connected cars

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Dell EMC, a part of Dell Technologies, enables enterprises to reinvent their business through Digital Transformation.

EXECUTIVE SUMMARY

CHAPTER 1 - Digital transformation in the car industry

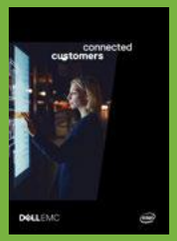
CHAPTER 2 - Connectivity across the automotive value chain

CHAPTER 3 - Connecting sales, marketing and after-sales

CHAPTER 4 - Back to the future

'No man is an island.' Nor is any system, organization or industry. The CONNECTED series dives into this new reality of 'everything connected'. It gives you the latest insights on digital transformation.

Also available:



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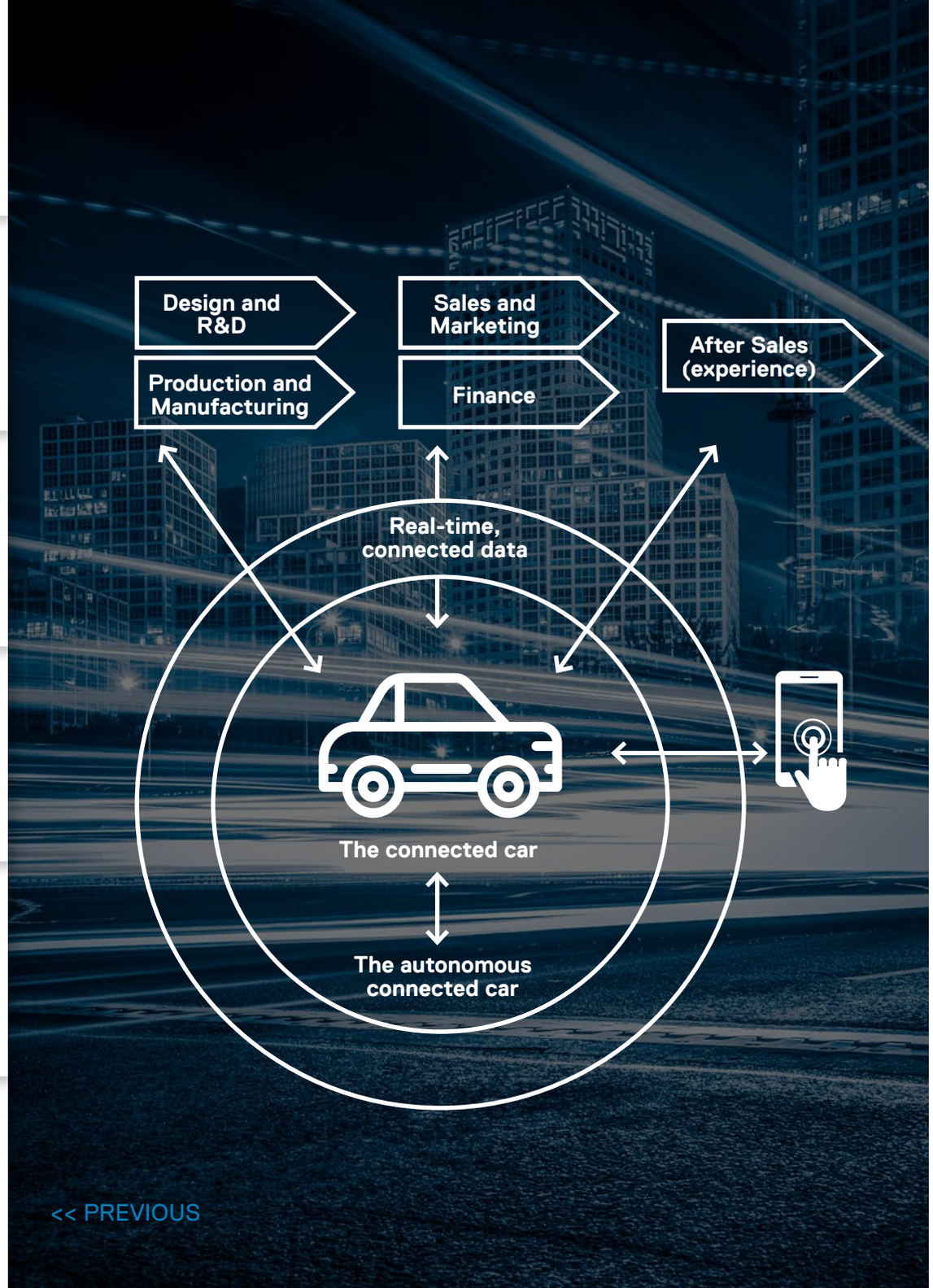


EXECUTIVE SUMMARY

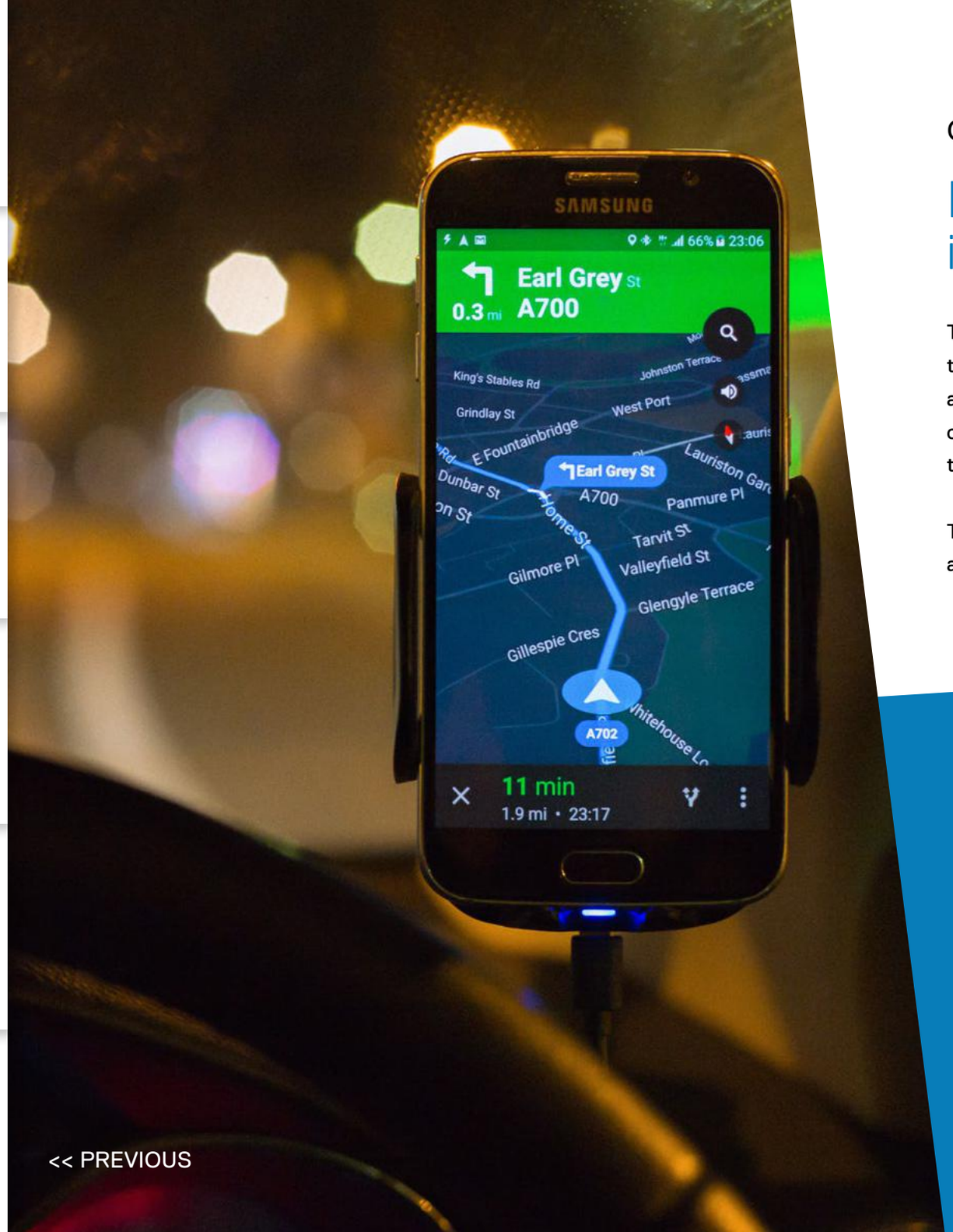
The connected car: connected across the automotive lifespan.

