World Economic Forum White Paper
Digital Transformation of Industries:
In collaboration with Accenture

Automotive Industry

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Table of Contents

1. Foreword

There is widespread recognition among leaders in most industries that the role of digital technology is rapidly shifting, from being a driver of marginal efficiency to an enabler of fundamental innovation and disruption.

Digitalization is the cause of large-scale and sweeping transformations across multiple aspects of business, providing unparalleled opportunities for value creation and capture, while also representing a major source of risk. Business leaders across all sectors are grappling with the strategic implications of these transformations for their organizations, industry ecosystems, and society. The economic and societal implications of digitalization are contested and raising serious questions about the wider impact of digital transformation.

While it is clear that digital technology will transform most industries, there are a number of challenges that need to be understood. These include factors such as the pace of changing customer expectations, cultural transformation, outdated regulation, and identifying and accessing the right skills – to name just a few. These challenges need to be addressed by industry and government leaders to unlock the substantial benefits digital offers society and industry.

Digital Transformation of Industries (DTI) is a project launched by the World Economic Forum in 2015 as part of the Future of the Internet Global Challenge Initiative. It is an ongoing initiative that serves as the focal point for new opportunities and themes arising from latest developments and trends from the digitalization of business and society. It supports the Forum's broader activity around the theme of the Fourth Industrial Revolution.

A key component of the DTI project in 2015 has been the quantification of the value at stake for both business and society over the next decade from the digital transformation of six industries. The 'compass' for these industry sectors is being set and it is imperative that all stakeholders collaborate to maximize benefits for both society and industry. Digitalization is one of the most fundamental drivers of transformation ever and, at the same time, a unique chance to shape our future. The World Economic Forum is committed to helping leaders understand these implications and supporting them on the journey to shape better opportunities for business and society.

In 2016, the DTI initiative will focus on the impact of digital transformation on an additional 10 industries, further deep-dives into industries from this year's project, as well as examine a number of cross-industry topics such as platform governance, societal impact, and policy and regulation.

The report was prepared in collaboration with Accenture, whom we would like to thank for their support. We would also like to thank the Steering Committee, the Working Group members, as well as the more than 200 experts from business, government and academia and over 100 industry partners who were involved in shaping the insights and recommendations of this project. We are confident that the findings will contribute to improving the state of the world through digital transformation, both for business and society.

Bruce Weinelt

Head of Digital Transformation

World Economic Forum

2. Executive Summary

Our analysis indicates that there is $0.67 trillion[1] of value at stake for automotive players and a further $3.1 trillion worth of societal benefits as a result of digital transformation of the industry up until 2025. In other words, industry stakeholders should take notice and come together to prioritize digital transformation initiatives given the potential for three times more value to be created for society than for industry.

This report considers the three key digital themes driving this change in value throughout the industry: the connected traveler, autonomous vehicles and the enterprise/ecosystem. It assesses their current state, explores the short-term and long-term impact that digitalization will have, and closes with recommendations for players in the automotive space.

The cycle of change begins with the connected and empowered consumer who is becoming more digitally conversant in all manner of electronic media. This, in turn, is driving a seismic change in all aspects of transportation and, by extension, society. It is a fact that for many, access to affordable transportation is the most important factor in lifting themselves out of poverty.

Since the days of horse and cart, people have proudly owned and lovingly cared for their analog transport machine. But digital is breaking that bond as it expands the boundaries of possibility. The smartphone, Internet, wireless and cellular communication are giving us an unending supply of conveniences and services. We expect the car to bring us the same. Now it's happening. Through the twin paths of assisted driving and self-driving, cars have features unheard of not many years ago. They park themselves, cruise hands-free on highways and with the pending arrival of full autonomy, we are approaching a time when there may no longer be 'drivers'. We will all be travelers using various forms of transportation that will be part of a seamless connected continuum coasting on roads that could be congestion-free.

People, especially the growing ranks of digital natives, see the vehicle not as a product to buy; rather, transportation is a mobility experience that might take them somewhere in a single vehicle or via multiple forms of transport. Today, there are real and substantial transportation costs. A driver in Moscow, Istanbul, Mexico City or Rio de Janeiro wastes more than 100 hours a year in congested traffic.[2] Globally, transportation causes more than 200,000 premature deaths a year from air pollution,[3] 1.25 million road deaths[4] and approximately 30% of the carbon dioxide (CO_2) emissions behind climate change.[5] Digitization of transportation has the potential to reduce many of these costs.

Digital is breaking the mold of the entire automotive value chain as it creates greater efficiencies and cost savings. The rise of industry-leading platforms, supported by the explosion in the breadth and depth of data available, accelerates and amplifies the impact that digital technologies are having. These shifts are disrupting business models for existing players, forcing them to fundamentally reconsider their businesses. To change at the pace of digital, players across the value chain will need to think about their structure, employee skills, hiring practices, how they collect and analyze data, and how they form partnerships inside and outside the ecosystem. They will need to consider their changing relationship with dealers and suppliers, and must effectively engage and maintain trust with consumers and their high expectations.

Lastly, this report raises three key questions for leaders and policymakers within the industry to consider and address:

- What incentives can cities and governments provide to prioritize self-driving and multimodal integration?
- How can the automotive industry collaborate with stakeholders in the private and public sector to save lives such as mandatory telematics solutions bundled with car sales and insurance?
- How can the automotive industry create a greater democratization of the flow of profits from data platforms, to accelerate societal benefits such as reducing fatalities and lowering emissions?

3. Industry Context

The automobile – the preeminent consumer product of the Industrial Revolution – is facing what may be its greatest moment of consumer change. This change is part of a digitally enabled convergence of accelerating technological, social and industry forces that is about to trigger an explosion of innovation in global transportation.

By its sheer size, the automotive industry has the power to continue to influence the future direction of humanity.[6] Historically, the car has become an essential means to access a middle class lifestyle in many developing countries. The industry is adjusting to a sharing society that sees transportation less as a product to buy and more as a mobility service – with the global market for shared vehicles and mobility offerings predicted to grow as much as 35% a year through 2020.[7]

"It doesn't make sense to be a car manufacturer anymore. I need to give you an integrated solution for your mobility." –Giuseppe Moder, Digital Marketing and Customer Relationship Management Director, Fiat Chrysler Automotive

The industry's traditional value chain of original equipment manufacturers (OEMs), suppliers, retailers and the aftermarket has been disrupted by new, digitally astute entrants in both the existing and extended value chain. New technologies have propelled business model innovations that have challenged and extended the standard value chain in offering new products and services to the consumer, as seen in Figure 1.

Figure 1: Automotive industry key segments

The digital trends have led to a growing relevance of new entrants in traditional segments and creation of new segments

Preliminary

Non-Exhaustive

Major Industry Participants – New

	Tier 1 Auto Suppliers	Auto Manufacturers	Retailers	Aftermarket	Nontraditional Industry Segments: Connectivity and Media	Nontraditional Industry Segments: Mobility on Demand
Traditional Peers	Bosch, Continental, Denso, Magna	Toyota, Daimler, Ford, Honda	Penske Automotive, Group 1 Automotive, Imperial Holdings, Inc.	Advance Auto Parts, GPC, LKQ	• Traditional Radio Broadcasting • Stored Media (CDs, USBs)	• London Black Cabs • Yellow Cabs • Radio Taxis • Hertz Car Rentals
New Entrants[5]	Windows Embedded, here, Mobileye	Google, Apple, Cruise, Faraday Future	Tesla, TrueCar, edmunds.com	eBay, Amazon, USAutoParts	Spotify, AT&T, Apple, T-Mobile, orange	Lyft, Uber, Hertz, BlaBlaCar
New Business Opportunities	• Growing relevance of digital components for features of interaction, connectivity and automation	• Digital companies • Creating self-driving cars • Converting regular cars into self-driving • Creating 3D-printed cars	• B2C retail witnessing rise of online portals offering reviews, comparisons and other information to guide purchase behavior	• E-commerce substituting traditional channels • Advent of preventive and at-your-doorstep services	• Media and Connectivity providers creating a customized in-vehicle digital ecosystem	• Transport services shifting mindset around vehicles as services to be consumed vs. products to be owned

Note: Most of the new entrants do not have a significant scale of business and the level of available financial reporting to be quantitatively represented in the profit pools

Source: Accenture Analysis

a. Market trends

This ecosystem has been put into a constant state of flux by three global macro trends that are disrupting the traditional market and competitive boundaries:

Urbanization: City populations are booming. For the first time in history, more than half of the world's population live in urban areas. Currently standing at 3.7 billion, this number is predicted to swell to 66% by 2050[8] – with 90% of urban growth set to take place in the developing world.[9]

Urban consumers are more sophisticated, more demanding and more digitally engaged in how they live, work, buy and communicate. They put a far greater premium on mobility. According to a study by Arthur D. Little and futurelab, currently, 64% of all travel is made within urban environments and the total amount of urban kilometers traveled is expected to triple by 2050.[10]

Urban mobility, along with connectivity and the demand for an array of digital channels of services and information, will dominate the future of the automotive industry. The products and business models required to succeed within this environment are yet to be determined.

