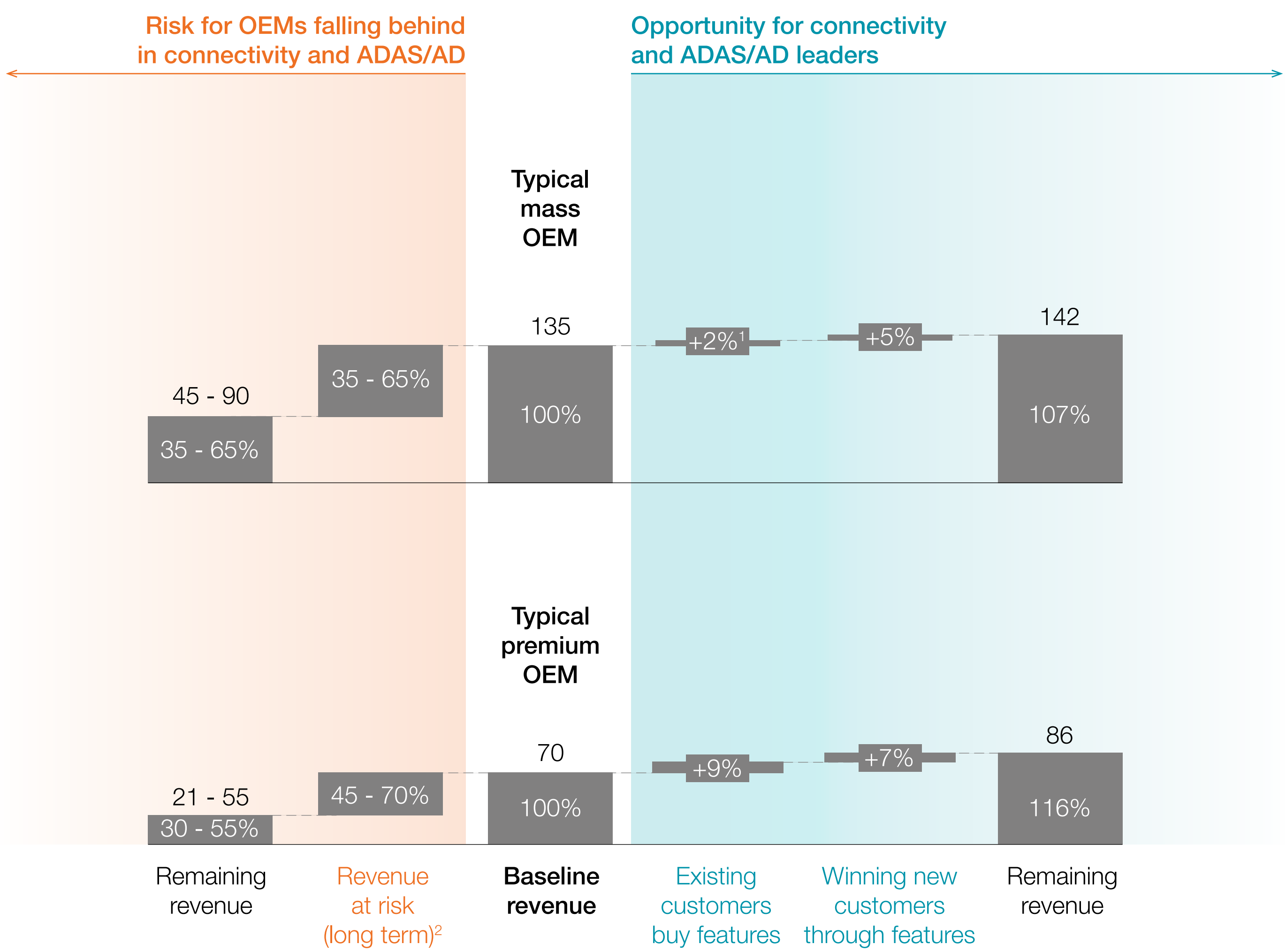
2 Cross-reference “McKinsey Connected and Autonomous Driving Customer Survey 2017”.