Apart from the connected smartphone, the connected car is quickly becoming **the biggest generator of connected data** for car companies and their customers.

The combination of a connected car and a smartphone generates in-depth and highly valuable insights **for all stakeholders across the automotive value chain and lifecycle.** This will provide the leverage needed to make the **autonomous connected** car a reality!

However, at the same time, the connected car will bring with it **additional challenges** like mobility-as-a-service.

The car industry, coupled with the mobility sector, is facing an extended period of disruptive innovation in many fields.

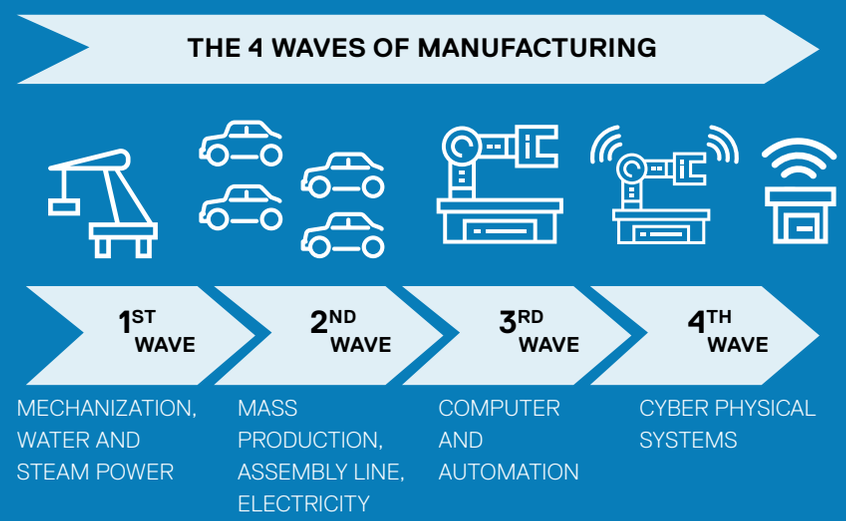


CHAPTER 1

Digital transformation in the car industry

Today's car still has its roots firmly planted where the industry began back at the end of the 19th century. Yet the modern vehicle looks very little like its early ancestor. Thanks to on-going digitization, it is increasingly becoming a datacenter on wheels. With the disruptive innovations we are currently seeing, the outlook of the car will change even more.

These changes won't come about just like that. There are many bumps in the road ahead.



Global challenges abound

The automotive industry is bracing itself for **a very challenging future** indeed:

- Political volatility
- Disruptive competition
- Changing customer demands
- An avalanche of new technologies
- Demand for eco-sustainability
- Strict compliance, legal and safety requirements
- Mobility-as-a-Service
- From owning to sharing a car

POLITICAL CHALLENGES

For an industry that is global by nature, **world trade agreements** are crucial. The recent surge of **protectionism** in some key markets and a new level of political volatility may impact the industry more than before. There is an increased need for original equipment manufacturers (OEMs) to build local partnerships to compete in the market.

ECONOMIC CHALLENGES

Post 2008, the global economic recovery offers opportunities for auto companies in mature markets and even more so in the **developing countries.** Yet below the surface, the industry still faces tough challenges. Lower total shareholder returns (TSR) may lead to additional consolidations in the future. Innovative car designers like electric carmaker Faraday Future and Google cars are entering the market while **tech start-ups** challenge the traditional supplier ecosystem.

Interest in new business models (e.g. car sharing) and new ways of mobility (e.g. Uber) challenge the concept of car ownership.

In time, this may even prove to be a bigger challenge for car manufacturers. Will **conspicuous consumption** be enough to keep car sales high?

SOCIAL CHALLENGES

Globally, the social pyramid is changing due to:

- **Ageing populations**
- **An increasing number of people now living in cities.**

Inner cities continue to tax car usage, yet where public transport is lacking, car ownership remains a necessary part of life. In the meantime, the consumer is increasingly interested in **more eco-friendly cars.** The share of hybrid and electric cars continues to grow be it slower than previously desired or predicted. At the same time, the **middle class** in many developed nations is declining as the wealth gap continues to widen. This will further impact the type of cars desired by the market.

As more people live and work in the city, the need to own a car reduces.

This is particularly a trend with Millennials and Generation Z.

1.6%

THE AUTOMOTIVE SECTOR ACCOUNTS FOR AN ESTIMATED 1.6% OF GLOBAL GDP.

Source: McKinsey

2billion

BY 2035, THERE WILL BE AROUND 2 BILLION VEHICLES ON OUR ROADS WORLDWIDE.

Source: Green Car Reports

TECHNOLOGICAL CHALLENGES

The car industry is on the brink of a new wave of innovation unseen since its inception.

- Hybrid and electric cars
- Faster product cycles & deployments
- Autonomous cars
- New (e-commerce) sales models
- In-car app stores
- Increased digitization throughout the product life cycle
- Continuous mobile connectivity and data stream inputs

This progress comes with additional challenges too.

- Consider safety and cyber security: **car hacking** may very well become a new phenomenon.
- In the case of hybrid/electric cars, there is the challenge of **battery life** and the infrastructure to support scale and wider usage.

ENVIRONMENTAL CHALLENGES

Sustainability and the automotive industry have yet to become a match made in heaven. Just consider the recent in-car software and emissions compliance issues. But global warming (and the subsequent legal measures) and declining oil reserves aren't going away. Emission standards continue to be lowered throughout the world as determined by the Paris Agreement. Car manufacturers that want to maintain market
access have to follow suit and need insights to effectively manage this.

While policies change over time, the overall direction stills seems to be heading clearly towards a more sustainable future.

LEGAL CHALLENGES

The relationship between the industry and governments continues to be close. Many efforts, like improved safety and visibility in traffic and better air quality for citizens, were often initiated by the industry with governments needing to keep up. These steps result in mandatory regulations to the benefit of all, see for example the European Union's eCall directive.