In seeking to manage these rapidly growing urban environments, many municipalities around the world are increasingly regulating how their citizens move through the dense urban landscapes via congestion pricing and access restrictions. This rise in municipal regulation and the focus on congestion management has significant implications for the automotive industry as a whole, and for consumers who move through these environments on a regular basis.

Shifting global population dynamics: The global population is growing, ageing and evolving. From 7 billion today, the number of people on the planet is set to hit 11 billion by 2100.[11] Between 2000 and 2050, the proportion of the world's population over 60 years old will double from about 11% to 22%.[12] Roughly 2 billion of the world's young people are digital natives,[13] and by 2030, an estimated 3 billion people are expected to enter the middle class, mostly in emerging markets.[14]

The demographic and geographic source of profits in the automotive industry has followed many of these trends. In 2013, people aged 55 to 64 became the age group most likely to buy a new car.[15] Following this trend, the BRIC (Brazil, Russia, India and China) markets, which accounted for 11% of global sales in 2002, jumped to approximately 35% in 2012.[16]

These continuing demographic changes mean it is critical to understand and anticipate consumer needs, aspirations and behaviors. The traditional markets of North America, Europe and Japan will remain important; however, understanding and capturing the value of emerging markets will be a prime differentiator.

Rapid expansion in global connectivity: Most dramatically, the world economy is transforming into a digital economy with a proliferation of cloud computing, big data and analytics, mobility and broadband connectivity, e-commerce, social media and the use of smart sensors and the Internet of Things.

With 7.2 billion gadgets and more mobile phones than people,[17] the world has never been this connected. By 2020, there will be more than 28.1 billion connected devices.[18]

The challenge for the automotive industry will be to adapt, thrive and stay relevant in this environment of flux. New thinking, flexibility and speed will be called for to match the pace of onrushing digital and demographic changes. How, for example, do you design a car so that its longer lifespan can accommodate the short life cycle of the digital technologies within it, such as field-programmable gate arrays (FPGAs) and radio frequency identification (RFID), to meet both the fickle and predictable demands of the consumer?

b. Digital transformation context

In nearly every sector of society and commerce, the digital revolution has turned long-standing business models upside down. When automotive was the new cutting-edge industry of the day, it too brought disruptive innovations to market such as mass production and the assembly line. While there have been huge developments in safety, build and performance in the past 100 years, there haven't been the astonishing products or breakthroughs like we've seen in the

technology sector. Digitization will drive more innovation in the automotive industry in the next 20 years than there has been in the past 100 years.

The digital transformation of the automotive industry is, in effect, the innovative reassembly of customer and company resources, and of products and services, in order to grow value, revenue and efficiency via digital technologies.

The speed of this transformation is governed by the advances in connectivity technology, changes in consumer behavior, the emergence of new business models, and by environmental trends and regulatory practices. The impact has been seen mostly in the aftersales stage of the value chain. However, digital is also having a significant transformational impact on R&D, procurement, assembly, marketing, parts and services. In the parts segment, 10 to 15% of all global revenue will be generated online by 2025, and for parts and service retailing, China will be the most attractive market for revenue growth in digitization.[19]

This digital transformation of the automotive ecosystem has also allowed a number of nontraditional, technology-based companies to enter at various points along the automotive value chain. This presents a growing challenge to the business models of OEMs and all entities along the traditional value chain.

Driving this change is the rise of digitally enabled and empowered consumers who increasingly demand that their vehicles provide the same level of digital utility and capability they have grown accustomed to in their electronic devices. Today's consumers live in a world of instant gratification. They expect products and services when and where they want them, 24/7. To them, transportation is not only a means to get somewhere but also an experiential and emotional journey enhanced by sophisticated user interface platforms giving them instant access to transparent data, augmented by a boundless array of social media and entertainment services. Meeting these demands is a particular challenge for an industry that throughout its existence has been focused on creating hardware products rather than delivering software solutions. Many travelers have experienced the frustration of looking up a destination on their mobile device – quickly and easily – only to have to do so again through an in-vehicle navigation system, in a much slower and more painful process.

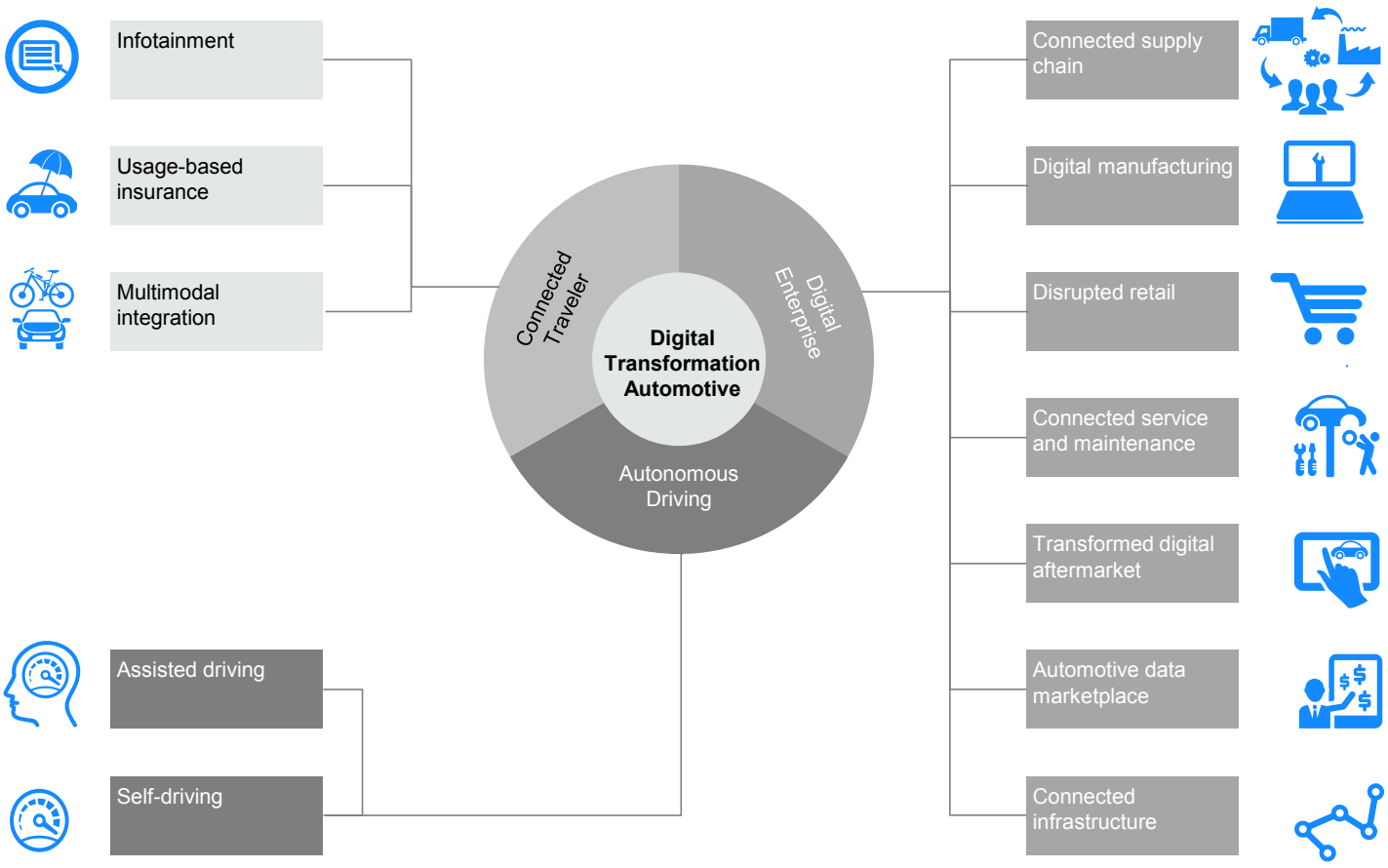
Players in the industry must also respond to fundamental consumer expectations around security and data privacy. The ability to manage and secure consumer data is a challenge faced by most industries in this increasingly digital world. However, the safety concerns associated with securing not only the customer's data, but also the physical vehicle and the transport experience lend a magnified importance to these concerns. Moving from selling a vehicle to providing individualized smart mobility services is forcing the industry to work well outside its comfort area, and the business models and routes to market success remain contested and unclear. This is underscored by the headlined triumphs of 'friendly' hackers. General Motors (GM), for example, has had to fix a software vulnerability in its OnStar RemoteLink iOS app after hacker Samy Kamkar built a device to allow an outsider to take over several vehicle functions. "It's a wide-open field," Kamkar says. "The carmakers are new to this."[20]

4. Future Horizons

We have identified three key themes in which the future of digital value will manifest itself within the automotive industry. These will be explored in this section:

- Connected traveler
- Autonomous driving
- Digitizing the enterprise and ecosystem

Figure 2: Digital themes and initiatives



a. Connected traveler

"Twenty-five to thirty years ago it was seats, the steering wheel, stereo…There wasn't a lot of value in the interior cabin area. Move forward 30 years... good chance up to half the value of the vehicle is electronic content." –Michael Robinet, Managing Director, HIS Automotive

The vehicle has evolved into a sophisticated computer-driven machine and is now becoming a digital hub for real-time two-way wireless data transfer. The human and the vehicle are moving toward total connectivity among devices, databases and objects: between vehicles, traffic and municipal services through sensor-embedded roads and infrastructure; and between entertainment and navigation services connected with any of the myriad of mobile devices embedded in the vehicle or in the hands of the traveler. By 2020, more than 90% of cars sold will be connected.[21]

Yet wireless communication, data analytics and cloud computing are relatively new technology areas for automotive players. This places them at a significant disadvantage compared to technology-centric companies such as Google and Apple, which have deep expertise, capabilities and even ownership in these technologies. These non-automotive players have also developed durable consumer relationships, especially with the important younger demographic. Further compounding this gap, historically, OEMs are unused to owning the customer relationship (including vast amounts of customer data), as this was traditionally done by independent third parties – the dealers.