3 Cross-reference Phocuswright's US online travel overview and US Bureau of Labor Statistics.

Exhibit 5

In comparison to the high value at risk for OEMs falling behind in connectivity and ADAS/AD features, the potential gain for market leaders is limited

Revenue in 2025 in USD billons or in percent of revenue



1 Typical mass OEM has no level 3 ADAS/AD offer until 2025, thus, revenue comes from other driver/vehicle features
2 Ranges from McKinsey Connected and Autonomous Driving Customer Survey 2017

SOURCE: McKinsey

3. FULLY CAPTURING THE AI-ENABLED VALUE OPPORTUNITIES REQUIRES OEMS TO INITIATE AN AI TRANSFORMATION

OEMs should take immediate action in order to capture value from AI and build the necessary capabilities to provide a competitive customer-centric, long-term service offer. To capture the full value potential and lead the market, a holistic AI transformation is required. Such an AI transformation is an integrated journey that spans processes related to implementing pilots establishing the AI core, and scaling up.

However, four discrete strategic actions that represent individual success factors for OEMs on the way towards holistic transformation can be applied in the short term to get the ball rolling and to begin to capture value from AI:

Collecting and synchronizing data from different systems. OEMs need to start now to ensure available data from existing systems is collected and aggregated in a structured way. Data must be synchronized as it provides the basis for further analysis and training of ML algorithms. This includes, for example, the unique identification of data and the definition of relationships of data to each other when they come from different systems. In addition to collecting data from OEM systems, OEMs should also collect customer, vehicle, and process data from vehicles and third parties, e.g., dealer systems. More granular knowledge of driving patterns enables OEMs to optimize their shared mobility offer, improve the design of batteries and electric vehicles, or better plan and operate the charging infrastructure.

Setting up a partner ecosystem. OEMs need to build up a partner ecosystem to close knowledge gaps and to limit the investments that are needed to access the AI value pool. The partner ecosystem will likely consist of both general technology partners and specific partners for departments or particular applications, for example, in manufacturing or supply chain. Many of the partners will be new entrants to the automotive market that bring important, highly specialized capabilities to the industry. The role of each partner within the ecosystem needs to be clearly defined, which includes deciding on the type of partnership that is envisioned. Apart from strategic partnerships with a long-term focus, many OEMs will need short-term partnerships to support the implementation or operation of AI applications as well as data acquisition and setting up of a standardized AI operating system.

Establishing an AI operating system. To enable scaling across broad application areas of AI, OEMs need to define their standardized IT stack and use it as an operating system for AI applications. This encompasses all layers from infrastructure to platform and specific services and includes activities from standardizing APIs to incorporating data from different systems. The resulting operating systems speed up further implementation, increase productivity, and thus create a scalable technical backbone.

Building up core AI capabilities and a designated AI team. During the quick implementation of pilots, OEMs will be able to see which resources and capabilities are essential and, thus, need to be built up in a more strategic way. While some OEMs will develop core AI capabilities in-house to use as a powerhouse for implementation across a company's areas, others will choose to establish strategic partnerships and source these capabilities. Irrespective of the strategy chosen, however, OEMs need to ensure continuous support for implementing AI applications in all of the different departments.

These four actions can help OEMs initiate the transformation and capture early, short-term value potential. To ensure the long-term viability of their AI strategy, however, OEMs will need to commit to a systematic process that looks at AI holistically and comprises three steps:

Project character

IMPLEMENT PILOTS

Prioritizing use cases and implementing pilots quickly. First pilot use cases should be implemented quickly, as they can be an early demonstration of the type of value that AI applications are able to generate. For each main department, OEMs should define their top three AI applications and implement them in a test-and-learn logic. This allows for testing in a safe environment before large-scale rollout of AI applications.

ESTABLISH THE AI CORE

Establishing the AI core. Building upon the aforementioned four success factors for getting the ball rolling, OEMs need to develop the AI core, including a standardized data ecosystem, partner ecosystem, and core AI team. Eventually, the AI core will be decisive for applying AI to autonomous driving and shared mobility services – the areas where AI is most important to an OEM's ability to leapfrog competitors and gain market share. Based on lessons learned from the pilots, establishing a single end-to-end view of AI ensures that AI will become part of the organization's fabric, i.e., a natural habit instead of a special event.

Steady state – using AI as "the new normal"

Along the entire use case landscape, OEMs need to prioritize applications to ensure the best use of their resources. OEMs should first focus on use cases that can be quickly tested and implemented before addressing larger use cases that require long-term planning and process adjustments. Furthermore, OEMs need to hire a substantial amount of software engineers, as software becomes a more and more important part of the business. To this end, automotive companies have to create a much more attractive environment for software engineers and data scientists. OEMs need to ensure that they are seen as similarly attractive employers as technical companies, that they offer competitive wages and attractive growth opportunities for software engineers and data scientists.