In turn, as **transparency** continues to gain importance for consumers and governments, companies are forced to increase the time and resources they spend on documenting the origin of the different components throughout the supply chain.

i

HELP IS UNDERWAY

As of April 2018, every new car sold in the European Union must have the eCall system installed. In case of an accident, eCall automatically sends data to the 112 emergency number. The data that is sent can be the type of vehicle, fuel used, time of accident and location. As such, emergency services can respond to the incident more quickly and appropriately, and reduce the severity of injuries and the number of deaths on Europe's roads. With eCall, emergency response times could speed up by 40% in urban areas and by 50% in rural areas.

95 million

THE NUMBER OF CARS PRODUCED WORLDWIDE IN 2016. A 55% INCREASE SINCE CRISIS YEAR 2009.

Source: Oica.net

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MIKUNI AND BMW USE DELL EMC TO FUEL THEIR SUCCESS

IT is the bedrock of many automotive companies, right from the start. To let designs hit the ground running, the industry cannot afford hardware and infrastructure solutions that are too slow to keep up with the heavy demands for scalability and speed. At the same time, car manufacturers' IT teams can offer more added value if they are not bogged down in routine maintenance tasks.

Dell EMC offers both on-premise and cloud solutions to this challenge. Japanese engine designer Mikuni, for instance, noted **a 20% performance uptick** thanks to implementing the Dell Precision Tower workstations to run its CAD applications for next-generation, fuel-efficient engines.

Famous German car maker BMW, on the other hand, moved to the cloud with a host of Dell EMC solutions, reporting a significant drop in IT costs and enjoying the advantages of tailor-made user personas and high scalability in storage capacities.

"The growing number of sensors in cars and the technology evolution towards higher resolutions of data types like video, radar and lidar result in challenges for traditional data management approaches."

Dr. Stefan Radtke
CTO EMEA Unstructured Data and Analytics Dell EMC

KEY TAKEAWAYS ON DIGITAL TRANSFORMATION IN THE CAR INDUSTRY

- The industry is facing an unprecedented wave of innovation
- But technology is just one part of the story
- Political, social, economic, environmental and legal challenges are heavily impacting the car industry as well

CHAPTER 2

Connectivity across the automotive value chain

The car is not the only thing being digitized. Vehicle production is transforming from an innovation standpoint. Robotized smart factories are dramatically changing the nature of manufacturing jobs. Software, sensor analytics and Artificial Intelligence (AI) have transformed the factory floor by removing mundane and routine assembly line work. In principle, all routine work that can be digitized will be.

"Any job that's even slightly routine is disappearing from the U.S. But this doesn't mean we are left with fewer jobs. It means only that we have fewer routine jobs."

Robert Reich
Professor and former Secretary of Labor for President Clinton

"For the first time, manufacturers have the ability to collect and mine massive amounts of data for real-time insights into product design and performance and give customers the products they want."

Source: CSC – How To Survive In The Era Of Orchestrated Manufacturing – A Report

Supply chain challenges

The top challenges the industry faces when it comes to supply chain are:

1. **Aligning operations** to real-time fluctuations in customer demand
2. Supplier performance in terms of **risk, reliability and quality**
3. Ensuring sufficient **supplier capacity** to meet demand
4. **Lack of information and material visibility** across the extended supply chain

Ongoing globalization has made all of this only more challenging. A dramatic example came with the March 2011 earthquake and tsunami in Japan. This caused the shutdown of a Japanese supplier that was the only global producer of a pigment used in a type of paint. Because of this instance, major automotive OEMs had to restrict a specific color of vehicles for a period of time.

At the same time, the global scope of the automotive supply chain has also highlighted the importance of well-documented provenance of all the materials used in a car. Legislation in different countries has become more stringent in response to conflicts around the globe.

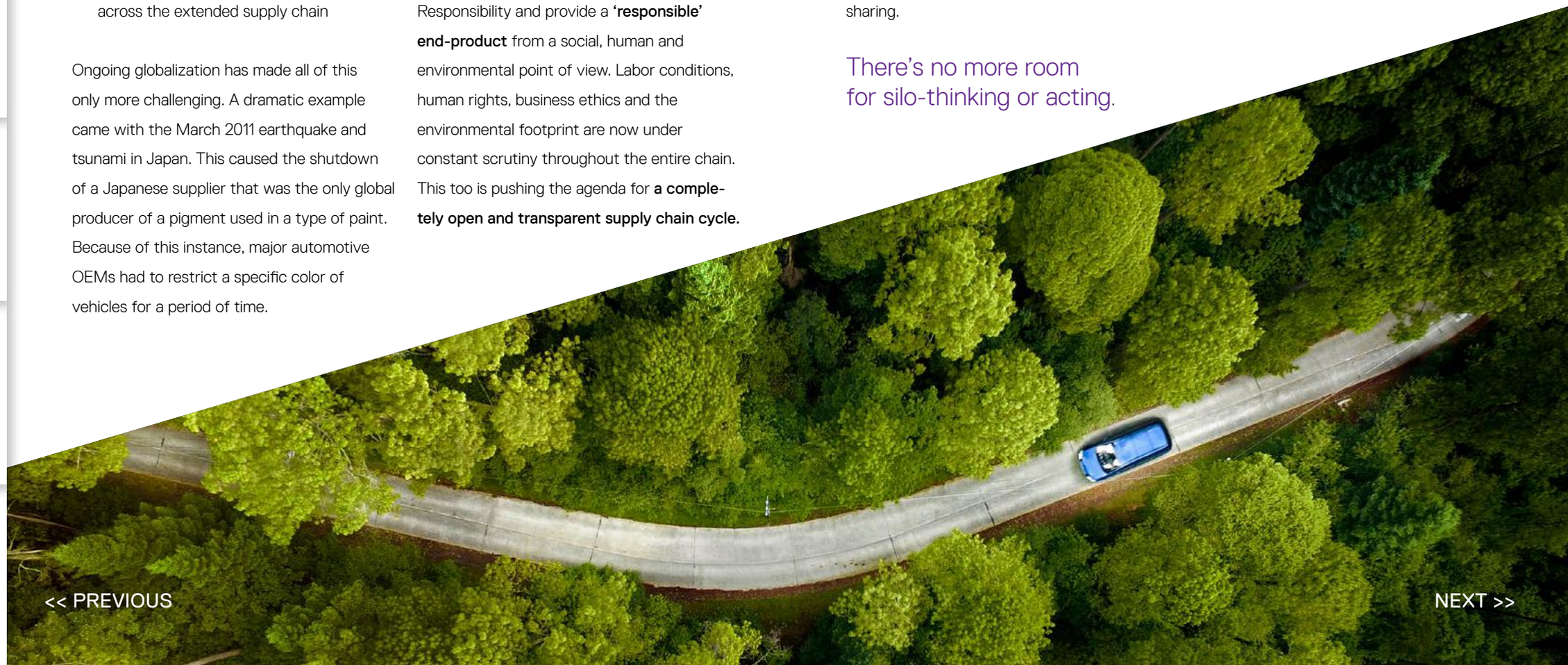
Car manufacturers and their suppliers are now expected to lead in Corporate Social Responsibility and provide a **'responsible' end-product** from a social, human and environmental point of view. Labor conditions, human rights, business ethics and the environmental footprint are now under constant scrutiny throughout the entire chain. This too is pushing the agenda for **a completely open and transparent supply chain cycle.**

Supply chain collaboration

Connectivity doesn't just begin within the factory walls. It already comes into play well before the actual production begins. **Advanced supply chain analytics** steer the industry away from reactive management models. The challenge is to **combine data from many different suppliers** into one unified view, as the focus shifts from internal cross-functional sharing of data towards cross-value chain sharing.