Case study

Apple knows that consumer needs drive innovation. It has integrated those needs into every aspect of its operation and can now anticipate and even lead customer behavior. Apple has also become an expert in automotive-centric activities. Through OEM partnerships, Apple's CarPlay software gives drivers wireless access to certain iOS features directly from the vehicle's built-in infotainment system.[22] Consumer familiarity with proprietary technology company ecosystems might influence vehicle purchase behavior. Apple continues to absorb and channel more of the relevant, connected in-vehicle customer experiences to itself, while leaving less-engaging aspects to the automakers and other suppliers.[23]

Infotainment

Automotive infotainment technology has seen dramatic advances in recent years. OEMs are moving away from proprietary software to open-source systems and more mobile-friendly platforms, and they are collaborating with more partners.

Infotainment is also evolving into both a location-based and condition-based service where products and services come to passengers based on where they are, who they are with and what their preferences are. Along with multimodal integrated services, another digital initiative under the connected traveler theme, location-based services can give customers end-to-end intelligent route planning across all modes of transportation, both automotive and non-automotive.

Case study

Jaguar Land Rover has introduced self-learning intelligent cars to its range of vehicles. Designed to limit distractions and provide a personalized driving experience, the system learns driver and passenger behaviors, needs and preferences. Integrating with the users' mobile phones, it can change comfort controls, entertainment choices, offer calendar reminders and navigation guidance.[24]

Imagine a world where Monique comes out of the gym and heads to her car. The fitness wearable on her wrist reports a heart rate of 120 beats per minute and a body temperature of 102°F. The car accordingly pre-cools its inside air and chills the seat. Because it is connected to her refrigerator at home, the car knows she is nearly out of her favorite fitness drink. She is notified that her vehicle is approaching a grocery store, and the store then offers her a discount coupon on that very drink.

While these location- and condition-based infotainment systems are mostly connected car services of the future given their more complex implementation requirements, subscription-based services have already arrived. However, they are

mostly limited to security and safety features such as roadside assistance. In 2013, the satellite radio subscription company SiriusXM acquired Agero's connected vehicle services and will provide security, remote access and system monitoring services in select 2016 Nissan vehicles.[25] Globally, the number of new cars with these features factory-installed is expected to grow from 11.5 million in 2013 to 50.8 million in 2018.[26] While some perceive significant opportunity for growth in the subscription-based services market, opportunities for automotive players to capture growth outside of security and safety is limited because many services already come to the consumer at no charge through smartphone apps.[27] Industry participants must carefully consider how they participate in this crowded market, and consider how to create new, differentiated sources of value based on unique insights from their data, supported by the rise of new ecosystems around service delivery.

Value at stake: By 2025, we predict advancements in infotainment will add $65 billion of operating profits to the overall industry value chain. This will largely be a result of infotainment hardware unit sales ($41 billion) growing at a compound annual growth rate of 4% from 2016 to 2025. OEM-driven applications and services are expected to contribute $14 billion in value creation as connected head units grow from approximately 23% of the market in 2016 to roughly 70% of the market in 2025. In contrast, we anticipate the user adoption of mobile-based and third-party applications from outside the automotive industry to create approximately $10 billion in value. Significant usage of free applications, particularly in mass market vehicles in emerging markets should limit the monetization potential of the service ecosystem.

Usage-based insurance

The world's major insurers are already adapting to the expanding digital universe, modifying and customizing policies based on individual driving behaviors. Many in the industry now use telematics – onboard wireless sensors that transmit driving information. While participation is voluntary, robust incentives for good drivers, through pricing discounts and other offers, make this a compelling consumer proposition. If they keep to the posted speed, don't accelerate quickly and limit their driving, they will be rewarded. This performance- or usage-based pricing is in addition to newly emerging peer-to-peer insurance programs and pay-as-you-drive policies.

Case study

Marmalade, an insurer in the United Kingdom, is exploring new frontiers in car insurance. It provides full comprehensive temporary policies for young learners. The policy includes a plan to provide feedback based on data transmitted from the telematics 'black box' to help the student drivers improve on their ABCs (accelerating, braking, cornering and speed).

Case study

Friendsurance, a German insurer, developed a peer-to-peer insurance product that leverages social media. Up to 15 Facebook friends buy a policy together. The group agrees on a limit to pay minor claims. Friendsurance covers anything that exceeds the limit and rewards the group if no claims are filed. This lowers administrative costs and, because your friends are partially covering you, it is expected there will be fewer fraudulent claims. The company says its prices are as much as 70% lower than market rates.[28]

The spread of digital within the automotive industry will make it easier for insurers to pull vehicles into their own repair networks. This has major implications for the business models of authorized dealers and OEMs if non-OEM parts are used in the repair process. Increasingly, both dealers and OEMs are focused on the extended relationship with the customer through building robust relationships in servicing vehicles and this risks disrupting this vital relationship.

Moreover, vehicle insurance may be completely upended by the connected ecosystem. Today, crash avoidance technology in assisted driving vehicles is lowering accident rates, and by the time autonomous cars operated by artificial intelligence (AI) reach critical mass, accident rates are likely to plummet. Globally, crashes kill 1.25 million people a year, injure 20 million to 50 million, cost $518 billion and are predicted to be the fifth leading cause of death by 2030.[29] The insurance aspects of this transformation are not fully clear. What is clear, however, is that a liability shift will take place. Instead of driver behavior, coverage will be placed on a car's manufacturer, the software designer, device maker,

map producer, the company that made the sensors in the highway or the vehicle, the operator, the passenger or the vehicle's owner.[30]

Insurance will need to adapt to the circumstances of driving – the specific patterns of the driver, how many passengers or customers are in the car, the purpose of the car (commercial or private), how passengers are insured, and the influence of assisted driving, where computer programs take over a number of tasks.

Who is covered and for what? The answer will be based on digital data, but this raises other questions. Who owns that data and who controls it? Is it the driver, the vehicle owner, the insurance company that installed the telematics device or the manufacturer of the device? Regulators will be in the midst of developing the answers and will have a large influence on the safety aspects of the digitization of vehicles.

Value at stake: We anticipate that incentivizing better driving behavior has the potential to generate $381 billion in economic benefits to consumers and society from reduced premiums and reduced crashes by 2025. We estimate the adoption of the service to grow from 4% of key markets in 2016 to 30% by 2025. Discounts to the subscribing population could range from 10 to 15% of premiums, as in a competitive market we expect 90% of cost savings by insurers to be passed on to consumers in the form of premium reductions. Over the next 10 years, 158,000 lives could potentially be saved as one could expect up to 5% reduction in potential crashes by 2025 due to better driving practices.

Multimodal integration

Multimodal connected transportation links all forms of road, rail and ferry travel, walking, cycling, all manner of automobile driving, public transit and the seamless connectivity among the modes. It brings together OEMs, automotive and non-automotive suppliers, and government planning, tax and regulatory entities. Full-scale multimodal integration would create significant social and environmental benefits. One outcome would be more efficient traffic management and less congestion. Urban areas could become more livable, with existing parking lots being repurposed since fewer of them are required. Urban planning and municipal investment would shift to better serve citizens. Less pollution and shorter commutes would enhance quality of life. An integrated multimodal transportation network could also greatly improve urban neighborhoods. Studies from both Harvard and New York University[31] on upward mobility found that in terms of cost and time spent by individuals in poorer communities, transportation can be the single largest factor in escaping poverty. An integrated multimodal network would lower costs for everyone while greatly expanding transportation access and increasing the options available to travelers.

Multimodal integration is expected to roll out over a longer time horizon, as a complex set of interdependencies and partnerships need to be established before an individual can have a seamless multimodal experience on a global scale. We are seeing the explosion of different players exploring various required capabilities to make multimodal integration a reality. Current small-scale pilot programs have proven the viability of the concept, but scaling this further will require new partnerships to be created along with the development of advanced application program interfaces (APIs) linking the various operating systems.