SCALE UP

Scaling up and rolling out the full AI transformation. Building upon the quick pilots and leveraging the AI core, OEMs should then scale up and roll out AI applications across the whole organization. Only this will enable OEMs to fully capture the value potential of AI along their core processes. To this end and in a first step, pilots that were initially implemented in individual factories or geographies need to be rolled out globally. Then, establishing a formalized organization for AI is required, and processes should be redefined for internalizing the application of AI. Capabilities that have been built during the implementation of pilots and their subsequent scale-up need to be leveraged for driver/vehicle features and mobility services.

This three-step AI transformation strategy enables OEMs to capture the short-term value pools in processes and effectively prepare for capturing the full long-term value potential. For an individual OEM, the resources freed up in the short term need to be reinvested, and the capabilities and experience gained should be leveraged to become a technology leader in driver/vehicle features.

GETTING STARTED

GETTING THE AI TRANSFORMATION GOING BY PILOTING AND IMPLEMENTING THE FIRST USE CASES AND CAPTURING INITIAL AI-ENABLED VALUE OPPORTUNITIES IN YOUR COMPANY DOES NOT REQUIRE LONG PREPARATION OR A LARGE UP-FRONT INVESTMENT. JUMPING IN HOLDS THE BENEFIT OF PRODUCING EARLY RESULTS AND HELPING YOUR COMPANY MAKE QUICK PROGRESS ON ITS JOURNEY TOWARDS BECOMING AN ORGANIZATION THAT EMBRACES THE FULL POTENTIAL OF AI.

IF YOU HAVE NOT STARTED THE TRANSFORMATION YET, WHAT ARE YOU WAITING FOR?

APPENDIX: METHODOLOGY OF MCKINSEY'S ARTIFICIAL INTELLIGENCE MARKET MODEL

McKinsey analyzed the elements of AI in automotive and developed a three-step proprietary market model to estimate the total value pool from the OEM perspective – starting with a use case logic:

Step 1: Forecasting OEMs' revenues and expenditures in 2025 not including any potential impact from new AI applications. Revenue, operational expenditure, and capital expenditure for each part of the value chain were collected for automotive OEMs from the profit and loss statements of their annual reports as well as from other market reports. Revenues and expenditure were projected for 2025 based on expected vehicles sales and revenue projections.

Step 2: Defining OEMs' current baseline and target states. The current level of AI application and automation for each step of the value chain was assessed. Then, based on expert interviews, a use case landscape was developed, and the target state of AI adoption was derived. This allowed for an evaluation of where and how AI can bring value.

Step 3: Deriving the value potential from the delta between the target state and the current baseline. The value from AI was derived by applying different metrics based on where and how the value is generated. For bottom-line effects along the OEM's value chain, AI's value results from the potential cost saving that comes with its adoption – excluding any potential costs related to the implementation and operation of AI. For top-line effects, the value potential is driven by the additional revenues that can be generated combined with the margins that can be achieved by adopting AI. Determining the top-line effects from driver/vehicle features included an estimate of the expected adoption rates.

LEGAL NOTICE

McKinsey is not an investment adviser, and thus McKinsey cannot and does not provide investment advice. Nothing in this report is intended to serve as investment advice, or a recommendation of any particular transaction or investment, any type of transaction or investment, the merits of purchasing or selling securities, or an invitation or inducement to engage in investment activity.

CONTRIBUTORS

Content contributors – core team

Jan Brockhaus, Senior Associate, Cologne

Johannes Deichmann, Associate Partner, Stuttgart

Jeldrik Pulm, Fellow, Cologne

Jasmin Repenning, Engagement Manager, Hamburg

Other content contributors

Knut Alicke, Partner, Stuttgart

Michele Bertoncello, Partner, Milan

Peter Breuer, Senior Partner, Cologne

Martin Linder, Partner, Munich

Detlev Mohr, Senior Partner, Stuttgart

Dennis Spillecke, Senior Partner, Cologne

Editing and layout

Jörg Hanebrink, Senior Communication Specialist, Düsseldorf

Johanna Löffler, Senior Media Designer, Berlin

Jennifer Busch, Copy Editor, Munich

Contacts

Matthias Kässer is a Partner in McKinsey's Munich office.
matthias_kasser@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

Dominik Wee is a Partner in McKinsey's Munich office.
dominik_wee@mckinsey.com

Media contact

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

A PDF version is available at: www.mckinsey.com

For more information on autonomous, connected, electrified, and shared mobility please visit:
www.mckinsey.com/mcfm

January 2018

Design contact: Visual Media Europe
www.mckinsey.com