All stakeholders throughout the complete supply chain – suppliers, procurement, and operations – must open up their data. The outcome will be **a fact-based value chain** that is open and visible and in which all can pro-actively adjust their operations to changing market and demand situations.

There's no more room for silo-thinking or acting.



Industry 4.0

Industry 4.0 takes digitization in manufacturing to the next level. The unifying elements are **automation** and **data exchange**. But underneath this is a wide variety of trends and technical disruptions that, together, make up the smart factory of tomorrow:

- **Advanced robots** can work alongside humans without endangering them while they can also handle a much wider variety of more refined tasks. Robots also become leaner, making them easier to set up and move around. This greatly reduces the time and money needed to reconfigure factory floors and production processes.

- **Cyber-Physical Systems** (CPS) combine and intertwine **physical and software components.** By gaining a more holistic overview of what happens throughout a production process, different components of the system can interact differently, depending on the context. As such, smarter use of resources can be realized. **Machine-to-Machine (M2M) communication** is crucial here.

- **Human-machine interaction** (HMI) comprises of different types of interfaces that let humans connect with machines (e.g. through touch interfaces or augmented reality via smart or VR glasses). This is how production can be monitored more closely, changing production demands can be met more rapidly and overall diagnostics and alerts can be improved. But also for training and overall assistance on the job, these interfaces can be a great help (e.g. what type of bolt needs to go where exactly). An increasing number of modern day laborers work around the shop floor with a tablet or likewise touch device.

- **3-D printing** and **rapid prototyping** can reduce time to market. Local Motors, which builds cars almost entirely through 3-D printing in its 'mini factories', can build a new model from scratch in a year. The industry average is six years. In addition, large car manufacturers like Vauxhall and GM already include these technologies into their assembly lines to increase efficiency and speed up production.

- **Virtual Factory** (VF) platforms create virtual simulations that help:
  1. Replicate real life scenarios in order to come up with suitable solutions quickly,
  2. Design and implement new products or production lines in a speedy and cost effective manner.

  The extremely high cost of setting up pilot plants or testing new production facilities is replaced by virtualization. As such, decision-making throughout the complete product lifecycle is greatly improved.

- **Big Data** and **advanced analytics** help operation managers and others plough through historical data, identify possible patterns and relationships between discrete process steps and use the insights to optimize production. As companies become smarter at this, they tend to **move from descriptive over predictive to prescriptive data models.** This is fuelled by an ever-increasing abundance of real-time shop-floor data and effective statistical models. As more advanced analytics become available to a wider group of employees across companies, the need for custom reporting by data scientists is reduced.
- **Machine Learning** brings greater predictive accuracy to every phase of the production process. It is used to improve yield rates at various levels and continuously improves preventative and Maintenance, Repair, and Overhaul (MRO) performance.

In summary, the **ultimate smart factory** is filled with networked machines that create an intuitive ecosystem capable of predicting potential issues upfront. In parallel, it becomes smarter through machine learning, autocorrects thanks to AI and automates logistics planning that addresses unexpected changes in production.

$19 trillion

THE FORECASTED TOTAL ECONOMIC VALUE ADDED BY IOT ACROSS INDUSTRIES IN 2020.

Source: Gartner

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A CLOSER LOOK – DELL EMC CUSTOMER CASE GEARING UP FOR DATA DRIVEN AUTOMOBILE MANUFACTURING AT NISSAN MOTOR COMPANY

1 **The situation -** Nissan Motor Company wanted to enhance automobile production at one of its major factories in Japan thanks to cutting-edge IT hardware. The goal is also that this Tochigi plant serves as the 'mother plant' for Nissan Motor, which means that when Nissan opens a new plant outside of Japan, the procedures and processes developed and implemented at the Tochigi plant will be transferred into this new location overseas.

2 **The challenge -** To achieve efficient work procedures and maintain the high standards of quality while controlling costs, reliability of IT hardware was an absolute must. The existing file server was struggling to cope with increasing volumes of data, and backup processes were taking an increasing amount of time.

3 **The approach -** Nissan considered three vendors and scored Dell highly in terms of rapid data backup times and price / performance. The manufacturing and engineering departments of the Tochigi Plant chose Dell PowerEdge R720 Servers and Dell Storage PS6210X arrays and based their solution on Dell DR4100 Backup Appliances running NetVault Backup software.

4 **The result**

- **Storage capacity was increased to 40TB** (20 times more).
- Backups can be retained for three months before archiving without worrying about available capacity.
- **Backup time** was reduced from 30 to 8 hours.
- **Maintenance costs were lowered** because of the reduced number of physical servers and thanks to VMware virtual server infrastructure.
- Nissan is ready to launch new programs to use big data for efficiency in manufacturing.

-40%

PICKERS AT LOGISTICS COMPANY KNAPP AG WEAR A HEADSET WITH AN AUGMENTED REALITY SEE-THROUGH DISPLAY. THIS HELPS THEM TO FIND THE RIGHT ITEM MORE QUICKLY WHILE AN INTEGRATED CAMERA KEEPS TRACK OF REAL-TIME STOCK. AS SUCH, ERROR RATES WENT DOWN BY 40%.

Source: McKinsey

KEY TAKEAWAYS ON CONNECTIVITY THROUGHOUT

- The automotive industry is digitizing throughout, but much remains to be done
- Industry 4.0 is taking car manufacturers to the next level
- Yet the data dots need to be connected well before production begins

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CHAPTER 3

Connecting sales, marketing and after-sales

The importance of connectivity throughout the automotive buying cycle is increasing in a competitive and crowded car industry.

This puts additional pressure on slim profit margins and emphasizes the importance of generating and nurturing new business models. The 'always connected customer' expects an equally connected experience. Not just pre- but post-sales as well.

"Consumers have evolved into wanting a more personalized and self-centered experience. To be treated as a segment of one."

Source: Capgemini Consulting
CARS ONLINE 2015 - The Selfie Experience -
The evolving behavior of the connected customer

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The 360° customer view

The connected customer expects a connected experience and car manufacturers are very well placed to create that 360° view of the customer:

- By connecting the many different touch-points throughout the complete buying cycle.
- By analyzing not just each individual's actions, but also gaining in-depth understanding of typical customer behavior across all prospects and customers.

This new depth of technological expertise also changes the automotive ecosystem.

Manufacturers have a long history of collaborating across company borders, as it has become completely impossible to do everything in house. The car industry now has to manage **a wider, more complex ecosystem** of diverse partners in order to meet the ever-expanding needs of customers. R&D efforts as well as manufacturing platforms are expected to integrate and be collaboratively shared instead of owned.

As such, Big Data analytics that car manufacturers can develop extend not only to their own marketing, sales and product development knowledge base. They can also put it to good use with their partners and OEMs throughout the product and sales life cycle.

"The possible 'Amazonification' of automotive sales raises both challenges and opportunities for the industry."

Source: Capgemini Consulting, Automotive Online Sales: The direct route to the customer.
Cars Online Trend Study, November 2016

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THE CONNECTED CUSTOMER

... expects the same experience across all products and services. The level of what is considered a 'standardized experience' continues to soar, fuelled by a digital experience across a wide variety of other industries. The connected customer is hyper- aware and expects a hyper-personalised experience. Customers already gather the larger part of their information online but they are also more open **to buying cars online.** Car manufacturers who are serious about e-commerce can tackle these issues by extending the different means of getting in contact with them. For example, by enabling options like **live chat**, also outside of regular business hours, or becoming an active participant in **social media** discussions.