Some of these advantages are only now emerging in municipalities where multimodal integration is being tested.

Case study

In Gothenburg, Sweden, 70 paying households have been using a service called **UbiGo**.[32] The single smartphone app provides access to public transit, car sharing, rental cars, taxis and bicycles. People get a single invoice and receive discounts when they use sustainable modes. Early results for this pilot program are promising. The vast majority of participants want to remain UbiGo customers. To make this concept a reality, a variety of players had to come together to create the infrastructure and build the range of services provided. Key partners are AB Volvo, Ericsson and the Viktoria Institute.

Value at stake: We estimate an aggregate benefit of $975 billion over the next 10 years to consumers as a result of multimodal integration. Consumers with low utilization of private vehicles will give up car ownership for cheaper multimodal solutions. We estimate that there will be up to 11% of annual potential vehicle sales impacted by 2025. Consumers will not just save on the cost of ownership but also realize time savings in situations where they do not drive

themselves. In addition, $274 billion of societal impact is driven through time savings, reduced congestion, fewer crashes and lower emissions.

b. Autonomous driving

"I think it's just going to become normal. Like an elevator. They used to have elevator operators, and then we developed some simple circuitry to have elevators just come to the floor that you're at, you just press the button. Nobody needs to operate the elevator. The car is just going to be like that." –Elon Musk, Chief Executive Officer and Product Architect, Tesla Motors[33]

The driverless car or autonomous vehicle (AV) is operated by millimeter-wave radars, cameras, ultrasonic sensors, lidar scanners, GPS technology, vehicle-to-vehicle and vehicle-to-infrastructure connectivity, and proprietary algorithms working seamlessly together to perform the entire dynamic driving task in all situations and conditions throughout an entire journey.

The potential impact? Nothing short of revolutionary. Wide-scale adoption will lead to unprecedented economic, social and environmental change. For the public, the independence and freedom of personal travel will be available to almost everyone – youth, seniors and the physically, mentally and visually impaired. The expected reduction of road congestion would bring wide-ranging work and personal benefits. The gains from a drop in vehicle accidents and deaths are obvious.

In the near term, the arrival of the AV pits the traditional evolutionary growth model of the legacy manufacturers against the riskier direct approach of nontraditional technology players.

The widespread commercial realization of AVs in the immediate future is hindered by technical constraints, legislative wariness, infrastructure barriers, unpredictable consumer acceptance and cost of development. Consequently, the production of AVs will require a full transformation of the automotive operation and its support ecosystem.

The route to critical mass adoption of AVs isn't clear. Acceptance may occur after years of incremental introductions of discrete autonomous functions, or more quickly, through the direct development of the radical new technology of autonomous driving. The major players in the market are pursuing one or both of these approaches. Technology giant Google has jumped right into producing a completely autonomous vehicle with no steering wheel. Hands-free autonomous cars are now being tested on public roads in Europe, Japan and the United States. Many OEMs are investing in both improving assisted driving capabilities and simultaneously exploring fully self-driving technologies.

Assisted driving

With each model year, new driver-assist functions become options or standard features and no longer just available on premium models. This gradually moves the driving public from the current position where we are actively 'in the driver's seat', to a new era where we are passive participants in the process of conveyance, which has become fully automated.

Case study

While saying its autonomous car is 5 to 15 years away, General Motors is continually adding assisted driving features such as crash avoidance, lane warning and automatic parking assistance.[34] In late 2016, it will begin selling its Cadillac CT6 with 'super cruise', which will make hands-free highway driving possible while the car maintains speed, lane position and vehicle separation. This kind of adaptive cruise control will later be available in mid-priced vehicles.

Assisted driving is already a reality, but the age of most vehicles on the road (9 to 11 years old) is delaying the realization of pervasive assisted driving capabilities. In the medium term, many of the assisted driving features that now exist in premium-branded cars will be more affordable and more common in mass-produced vehicles.

Advances in assisted driving capabilities are being introduced to a marketplace where there can be limited, inconsistent or unclear regulations depending on geography and differing interpretations of the rules. For governments, the priority may be to develop strong and unambiguous regulations to govern the incremental improvements in assisted driving technologies before writing the rules for autonomous vehicles.

Value at stake: We anticipate that economic benefits to consumers and society will exceed $1 trillion over the next 10 years driven by reduced accidents and lower insurance premiums. Improved vehicle safety due to advanced driver assistance systems (ADAS) and electronic stability control (ESC) installations could reduce 9% of potential crashes by 2025, and avoid 5% in additional premiums that consumers would have had to pay in the event of vehicles being less safe. More importantly, the enhanced safety has the potential to save 902,000 lives over the next 10 years by preventing fatal incidents.

Self-driving

This path has drawn intense media attention. Several technology companies are working on creating vehicles capable of navigating themselves through mixed traffic conditions on all roads and highways. Best known among the projects now in development is from Google Auto LLC,[35] a subsidiary of Alphabet and Google X. Its autonomous vehicles are racking up 10,000 miles a week[36] learning to drive on public roads. They have logged nearly 2 million miles of testing. The company says that all the accidents involving its cars (only about a dozen) were caused by other drivers. Google projects the vehicle to be released for sale between 2017 and 2020. Google is interested in not only the automotive industry for its own sake, but to defend and strengthen its core business in advertising and data revenue business models. It has courted manufacturing partners but none have emerged. Tesla is also aggressively developing electric cars that will run autonomously, and media speculation is that Apple has a project underway and may be in talks with a major manufacturer.[37]

Even as the legacy automakers are developing new driver-assist technologies, many have parallel AV projects well under way. Audi, BMW, Mercedes-Benz, Nissan and Toyota are among the players experimenting with self-driving vehicles. Volvo, which has been testing 'road trains' of robotic cars, is aiming to be first to market.

Case study

Volvo Car Corporation announced its Drive Me project as it rolls out a number of features in the driver-assist category in early 2015.[38] In partnership with the Swedish government, 100 production-ready autonomous cars will be in the garages of customers by the end of 2016. The cars will be allowed to drive on 30 miles of roads in the city of Gothenburg in what would be the first public test of a self-driving vehicle.

Self-driving vehicles are also already a reality in proof-of-concept testing around the world. However, the sheer scale and number of legislative, infrastructural and technological barriers will slow the rate of adoption. As both modes continue to advance, the number of automated vehicles will grow, but adoption rates will vary by region due to regulatory, technological and consumer differences.

"The possibility of cyber attackers to intrude in a system that is connected is much higher. The moment you connect a vehicle to the Internet, you expose it to more cyberthreats; that is a topic that needs to be addressed by automakers and policymakers but we are only at the beginning." –Andreas Mai, Director of Connected Vehicles, Cisco

Significant questions also loom with regard to consumer confidence. Can we trust computerized systems with our privacy? Are autonomous cars physical extensions of the personal data-hungry technology companies that made them? Can we trust these systems with our lives? Though the human factor is the major cause of accidents, will travelers entrust their safety to computers and algorithms? Will we have any control or at least an emergency override switch if the machine brain malfunctions? We have already seen friendly hackers (researchers and graduate students) take over connected vehicles; malicious players are certain to be lurking in the shadows to exploit the many interconnected links to penetrate and control vehicle systems. To ensure public trust and avoid high litigation costs, managing cybersecurity risks will be imperative.

Value at stake: We expect $2 billion of value migrating from traditional vehicles to fully self-driving ones and an addition of $16 billion to operating profits from higher ticket prices of self-driving vehicles and sales of self-driving add ons. We have assumed that the first commercially viable products would appear in the market by 2019. The share of annual vehicle sales contributed by self-driving vehicles is assumed to grow to 5% by 2025, with 80% of the market going to self-driving add-on packages, such as more evolved versions of the RP-1 product by Cruise. We anticipate that the

remaining 20% of the market would be captured by fully autonomous vehicles such as the ones being piloted by Google.

In addition to moving people, there is huge potential for AVs in hauling freight and logistics. More can be read about that in the World Economic Forum Digital Transformation of Industries Logistics white paper.

c. Digitizing the enterprise and ecosystem

Digitization will likely drive substantial improvements to the value chain through enhanced efficiencies, reduced costs, greater collaboration and more innovation. As OEMs seek to expand from business-to-business through their dealerships to a business-to-consumer model, there will be new ways to engage with customers, partner with suppliers and interact with data. The increasingly connected vehicle will alter business strategies from selling a product to providing a customer experience-centric value proposition.

Connected supply chain

The primary benefit from interconnecting the supply chain is cost reduction through a better managed end-to-end process. Historically, the automotive industry has maintained national and regional manufacturing and supplier relationships. The supply chain has been characterized by long lead times in a complex structure, aimed at getting the right parts into the right factories at the right time. In recent years, there has been a strategic decision to decentralize both production and the supply chain.

In addition to lowering costs, digital will drive other significant changes. In the near term, it will accelerate supply chain transparency through continued partner system integration. Data gathering and analytics will reduce the number of defects and speed up the whole process of component design, manufacture and delivery. Much of this integration will be facilitated through the cloud, where every party in the chain will be looking at the same data, thereby creating better flexibility and stability.

A decentralized and connected supply chain can reduce costs from regulations that include import duties and protectionist laws. Suppliers and assembly plants might be located in large markets such as China. OEMs are also able to make locally relevant vehicles (e.g., China's unique demand for long-wheelbase limousines) and to serve local market brand development ("Made for you and made in your country").

Social media monitoring across the supply chain can more quickly identify component quality breakdowns where a supplier rather than the vehicle manufacturer would have to redesign, rebuild and resupply a part. The exploding growth of data from the connected Internet of Things throughout the supply chain will demand new skills for workers and managers.

In the longer term, 3D printing could become a primary means of creating parts either at the main plant or point of service. It could result in the collocation of suppliers and assembly plants. This would allow for continued integration across the value chain for seamless manufacturing and fulfillment. As costs come down and quality of the final product goes up, 3D printing is bound to play a greatly expanded role in parts production.

Case study

In the spring of 2015, the Federal Aviation Administration certified the first 3D-printed part for installation inside commercial jet engines manufactured by **General Electric**. Flight tests have begun on a new-generation engine that holds 19 3D-printed parts.[39]

Case study

One of **Bosch**'s projects in development would put sensors throughout its factories and third-party logistics providers. The data would present a complete view of all shipments in transit from assembly to point of delivery.[40]

Digital manufacturing

The automotive industry has been one of the most aggressive in replacing manual labor with automation. On the assembly line, robots now work alongside humans. New-generation robots can do multiple assembly tasks. Robotics, artificial intelligence and the Internet of Things have all become part of a new industrial revolution.

Over its evolutionary cycle, the smart factory requires heavy investment in connectivity and automation, advanced algorithms for managing workflow, scheduling jobs, creating supply side and customer side information sets. Investment is also required in technologies that enable virtualization of design and testing to achieve faster time-to-market and lower physical prototyping and testing costs. Predictive asset maintenance will also more accurately anticipate and pinpoint machine and part failures.

In the smart factory, these connected and intelligent machines will accelerate operations, create flexibility in customization or retooling a line, and improve performance by lowering defect rates.

Case study

Siemens operates a small electronics plant in Amberg, Germany. In 1990, it was 25% automated. It is now 75% automated and defect rates have dropped to below 12 per million. Output has increased 8.5 times with little change in the number of employees.[41]

The primary barrier to building a smart factory is the massive capital necessary to replace the legacy infrastructure still in place in most assembly plants and the absence of a business model to justify the investment. However, the advantages from connected machines on the factory floor (speed of operation, flexibility in customization, improved operating performance, faster response to consumer demands and cost reductions) will likely, over the long term, overcome today's obstacles.

Disrupted retail

"When you consider what matters to the customer – updates, security of my data, an online persona – when you go to a car dealership, they're still trying to sell you floor mats!" –Kent Helfrich, Vice President and Chief Technology Officer, Flex Automotive

Relationships across the entire retail landscape are being altered by the digital revolution. OEMs, dealers and customers are dynamically redefining how they interact with each other, with consumers increasingly expecting a seamless experience across both digital and physical touchpoints, regardless of who they are interacting with. Customers are using the manufacturer's digital options (website, online configurator, call center, virtual agent and published online reviews) to educate themselves, comparison-shop and virtually test-drive and build their dream cars. As one industry insider says, "10 years ago, shoppers came into the dealerships to do research. Today, they already know the market and the car they want. All of that is because of the Internet."[42] Among retailers, 81% now have websites through which customers can buy goods and 75% allow for mobile device transactions.[43]

OEMs and dealers must fundamentally reconsider how they engage with customers before, during and after the sale. When and how customers interact with salespeople require different skills across the sales cycle in and out of the showroom. The paper-intensive purchase transaction will need to be digitized.

Case study

Audi's virtual showroom in London is designed to sell both cars and the Audi brand. Only four physical cars are on display. On the walls are enormous video screens on which customers can see all specifications for their chosen model. With authentic sound effects, they can open the doors, look inside and watch the car zoom away. Audi is also piloting a wearable virtual reality device that gives car buyers a first-person interactive experience. The computer program includes tens of millions of different renderings of a model's various components and features which the device wearer can see from any angle.[44]

Case study

Honda is among the OEMs in India transferring the whole purchase experience to the customer's home. For mid-priced models, the test drive, all discussion about colors and options, and the negotiation are done at the customer's home. The buyer never needs to step into the dealership.

"You're finding more and more the OEM is connecting directly with the consumer; you're buying vehicles directly from Tesla. That has been a gut-wrenching experience for the industry." –Michael Robinet, Managing Director, IHS Automotive

Some OEMs may, like Tesla, want to bypass the middleman and sell directly to the consumer. However, they will then need to consider the asset risk of forecasting demand, managing asset depreciation and dealing with used cars and trade-ins. In the United States, the federal government has suggested to back Tesla's right to bypass dealers and sell directly to consumers,[45] but state franchise laws are making this difficult for the company.[46] Similar barriers exist in other countries.

Value at stake: We estimate around $90 billion worth of operating profits migrating from traditional to digital channels open for competition among OEMs, dealers and third-party online platforms. This migration will also drive advertising and lead generation revenue streams for car comparison websites and third-party online retailers, potentially adding $28 billion to their bottom line.

Connected service and maintenance

Predictive maintenance: Increasingly sophisticated in-vehicle diagnostic systems, smart components and ubiquitous connectivity allow the vehicle and even some components to proactively signal when they need maintenance or replacement. Continuous data analysis creates new opportunities for preventive maintenance. This dramatically reduces critical, unanticipated failures and reduces the frequency and severity of recalls.

Case study

For trucking fleets, **Michelin** now leases tires and offers a tire monitoring program. Using telematics and predictive analysis, the service provides over-the-road tire monitoring. Data is collected digitally and fed into the fleet's asset monitoring system, giving companies real-time performance analysis and wear data of specific tires on individual trucks.[47]

The explosion of cheap sensors has brought down the cost of predictive maintenance and enabled next-generation servicing. Today's vehicles are already alerting drivers about service visits. As more sensors are installed in vehicles, the accuracy of the servicing will greatly improve. The implications of these data flows – be they software updates or predictive maintenance interactions – is that they provide an opportunity for OEMs to maintain their connection with the customer. This is particularly true as ownership of the vehicle changes throughout the life of the car. The second owner will be incentivized to stay connected to the OEM through both service and maintenance activities – a key priority as OEMs seek to maintain their relationship with the end consumer, not just through the purchase phase, but across the life cycle of the car.

Value at stake: We expect remote diagnostics enabled by telematics to add $60 billion of profits to OEMs, suppliers and telematics service providers. OEMs can expect to see added benefits of reduction in warranty costs for subscribers. As a consequence, dealers and independent service centers stand to lose $44 billion in operating profits over the next 10 years.

Next-generation service: Digital is changing the whole concept of servicing in how it's done and who does it. Increasingly, service is becoming not only a mechanical adjustment or part replacement but also a software upgrade, with the service technician acting more as a computer diagnostic expert.

Software improvements create performance improvements in both the overall engine and in individual mechanical systems; trouble with a clutch might be improved by software changes to computer steering components. Parts last longer and optimal performance parameters are maintained.

Case study

Instead of switches, knobs and gauges, most car functions and performance metrics in a **Tesla** Model S come through a single 17-inch touchscreen. For the driver, this digital interface reduces complexity and adds flexibility. Periodic over-the-air software updates allow some of the vehicle's original mechanical design features, including the look and feel of the touchscreen, to be upgraded to continuously meet consumer expectations.[48] Tesla is the only manufacturer providing automatic over-the-air firmware updates to allow the car to improve safety, performance and infotainment capabilities.[49]

Where will the servicing be done? For dealers, service is their primary profit center and they're going to do what they can to protect and expand this. Unless regulators step in, OEMs might release their proprietary software updates to their dealers and not third-party repair shops. With the complexities of computer code, customers could also have greater confidence in the work of a factory-authorized dealer than an independent service shop especially for major software upgrades. As software updates continue to become the norm, service may be delivered in completely different ways – pushed from the OEM over the air, downloaded on demand by the driver, or even conducted through a dealer network with a different configuration. The traditional large footprint dealer servicing centers may be replaced by convenient drive-through kiosks. As with other aspects of the connected vehicle, cybersecurity for over-the-air updates will remain a concern to be addressed.

Value at stake: We expect a potential shift of $105 billion over the next 10 years from independent service centers and smaller dealerships to high-end, authorized service centers. Loss of business through remote servicing could potentially erode $6 billion in operating profits derived from the auto servicing profit pool.