THE ONLINE EXPERIENCE

... drives a large part of the purchase decision. By providing personalized web pages, enabling live chat sessions with knowledgeable service staff, remembering preferences and taking these along a wide variety of channels and devices, the connected customer can be nudged further into the sales funnel.

THE CAR MANUFACTURER

... is well placed to capture as much data as possible from various sources to create the right type of omni-channel experience for its customers. By creating a nuanced 360º customer view, the right type of consistent messaging can be cascaded to stakeholders in the sales funnel. Car manufacturers that embrace digitization and e-commerce have to clearly define the role and relationship with their dealership network. Especially with an **aftersales market** that is crucial to the overall profit margin. Maintaining a win-win-win relationship between **OEM, dealer and customer** is likely to remain crucial for the forseeable future.

THE CAR DEALER

... captures and understands preferences of customers when (and preferably even before) they enter the showroom. By combining all the customer data available (e.g. from the car manufacturer), the connected customer can gain time with the latest technologies (e.g. virtual reality), while receiving a highly personalized experience. For the car dealer, emphasis will continue to shift from passing on information to providing customer experiences that are difficult to reproduce digitally (e.g. test drives).

THE FINANCIAL EQUATION

For many consumers, buying a car is the second largest purchase in their lives (after buying a house). Making pricing easy to understand and adding attractive financing schemes greatly help customers gain a full understanding of the financial picture and enable increased sales for the car company.

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EXPERIENCE YOUR NEW CAR THROUGH VIRTUAL REALITY

Jaguar Land Rover wanted the launch of its newest electric model I-PACE to be as unique as the car itself. There was, however, only one physical model available. Through the combined efforts of creative agency Imagination, VR headset producer HTC, Dell EMC and Jaguar Land Rover, a virtual reality setup was developed. As such, automotive journalists could experience the new car simultaneously in Hollywood as well as London, By using 114 machines for the one-day event, it was possible to show 90 frames per second and generate a virtual reality experience beyond compare. The London press audience was able to experience the car while the only existing specimen was on the other side of the Atlantic. Plans to expand virtual reality to dealers and beyond are now being considered.

1.5

CAR BUYERS VISIT BETWEEN 1 AND 1.5 DEALERS BEFORE BUYING A CAR. A GENERATION AGO, THEY VISITED 4 TO 5.

Source: PWC, The 2017 Automotive Industry Trends

+30%

BY USING THE DATA FROM AN ONLINE CAR CONFIGURATOR AND WITH THE HELP OF ADVANCED ANALYTICS, AN AUTOMAKER WAS ABLE TO DRAMATICALLY REDUCE THE NUMBER OF PREMIUM OPTIONS CUSTOMERS WOULD BE WILLING TO PAY FOR. THE IMPACT ON DEVELOPMENT TIME AND REDUCED PRODUCTION COSTS RESULTED IN A 30% IMPROVE IN GROSS MARGIN WITHIN 2 YEARS.

Source: McKinsey

93%

... OF DRIVERS SEEKING TO PURCHASE A NEW VEHICLE USE SOME FORM OF DIGITAL PROCESS TO RESEARCH THEIR BUYING PREFERENCES.

Source: Accenture Digital Marketing Consumer Survey, December 2014

75%

... OF CAR BUYERS STATE THEY WOULD CONSIDER COMPLETING THE FULL CAR PURCHASE ONLINE (INCLUDING FINANCING, PRICE NEGOTIATION, BACK OFFICE PAPERWORK, AND HOME DELIVERY).

Source: Accenture

500,000

THE NUMBER OF CARS TRADED ON EBAY EVERY YEAR.

Source: McKinsey & Company - Innovating automotive retail

"OEMs selling directly have a competitive advantage over pure online retailers because they can deliver a consistent omni-channel experience. They can offer all car models online, as well as servicing and warranty. They can also provide a complete offer including the vehicle, financing and insurance."

Dr. Rainer Feurer
Senior Vice President Sales Strategy and Steering, BMW Group

"Customers also expect more and better communications during the period between purchase and delivery. Most would like to be contacted at least weekly."

Source: Capgemini Consulting
CARS ONLINE 2015 - The Selfie Experience

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After the sale

Connectivity is a never-ending story. It continues immediately after the sale, for example by actively notifying the buyer of the car's manufacturing and delivery status. It also extends throughout the customer's usage of the car lifecycle.

As more and more things get connected, the driving experience and everything that surrounds it, will become fully intertwined.

20% > 50%

WHILE THE AFTERSALES BUSINESS ONLY MAKES UP 20% OF A CAR MAKER'S REVENUE, IT ACCOUNTS FOR HALF OF THE TOTAL PROFIT.

Source: Accenture, The 2015 Autombilewoche Supplement

"Many of the latest connected vehicle models now anticipate to an upcoming maintenance need by transmitting that information to the driver's preferred shop to schedule a service appointment, generating significant after-sales revenue."

Source: Connected vehicle - Succeeding with a disruptive technology -
By Accenture's Andreas Gissler

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A CLOSER LOOK – DELL EMC CUSTOMER CASE
SERVICE KING – GROWING THE AFTER-SALES BUSINESS 5-FOLD

1 **The situation -** Service King is the largest independently owned and operated provider of collision repair services in the U.S. When customers bring their cars or trucks to Service King, they expect expert repairs and short wait times. Meeting those expectations is part of the strong customer-centric approach the chain upholds.

2 **The challenge -** Service King needed to improve the performance of its primary in-store business application while better supporting its expansion. The business management solution was used by the chain's 2,000 employees across 267 facilities, but suffered from problems caused by the organization's aging networking, server and storage technologies. A painful situation in a world where customers want instant gratification.

3 **The approach -** The company chose to implement an end-to-end Dell IT infrastructure based on Dell wired and wireless networking technologies, Dell PowerEdge servers, Dell Compellent storage and Dell ProSupport Plus for support.

4 **The result**
Service King was able to reduce wait time by 20 minutes per customer and increase application performance by 300%.

"On average, our service advisors save up to 20 minutes per customer each day because of the Dell wireless infrastructure. That means they can not only get customers out the door faster, but also handle more customers in a day."

Jody Cantello,
Network Infrastructure Manager, Service King Collision Repair Centers

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THE CONNECTED CAR

... continuously captures relevant information during its usage and shares this with other stakeholders throughout the car's life cycle. Sharing should however happen in full **transparency**, in accordance to the connected customer's wishes and in compliance with **privacy laws**.

CONNECTED SAFETY INFORMATION

Not just software updates happen over the air: tips on keeping drivers and passengers safe on the road will be enhanced as well. Notifications of alternative routes, possible dangerous situations along the way, technical updates (like tyre pressure and more) can all help to improve driver and passenger safety.

CONNECTED SERVICES

As **machine learning** and **AI** develop in sophistication, add-on services will continue to enhance (and extend) the driving experience. For example: real-time notification of nearby offers, the best fuel price along the road or on board entertainment options (such as preferred music, news updates, media streaming etc.). OEMs are expected to increasingly **collaborate with other providers** in this field to make sure the offering meets customer needs. A larger part of OEM income will come from these add-on services.