Transformed digital aftermarket

The average age of cars in the European Union is 8.6 years.[50] In the United States, it's 11.4 years.[51] In consumer electronics, older computers eventually cannot accept operating system upgrades. Will it be the same with older vehicles that have digital systems, not just in navigation and infotainment, but in mission-critical safety and performance systems? Cars now last longer. Second ownership is more common and the sale and service of used vehicles is an important revenue stream for dealers. Second owners also have expectations that all of a vehicle's systems will be current. This will take place in a transformed aftermarket where a vehicle's connected navigation and infotainment components can be upgraded. Existing aftermarket players will shift sales and services to meet this burgeoning demand for upgrades that allow the consumer to stay connected. To better facilitate software and hardware upgrades, manufacturers and suppliers will be expected to make their systems forward compatible.

In the transformed aftermarket, there will be greater price transparency. Drivers will be able to access a large amount of information about the vehicle they are buying. Vehicles will need to be designed so that their software and technology can be easily updated. This will be enabled through improvements in data analytics and more open access to data.

Value at stake: Close to $26 billion of operating profits will be at stake for parts retailers that wish to capitalize on digital channels for customer engagement. However, approximately $2 billion of operating profits could be eroded due to weaker pricing versus offline channels.

Automotive data marketplace

One of the most transformative impacts of digital is the development of a data economy. New data-driven business models have emerged across the landscape. Companies in all industries are seeking to understand what data they have and can potentially collect, what data others might have, and how they can use all this information to better serve customers and constituents. This is especially true in the automotive industry, which is one of the most data generation-intensive industries in the world – second only behind utilities. The commercial promise of more precisely targeted customer offers, new business models, and increased efficiency from data and analytics make these new businesses a veritable gold mine for automotive players. The question is not whether companies will continue to find new ways to exploit their own data and open data, but when and how.

To fully realize the commercial and social benefits of the data that is generated across the industry, industry participants need a secure and robust data market where they can come together to trade data. This will allow organizations to be

more targeted and efficient in their data collection processes, both to support their own business objectives, and to transact in the data marketplace.

This data market may develop through one of two parallel paths – either the creation of a consortium of partner organizations where multilateral data sharing agreements are in place across the partnership, or through a true data marketplace where buyers and sellers of data can meet. In both cases, companies will be able to access data from outside their organizations to gain a more holistic understanding of the customer, and use this data across their value chain – from design and production to sales and service.

We are already seeing early stages of this. For example, TransportAPI consolidates data feeds from some of the United Kingdom's transport services and makes them available to developers, which use the information to build applications that track buses or tell you where the nearest Tube stop is. Transportation infrastructure has been computerized for a long time, but what is new is making the data available publicly on the Internet.[52] Additionally, we are seeing the industry increasing its commitment to data protection. At last year's Frankfurt motor show, the European Automotive Manufacturers' Association announced a new data protection commitment that "its members intend to respect",[53] including transparency, maintaining data security and processing personal data in a proportionate manner.

Clearly, there are a host of challenges to overcome to make this a reality. Most pragmatically, companies are still grappling with the technical and architectural components to handling large and rapidly moving amounts of data (and the underlying analytics capabilities to make sense of this data). There are additional concerns over data security and customer acceptance. Regulators will need to ensure that antitrust concerns are addressed, particularly in markets where consortia are partnering to drive new product and service offerings. Lastly, this implies a very different thought process about how and when data is shared, as many organizations have historically closely guarded their data even without being able to monetize it.

Value at stake: Data exchanges are expected to create $36 billion of operating profits for OEMs from jointly run data exchanges operated at scale, with benefits derived mainly through third-party monetization and reduced cost of data acquisition for OEMs contributing to the exchange.

Connected infrastructure

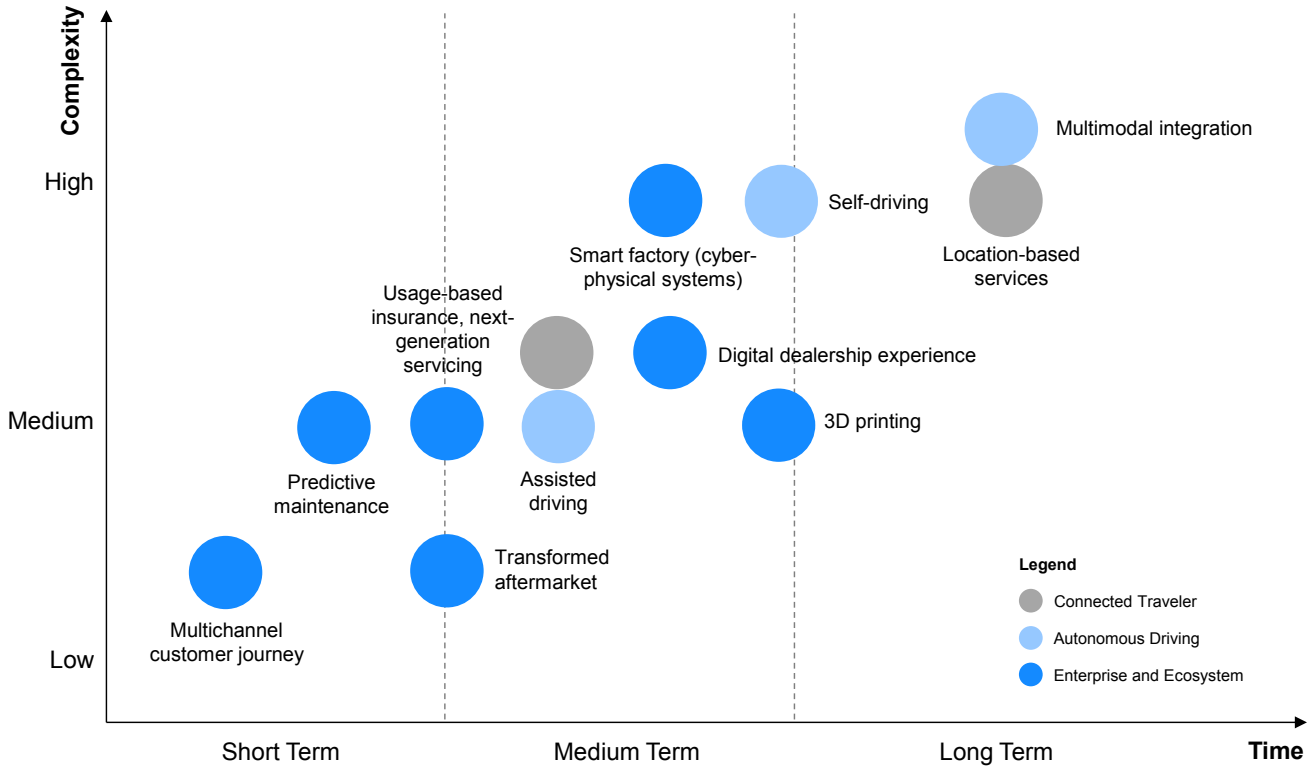
Imagine if vehicles could talk not just with each other (vehicle-to-vehicle, or V2V) but also with roadside infrastructure (vehicle-to-infrastructure, or V2I). Telecommunications companies are seeing opportunities in machine-to-machine communication in vehicles. In the third quarter of 2014, AT&T, for the first time, connected more new vehicles than it sold new smartphones.[54] V2V and V2I are key enablers of intelligent transportation. Sensors, transponders and RFID readers in the road, traffic lights, bridges and parking lots will create an integrated communications network of continuously moving digital information to increase safety and improve traffic flow.

An integrated infrastructure-based network would be a boon to infotainment functionality for the connected traveler. Moreover, government agencies could use data from V2V and V2I communication to better mitigate traffic congestion and improve public safety. The National Highway Traffic Safety Administration in Washington, D.C. has stated that this technology could address 80% of crashes involving unimpaired drivers.[55]

However, if there is to be broad rollout of connected infrastructure hardware, public and private cooperation will be needed to share costs and develop universally agreed-upon standards in data sharing and management.

The complexity and time frame for these initiatives to reach mass adoption varies and is highlighted in the figure below.