CONNECTED DATA

Data is money and increasingly, **sharing of data will come at a price**. Customers can be incentivised to share their data with various stakeholders in exchange for reductions, coupons, more personalized services or other benefits. Insurance companies, for example, have already begun to offer dynamic pricing based on mobile data captured during driving. More prudent drivers now pay less.

CONNECTED DEVICES

There are already various mobile apps available that **connect the driving with the non-driving experience**. Consider for example car-location finders and parking apps. The interconnectedness between car and various mobile devices continues to increase facilitating the options to book maintenance appointments or giving car owners up to date status reports on their car, upgrade and financing options.

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The connected car 2.0

... connects with other cars, mobile devices, the city and its surroundings. As the number of connected data points increases, the ability to make sense of all this data will be crucial in paving the way for the autonomous connected car.

OTHER CONNECTED CARS AND VEHICLES

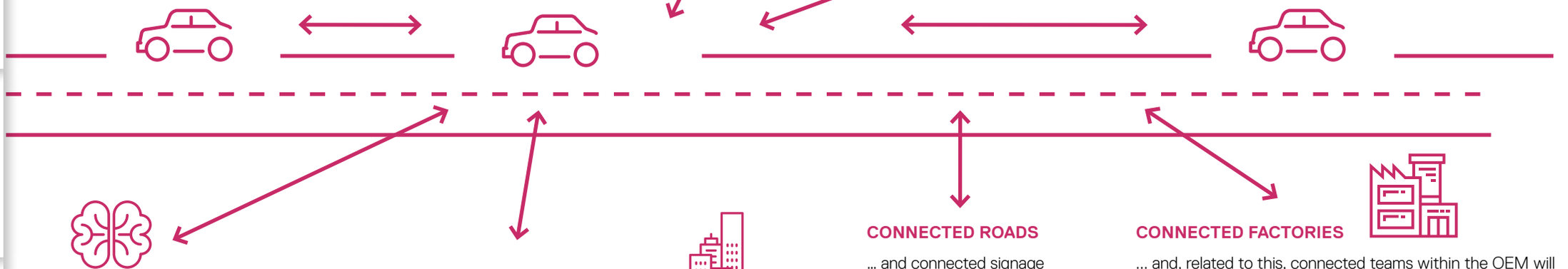
... will provide a more robust and more complete understanding of the complete surroundings of the car. The goal? Make driving more secure and predictable. Connected cars can anticipate to dangerous situations before they occur and avert potentially troublesome situations.

CONNECTED DEVICES

... like smartphones already connect with cars. The expectation is that the convergence between mobile device and car will continue to soar, further fusing the driving and non-driving experiences.

CONNECTED DATA AND SOFTWARE

... will be pushed over the air whenever needed. Tesla is already doing this for many of its product updates and as the share of software in a car increases, this will only happen more frequently. But as the car becomes increasingly more software driven, the need for more security to avoid hacks increases as well.



CONNECTED INTELLIGENCE

... will also fuel many other stakeholders throughout the buying and production life cycle. Better attuned services and apps by third-party providers will meet customer needs better. More connectivity will become a self-reinforcing mechanism.

CONNECTED CITIES

... will become increasingly smarter about traffic control. The smart city will direct traffic flows more optimally taking into consideration different needs of different drivers. Urban planning, too, may change drastically as more intelligence flows in.

CONNECTED ROADS

... and connected signage will better streamline traffic to wherever it needs to go. Could this mean the end of a frustration every driver anywhere in the world experiences: traffic jams?

CONNECTED FACTORIES

... and, related to this, connected teams within the OEM will capture masses of real-time usage information that can fuel the complete R&D and production cycle:

- Options that aren't used in actual driving situations can be removed.
- Less performing parts can be replaced throughout the production process.

Constructing a car will become a real-time continuous improvement process.

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A CLOSER LOOK – DELL EMC CUSTOMER CASE
THE MERCEDES ME APP

In a new era of digital transformation, Mercedes-Benz wants to raise the bar for the industry via a holistic, unique experience for drivers. The Mercedes me app contributes to this goal by giving drivers real-time information about the status of their vehicle's vitals through their smartphones or smart watches. The app also includes remote control of things like auxiliary heating, the ability to open and close the door lock from afar, and a convenient navigation tool.

Mercedes me was created on Pivotal's cloud native platform, Pivotal Cloud Foundry and Spring Boot, and supercharged by Pivotal Labs' agile software development methodologies. Pivotal is part of Dell Technologies and is strategically aligned to Dell EMC.

"In our Digital Lab, we are working on a digital ecosystem that offers our customers a new user experience, new mobility services and a raft of networked vehicle services. We are creating completely new products for our customers, and are therefore turning Volkswagen from a car manufacturer into a mobility provider."

Dr Martin Hofmann,
CIO Volkswagen Group

2025

BY 2025, ALL NEW CARS SOLD WILL BE CONNECTED IN ONE OR MULTIPLE WAYS.

Source: Accenture, Connected vehicle - Succeeding with a disruptive technology

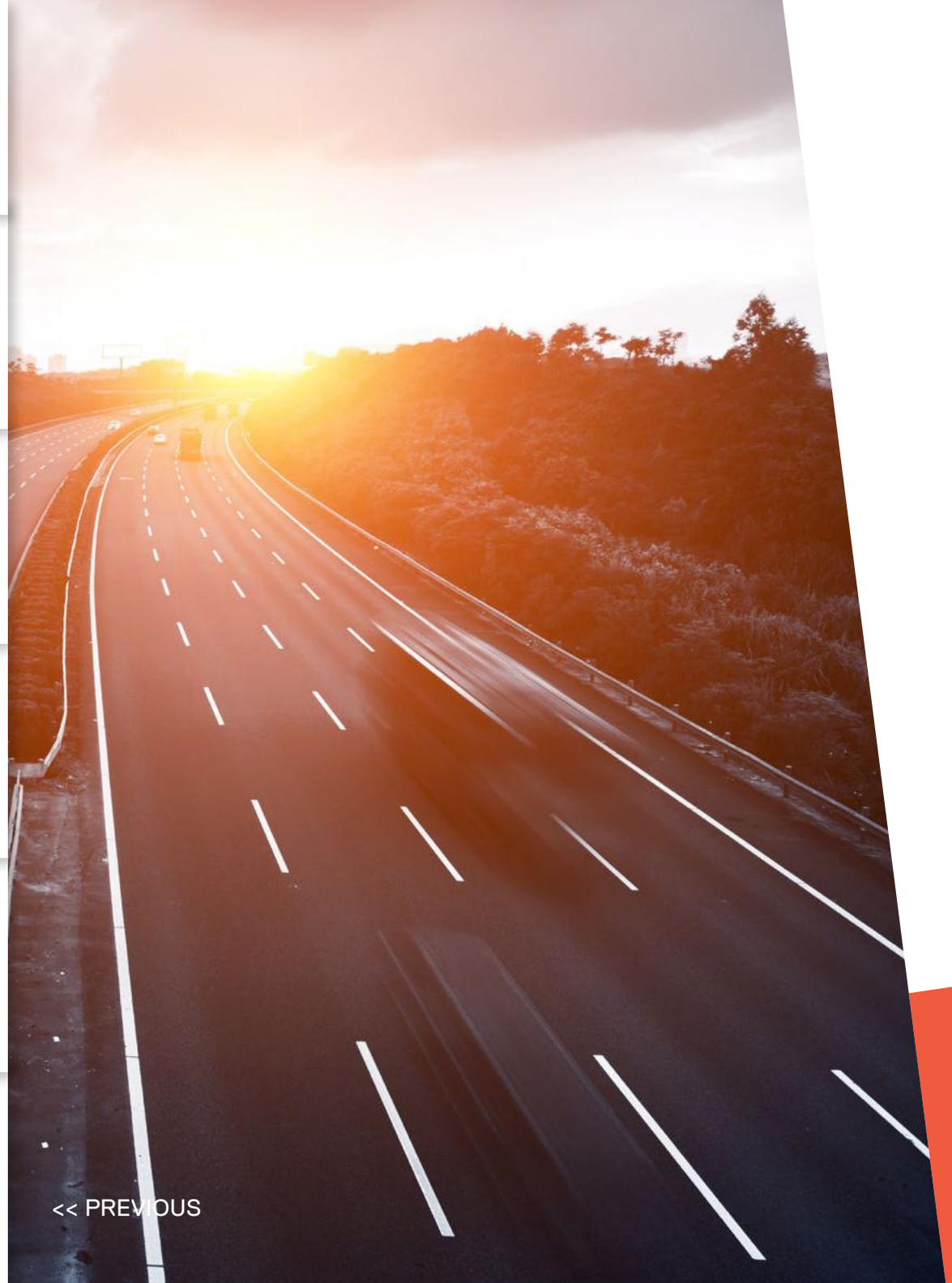
The connected car 2.0: wrap up

A fully connected automotive landscape will be quite different from what we have today. As more and more things become connected, **creating an automotive ecosystem** that facilitates these connections will become more important. Challenges around data standardization, privacy, IP and more will have to be tackled.

No small feat for any industry, but an inevitable one if we want to take connectivity to new heights.

KEY TAKEAWAYS ON CONNECTING SALES, MARKETING AND AFTER-SALES

- Car manufacturers should aim to seamlessly integrate the physical and online sales experience: end-to-end portfolio options can be provided to customers, including also additional products and services (e.g. insurance or warranty options), most likely provided through a wide variety of partnerships
- But connectivity is a never-ending story that extends after the sale: more connected devices, services and things will create an explosion of connected data, which in turn will boost the connected car 2.0
- Ultimately, car manufacturers will have to seriously think 'beyond the car' by launching alternative mobility options (e.g. car sharing, pay-per-use, more flexible ownership models and more).



CHAPTER 4

Back to the future

What's next for the connected car?

Two trends stand out:

1. The autonomous connected car
2. New mobility business models.

Self-driving cars continue to spur the imagination. Many dream of being driven around while working, meeting, talking to friends or family. But before we reach this incident free mobility utopia, many challenges need to be overcome. Not just technical ones, also ethical ones!

The rise of the driverless car may, in fact, coincide with another important trend: that of new mobility business models. For people living in cities, owning a car is becoming less relevant. Making sure you get around through whatever combination of mobility means may be a better deal to many.

Maybe, the ultimate solution will be a symbiotic relationship between the autonomous connected car and new mobility business models.

"The changes in the automotive industry are just phenomenal. We're experiencing a change which we've never seen in this industry."

Simon Bolton
CIO, Jaguar Land Rover

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The self-driving car

Many analysts consider it just a matter of time before fully self-driving cars become a common sight on our streets. The more **Artificial Intelligence** (AI) matures, the more likely the autonomous car becomes. The self-parking car is already widely accepted. The drastic increase in **advanced driver-assistance systems (ADAS)** is crucial here.

But general **industry standards** for these ADAS systems are still in flux. Many different settings (camera centric, radar centric or hybrid solutions) are still being researched.

As the level of autonomy increases, the number of different systems being used increases as well. As does the level of complexity that is needed to run all of these in unison. Making sense of the data and responding appropriately is an extra challenge while the speed of progress continues to fluctuate.

Technology unison

Autonomous vehicles rely on a **myriad of technologies** that need to work in unison:

1. The global positioning system **(GPS)** locates the car
2. Light detection and ranging **(lidar)** systems use light beams to estimate distances between obstacles
3. **Cameras** collect additional images that need to be processed
4. Electromagnetic waves or **radar technologies** bounce off on objects and determine speed and distances
5. **Infrared sensors** detect objects in low lighting conditions
6. **Ultrasonic sensors** help out with handling short distances
7. **Vehicle-to-vehicle** (V2V) and **vehicle-to-infrastructure** systems collect additional surrounding information
8. **Internal navigation systems** (INS) and odometers keep track of the car's inner workings
9. Prebuilt maps aid in gaining an understanding of the environment

€500billion

THE TOTAL BUSINESS VALUE OF CONNECTED CAR SERVICES BY 2025. THIS INCLUDES SERVICE FEES, 3RD PARTY ACCESS, OVER-THE-AIR UPGRADES AND MORE.

Source: Accenture Strategy

"Autonomous or self-driving cars, changing ownership and usage models and heightened customer expectations; the automotive industry is on the brink of a revolution."

Mike Woodward
Deloitte, UK Automotive Industry Lead

The 95% confidence interval for horizontal geo-location of the GPS is around 8 metres, which can be the difference between driving in the right lane or in the wrong (opposite) direction.

Source: McKinsey & Company Report - Self-driving car technology: When will the robots hit the road? (May 2017)

Ethical challenges abound

While the hardware has already made great strides in terms of processing power, **software still has to make a few leapfrogs to intelligently run an autonomous car.** Simply consider the decision-making systems: 'if-then' rules don't cut it as the number of scenarios could quickly run in the millions. Artificial intelligence (AI) and machine learning are needed here. Also take into account the need for fully trustworthy fail-safe systems. A car's software can't freeze while driving on a busy highway.

Complex technical challenges and sceptical consumers concerned about safety are some of the key roadblocks. Market research shows that safety is the quintessential element for consumer adoption across different markets worldwide. One key element to overcome this fear is through an established track record of autonomous cars being driven safely. But this too will take time.

While self-driving cars are the talk of the town, many experts believe it may take somewhat longer before self-driving cars are ubiquitous.

Levels of autonomy

Global industry association SAE International developed a system to indicate the levels of vehicle automation:

- **Level 0: no automation.** Human drivers do everything.
- **Level 1: driver assistance.** A driver-assistance system either steers or accelerates and decelerates cars in a mode specific way. Human drivers perform all other aspects of dynamic driving.
- **Level 2: partial automation.** Using information about the driving environment, one or more driver-assistance systems execute both steering and acceleration/deceleration in a mode-specific way. Human drivers perform all remaining aspects of dynamic driving.
- **Level 3: conditional automation.** An automated-driving system undertakes all aspects of dynamic driving, with the expectation that the human driver will respond appropriately to requests for intervention.
- **Level 4: high automation.** An automated-driving system undertakes all aspects of dynamic driving, even if human drivers do not respond appropriately to requests for intervention.
- **Level 5: full automation.** An automated-driving system undertakes all aspects of dynamic driving throughout a drive, under all roadway and environmental conditions that human drivers can manage.