Figure 3: Automotive industry initiatives time horizons



Time indicates full technology maturity and vast industry wide adoption

Source: Accenture Analysis; Industry SME Interviews; Press Searches

d. Digital initiatives: Value at stake

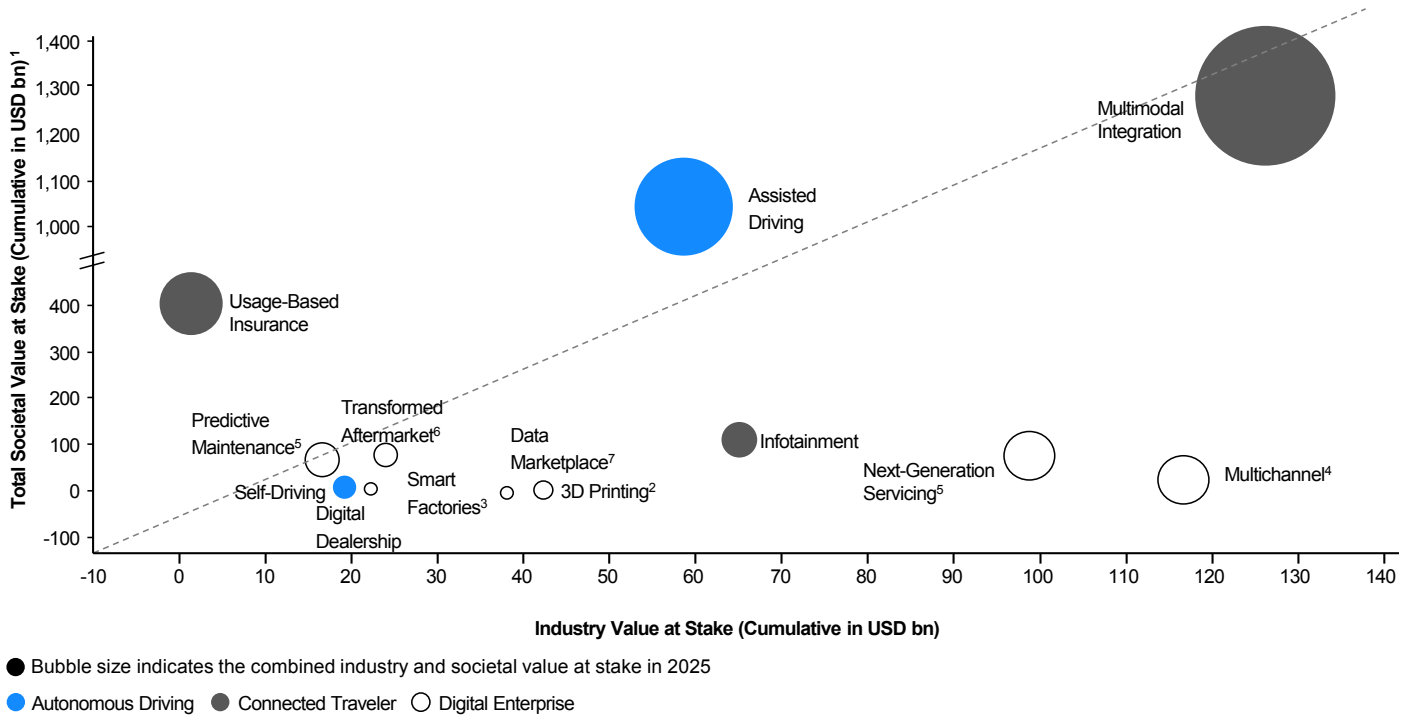
Digital will manifest itself in the automotive industry through the individual initiatives explored in the preceding pages. While these initiatives are already transforming the industry, understanding that they are being driven by three fundamental shifts becomes crucial as we consider what players in the value chain must do to stay relevant.

- **Power to the consumer:** There is no doubt that the dynamic between customers and the enterprises that serve them is shifting with the rise of digital. Consider the rise of social media and the increasing impact of owners' groups. Communities are much broader and are a crucial digital touchpoint for enterprises to engage with. We've already seen the first generation of enterprises managing this social dynamic. However, the rise of peer-to-peer networks impact both the OEM and dealers in a dramatically expanded way, with the opportunity to connect to the consumer and to the ecosystem. Digital is enabling a much more robust understanding of customer desires, allowing the enterprise to meet these needs and realize value in more robust ways.
- **Emergence of new business models:** Digital is creating the opportunities for new business models. We've seen the first generation of these models disrupting automotive businesses, and will clearly continue to see the ongoing evolution of business models as enterprises find new ways to drive value.
- **New data flows and the development of industry standard platforms:** Data is the foundation of many of these initiatives. Everything links back to the quality of the data and the connections and platforms that are emerging across different players. As data flows in new and unexpected ways, across players up and down the value chain, these interactions become critical to realizing opportunities that digital is presenting. While we are seeing an ever-increasing flow of data across this industry, we are just at the beginning. We already have performance and

infotainment data flowing rapidly across the ecosystem, but when V2V and V2I data begin to flow and become enriched with other social and personal data, the value at stake will rise exponentially.

- In summary, our analysis indicates there is approximately $0.67 trillion of value at stake for automotive players as a result of digital transformation of the industry through 2025. Moreover, societal benefits are worth five times more at an estimated $3.1 trillion.[56]

Figure 4: Automotive industry digital value at stake



Note: (1) Total Societal Value at Stake includes impact on the consumers, society and environment. Impact on external industries has not been considered. Economic value of congestion reduction and emissions considered in societal impact. The connected infrastructure initiative has not been valued. (2) Covered under the initiative connected supply chain. (3) Covered under digital manufacturing. (4) Covered under disrupted retail. (5) Covered under connected service and maintenance. (6) Name shortened from transformed digital aftermarket. (7) Name shortened from automotive data marketplace. Source: World Economic Forum, Accenture Analysis

Based on the nature and size of impact across the themes of connected traveler, autonomous driving and digital enterprise, we have identified four categories in which value at stake manifests itself: **the customer journey**, **data-driven services, new business models** and **societal benefits**.

1. The **customer journey** happens across multiple channels, with consumers increasingly expecting a seamless omni-channel experience. We have identified four areas: the multichannel customer journey, next-generation servicing, transformed aftermarket and digital dealerships in which digital disruption will put $263 billion of value at stake for the industry.
2. **Data-driven services,** made up of infotainment, predictive maintenance and the data marketplace offer $117 billion upside to the industry through connectivity with the consumer and the vehicle. However, there will be losers in this equation as dealers and independents lose profits from disintermediation. We have identified three key areas which will be impacted:

- **Infotainment:** $65 billion of operating profits should add to the overall industry value chain driven by infotainment hardware unit sales ($41 billion), OEM driven applications and services ($14 billion) and user adoption of mobile based and 3rd party applications from outside the automotive industry ($10 billion) in value. Significant usage of free

applications, particularly in mass market vehicles in emerging markets should limit the monetization potential of the service eco-system.

- **Predictive Maintenance:** Remote diagnostics enabled by telematics should add $60 billion of profits to OEMs, suppliers and telematics service providers. OEMs can expect to see added benefits of reduction in warranty costs for subscribers. As a consequence, dealers and independent service centres stand to lose $44 billion in operating profits over the next ten years.
- **The Data Marketplace:** Data exchanges are expected to create $36 billion of operating profits to OEMs from jointly-run data exchanges operated at scale with benefits derived mainly through third-party monetization and reduced cost of data acquisition for OEMs contributing to the exchange.

3. As nontraditional players such as Google and Uber attempt to drive market disruption, we estimate approximately $144 billion will be at stake for the industry over the next 10 years with the emergence of **new business models** linked to self-driving vehicles and multimodal integration. The magnitude of impact should be significantly higher beyond 2025 when technology development allows for mass adoption to occur.
4. The greatest impact to the auto industry will come from **societal benefits** such as reduced costs of vehicle ownership, lower premiums, reduced crash costs, reduced maintenance costs, fuel savings and lower carbon emissions. We estimate this to approximately add up to $3.1 trillion and 1.2 million of lives saved over the next 10 years. There will be approximately 540 million metric tons in potential emission reductions over the next 10 years from all initiatives combined. This is against a global backdrop of nearly 37 billion metric tons of annual emissions. The societal impact is largely driven by three initiatives:

- **Automation and connectivity of driving:** We predict greater than $1 trillion in economic benefits to consumers and society from reduced accidents and lower insurance premiums by making the vehicles safer. The vehicle parc share equipped with one or more ADAS components is expected to grow from 1.5% in 2016 to 30% in 2025.[57] In combination with the high and growing ESC adoption, this will reduce approximately 9% of potential crashes by 2025, and avoid 5% in additional premiums that consumers would have had to pay in the event of vehicles being less safe. More importantly, the enhanced safety has the potential to save 902,000 lives over the next 10 years by preventing fatal incidents.
- **Multimodal integration:** We estimate an aggregate benefit of $975 billion over the next 10 years to consumers. Consumers with low utilization of private vehicles will give up car ownership for cheaper multimodal solutions. We estimate that there will be up to 11% of annual potential vehicle sales impacted by 2025. Consumers will not just save on the cost of ownership but also realize time savings in situations where they do not drive themselves. In addition, $274 billion of societal impact is driven through time savings, reduced congestion, fewer crashes and lower emissions.
- **Usage-based insurance:** Incentivizing better driving behavior has the potential to generate $381 billion in economic benefits to consumers and society from reduced premiums and reduced crashes. We estimate the adoption of the service to grow from 4% of key markets in 2016 to 30% by 2025.[58] Discounts to the subscribing population could range from 10 to 15%[59] of premiums, as in a competitive market we expect 90% of cost savings by insurers to be passed on to consumers in the form of premium reductions. Over the next 10 years, 158,000 thousand lives could potentially be saved as one could expect up to 5% reduction in potential crashes by 2025 due to better driving practices.

5. Recommendations

'No regret' capabilities refer to the short-term essential capabilities and strategies that organizations and enterprises can adopt immediately to remain relevant in the digital age.

In a dynamic industry where digital is a relatively new concept, getting the basics right is necessary in the long run. No single set of recommendations will be equally applicable to all organizations across the value chain. However, our analysis points to several fundamental capabilities that are crucial to survival in the emerging digital world. They fit broadly into four major areas:

- **Structure and stills**
- **Data and analytics**
- **Partnerships and ecosystems**
- **Customer engagement and experience**

Leadership and policymaker discussion topics

- **What incentives can cities and governments provide to prioritize self-driving and multimodal integration (e.g., Gothenburg and Singapore)?**
- **How can the automotive industry collaborate with stakeholders in the private and public sector to save lives such as mandatory telematics solutions bundled with car sales and insurance? (e.g., Germany versus US difference)**
- **How can the automotive industry create a greater democratization of the flow of profits from data platforms, in order to accelerate societal benefits such as reducing fatalities and lowering emissions?**

Structure and skills

Create digital talent strategy to support digital skill requirements including a new skill sourcing approach:

More than adding systems, software and connectivity, enabling full digital integration must also include a new and comprehensive skills strategy for talent.

Many leading organizations now view their talent portfolio as a flexible pool of internal and external skilled resources. They've also begun to employ nontraditional hiring practices to tap this pool. They are leveraging their partnerships to bring in qualified talent. They have developed talent strategies that are clear, transparent and well-articulated. New programs and practices are used to build trust with legacy employees who are made to feel like stakeholders and see that their value will be enhanced by skills training. Talent acquisition targets are updated to meet present and anticipated requirements.

- What updates to your talent strategy have you recently completed to support digital talent acquisition and retention?
- How do you adapt the working environment to match the preferences of new employee mindsets?
- Have you clearly articulated the digital skills required in your key roles, in light of the outcomes you want to drive?
- How are you complementing your hiring with upskilling existing employee capabilities?
- What partnering arrangements do you have with other institutions (academia, consulting and partners) to secure additional talent?

Enhance the organization to support digital customer engagement, digital products and data services: Digital evolution affects all aspects of the organization, from supply chain to manufacturing, the dealer network and service. Progressive digital integration requires rethinking the operating model, organizational structure and key processes to support digital systems, data services and customer digital experiences. The objective is to use new digital capabilities to break down silos and make the organization more agile to quickly pursue new market opportunities, overcome volatile market forces and shifting consumer trends, and increase margins and market share.	• When addressing a new market opportunity, what are the key barriers standing in your way? How can you modify the organization or key processes to overcome these barriers? • Has your organization recently examined how it needs to be more collaborative and agile to compete in an increasingly digital industry?
Data and analytics	
Learn from technology companies in adopting a data-driven culture: In the fast-moving and complex digital enterprise, tradition and going by gut instincts will no longer keep an organization in the vanguard. For legacy companies to become agile, data will need to influence all decisions and leadership must be comfortable working in this arena. Competitive advantage is gained when data and analytics are aligned and used as a business tool throughout the organization.	• How are decisions made within your organization? What level of data-based insights are required to support your business decisions? • Do you have a chief data officer or chief analytics officer? • How might an increased focus on data-driven decision making improve agility and facilitate operations across your operational areas?
Invest in improved analytics capabilities to benefit digital products, production and sales: Gathering, enriching, interpreting and putting existing and new data sources to use is critical to remain consumer-relevant and to win in the increasingly competitive automotive landscape. Many companies are now investing in building a robust data architecture that will support the entire value chain and service/product life cycle to achieve desired business outcomes including a better understanding of how to lock in customer loyalty. Additional support is required to identify, harvest, mine and secure the data that feeds the analytics engine.	• How is analytics supporting your critical business outcomes at each stage of the process? • How are you leveraging the data available? • How are you securing new sources of data? • How are you leveraging machine learning to refresh insights in real time?

Partnerships and ecosystems	
Foster ecosystem collaboration: Enterprises across the value chain are working together in new and intriguing ways. Municipal codes and national regulations are common industry hurdles that don't have to be seen as barriers but as opportunities for collaboration. To pursue mutual benefits, municipalities can help leverage public/private partnerships. Strategic thinking and planning can help enterprises find new ways to collaborate, and discover opportunities where someone in the mobility value chain can lead this dynamic ecosystem across competitors, with customers or regulators.	• What opportunities exist to collaborate with others in the ecosystem (partners, competitors, municipalities) to develop market-leading platforms or solutions? • As integrated, multimodal networks emerge, what role is your enterprise taking in participating in and shaping that ecosystem? • What value creation opportunities exist through opening your data, insights and designs?
Identify new partners outside the ecosystem to drive breakthrough innovation: Beyond the universally shared benefits from collaboration, strategic partnerships can also stimulate innovation. New business models will emerge from sharing data and insights, and drive service and product innovation with new and emerging partners from other industries. Cross-industry collaboration will become an integral part of the digital consumer experience.	• Which companies do you consider to be the most innovative in providing digital customer experiences outside of the automotive industry? What unmet needs could you jointly solve? • What companies would you never consider collaborating with? Now consider – if you did collaborate with them, what would you focus on? How would that change how you think about fostering innovation?
Customer engagement and experience	
Enhance omni-channel customer engagement: It is important for automotive players to stay relevant to the customer by creating a unified customer experience strategy. This helps OEMs see themselves not as selling a product so much as selling an experience, a solution and a relationship. When all digital channels to the consumer are open and transparent and not merely for marketing, the car buyer more easily develops a bond with the brand. This is reinforced when these channels are the means for an ongoing 'conversation' to answer complaints, share information and solicit customer ideas to incorporate into design.	• How are you engaging your customer across the range of channels, devices and formats (existing and emerging)? • How are you leveraging your digital capabilities to build engagement with your brand across various customer touchpoints?

Meet the automotive 'prosumer':

It's all about trust. When a trusted environment is created, customers are comfortable interacting with industry players across the value chain, providing valuable feedback on experiences, products and services. This is information can be used to continuously improve products and services, while enhancing the quality and relevance of offers and solutions, and further reinforcing the customer's connection and engagement.

- What steps are you taking to proactively build trust with your customer base?
- How are you systematically gathering customer input to feedback into your design, manufacturing quality assurance and customer engagement processes?
- What customer attitude-sensing mechanisms do you have in place to regularly and systematically monitor key consumer opinions?

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Contributors

Adrian Hallmark, Group Strategy Director Jaguar Land Rover, JLR

Allan Stejskal, Chief Information Officer, AutoNation

Andreas Mai, Director Smart Connected Vehicles, Cisco

Byron Foster, Group Vice President and General Manager, Complete Seat and Strategy, Johnson Controls (JCI)

Dr. Ki Chun Lee, Director R&D Planning Group, Hyundai

Dr. Stefan Scholer, Head of Strategic Corporate Planning, Audi AG

Dr. Wolfgang Epple, Director Research and Technology, JLR

Giuseppe Moder, Digital Marketing and Customer Relationship Management Director, Fiat Chrysler Automotive (FCA)

Ivan Huang, Senior Marketing Manager, Huawei

Juergen Daunis, Sales Director, Automotive Ericsson

Kent Helfrich, Vice President, Design and Engineering in High Reliability Group, Flextronics

Michael Robinet, Managing Director Advisory Services, IHS Inc.

Philipp Sayler von Amende, Senior Vice President, OEM Insights and Solutions, TrueCar

Rahul Shandulya, Chief Information Officer, Mahindra

Ron Frey, Chief Strategy Officer, AutoNation

Russell Foltz-Smith, General Manager of Data Products, TrueCar

Sarwant Singh, Senior Partner, Frost & Sullivan

Sunam Sarkar, President and Chief Business Officer, Apollo Tires

Stephanie Huf, Head of Marketing and Communications, Southeast Asia, Ericsson

Stephen Pattison, Vice President for Public Affairs, ARM

Xiaodong Sun, Senior Vice President of S&M, Chery and Qoros Auto Chery

Digital Transformation of Industries project team contributors

World Economic Forum

Mark Spelman, Head of Future of the Internet

Bruce Weinelt, Head of Digital Transformation

Alex Mitchell, Head of Automotive Industry

Andrey Berdichevskiy, Community Lead Automotive Industry

Accenture

Anand Shah, Digital Transformation Engagement Lead

Margaret Van Winkle, Accenture Digital

Jack Calderwood, Accenture Strategy and World Economic Forum Secondee

Shishir Shroff, Accenture Strategy Value Expert

Rohit Bhat, Accenture Strategy

Mark Pearson, Accenture Strategy Automotive

Luca Mentuccia, Accenture Automotive

Christina Raab, Accenture Automotive

Alberto Sernia, Accenture Automotive

Soren Kristensen, Accenture Automotive

7. Endnotes

[1] Disclaimer: These calculations are subject to change. Impacts are based on estimates and would vary in range given a change in adoption rates or disruption in any of the initiatives

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