275 million miles

THE NUMBER OF MILES REQUIRED FOR AUTONOMOUS VEHICLES TO DEMONSTRATE, WITH 95% CONFIDENCE, THAT THEIR FAILURE RATE IS AT MOST 1.09 FATALITIES PER 100 MILLION MILES – THE EQUIVALENT OF THE 2013 US HUMAN-FATALITY RATE. TO DEMONSTRATE BETTER-THAN-HUMAN-PERFORMANCE, THE NUMBER OF MILES REQUIRED CAN QUICKLY REACH THE BILLIONS.

Source: McKinsey & Company

+50%

THE GLOBAL NUMBER OF ADAS SYSTEMS PRODUCED/INSTALLED, INCREASED BY 50 PERCENT BETWEEN 2014 AND 2016, FROM 90 MILLION UNITS TO 140 MILLION.

Source: McKinsey & Company

The 'Uberization' of mobility

Being driven instead of driving yourself is gaining ground, especially in emerging nations like China and India, where almost half of all consumers indicate they use a ride-hailing service at least once a week. This is also a tendency that's fuelled by Millennials who are more likely to use such services compared to other age groups (Gen X, the Baby Boomers). These younger drivers don't feel the need to own a car, putting additional stress on car manufacturers and dealers. Being able to get around is gradually becoming more important than getting there with your own car. How well-prepared are OEMs to these challenges?

49%

A STUDY SHOWED THAT 1 IN 2 CONSUMERS WOULD RATHER BUY A FLEXIBLE MOBILITY MODEL (E.G. CAR SHARE, PAY-PER-USE) ONLINE THAN JUST BUYING A CAR.

Source: CapGemini, Automotive Online Sales: The direct route to the customer. Cars Online Trend Study, November 2016

Race cars leading the way of Big Data analytics

For decades, motor racing has been leading the innovation game in terms of performance and safety. The car of the future will surely integrate breakthroughs that were first implemented on the track.

For instance, Dell EMC has developed specific infrastructure solutions for motorsport, combining cloud computing and data analytics together with Intel. One of the most prestigious customers Dell EMC has the pleasure to work with, is a F1 Team that re-engineered and refreshed its IT infrastructure with VCE Vblock Systems from Dell EMC as the foundation of a high-performing private cloud. The new converged infrastructure doubled IT system performance, enabling faster access to real-time data analytics for better race car re-engineering in the factory and speed on the track.

72%

... OF GERMAN CONSUMERS DON'T FEEL THAT SELF-DRIVING VEHICLES WILL BE FULLY SAFE.

Source: Deloitte Global Automotive Consumer Study, 2017

DELL EMC

A CLOSER LOOK – PIVOTAL CUSTOMER CASE*
BMW – BIG DATA ANALYTICS KEY FOR PREDICTIVE CAR MAINTENANCE

1 **The situation -** BMW listed Big Data and predictive analytics as vital elements of future customer engagement. The primary goal of the car manufacturer is predictive maintenance and being able to detect defects at the earliest stage.

2 **The challenge -** BMW has to handle big volumes of incoming data while considering and protecting its customers' privacy. Another challenge is getting the car and IT development teams working in sync.

3 **The approach -** BMW uses the Pivotal Big Data analytics platform to help overcome these challenges. Pivotal components and analytical algorithms from the IT team at BMW are integrated and enriched in the back end.

** Pivotal is part of Dell Technologies and is strategically aligned with Dell EMC*

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Digital transformation in the car industry

The car industry is digitizing fast. But it still needs to pick up the pace!

Automotive CIOs have a lot on their mind when it comes to digitization, but there are many elements holding them back: budget and resource constraints, privacy and security concerns, a lack of skills and expertise and an immature digital culture overall. CIOs face a constant balancing act between 'IT-as-it-used-to-be' and 'IT-as-it-should-be':

69%

... OF AUTOMOTIVE CIOS BELIEVE THEIR ORGANIZATION IS HELD BACK BY TOO MANY TRADITIONAL APPLICATIONS THAT ARE STILL IMPORTANT TO THE BUSINESS.

Source: The EMC Digital Business Survey

IT-AS-IT-USED-TO-BE	IT-AS-IT-SHOULD-BE
• Secure and optimize existing enterprise and plant IT • Manage Digital Transformation • Support the business units with IT services • Become an enabler of the business • Provide flexible IT services globally	• Support the new era of automotive business • Support 2nd and 3rd platform apps • Enable seamless supplier interaction - customer interaction - partner interaction • Be an active driver for new business models

TO CONCLUDE

Will the next Ford T be an autonomous electric car? Or will it be an all-round mobility solution? Or a combination of mobility means that even includes (electric) bicycles, trains and flights?

Few industries today face disruption as much as the car industry. An industry that still impacts everyone around the globe. As global populations continue to grow, the economic, ecological and social challenges only become more pronounced. The connected car and the car manufacturers will play a key role in addressing these challenges.

KEY TAKEAWAYS ON BACK TO THE FUTURE

- The autonomous car continues to spur our imagination, but technological (and ethical) challenges still need to be answered
- Connected data is the unifying element: who owns the data owns the future
- The Uberization of mobility may disrupt the car industry even more. How well prepared are OEMs to deal with this?
- The automotive CIO must continuously balance 'IT-as-it-used-to-be' with 'IT-as-it-should-be'

DELL EMC AND THE CONNECTED CAR

DELL EMC modernizes, automates & transforms across the automotive industry.

The connected world, with its vast options for personal mobility, as well as the changing demographics of car buyers, has had a dramatic influence on what defines the modern vehicle. Connectivity, agility, mobility and autonomy are new and key influences that force the automotive industry to make ground-breaking changes.

The future car landscape is shaped by fuel economy, environmental efficiency, alternative vehicle ownership options, ride sharing, fleets of (semi-)autonomous vehicles for urban transportation, and more. All these factors are converging into a transformation of the modern car into a digital mobility end-point that actively participates in the Internet of Things (IoT) landscape.

Dell EMC's industry leading technologies are delivering solutions to this emerging automotive world that help the OEMs and Tier 1 suppliers develop vehicles for their customers that are:

- Always On
- Always Connected
- Always Secure

ABOUT DELL EMC

Dell EMC is part of Dell Technologies, a unique family of businesses that provides the essential infrastructure for organizations to build their digital future, transform IT, and protect their most important asset, information. The company services customers of all sizes—ranging from 98% of the Fortune 500 to individual consumers—with the industry's broadest and most innovative portfolio from edge to core to cloud. Dell Technologies family consists of the following brands: Dell, Dell EMC, Pivotal, RSA, SecureWorks, Virtustream, and VMware.

DELL EMC ACROSS THE AUTOMOTIVE VALUE CHAIN

R&D	PRODUCTION	SALES & MARKETING	CAR FINANCIAL SERVICES	AFTER SALES	MOBILE INTERACTION
Supply Chain Collaboration	Production Engineering	Innovative Car Configurators	Customer Self-Service Portals	Enhance After Sales Experience	Connected Car Applications
Test Vehicle File Share	Auto Plant SOP Management & Insights	Enhanced Web Engines	Automate Loans	Online Manuals & Service Information	Customer Mobile Interaction
HPC Engine Test & Analytics	Secure MES Infrastructure	Improved Brand Identity	Improve Asset Utilization	Automate fault & recall management	Traffic Incident Prediction
CAD/CAM Design Infrastructures	Intelligent Machine Learning & Analytics	Online Dealership Security	Augment Post-Sales Business	Maintenance & warranty prediction	Driver identify management
		Sales Funnel Optimization			Data lakes for mobility value chain

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