

An aerial photograph of a two-lane asphalt road winding through a dense forest. The trees are in various stages of autumn, with colors ranging from deep green to bright yellow and orange. A single dark-colored car is driving on the road, moving away from the viewer. The road has white lane markings. The overall scene is captured from a high angle, looking down at the road and the surrounding woods.

CLOUDERA

Driving Automotive Success Through Connected Data

Powering the future of Connected Vehicles
and Connected Automotive with Cloudera

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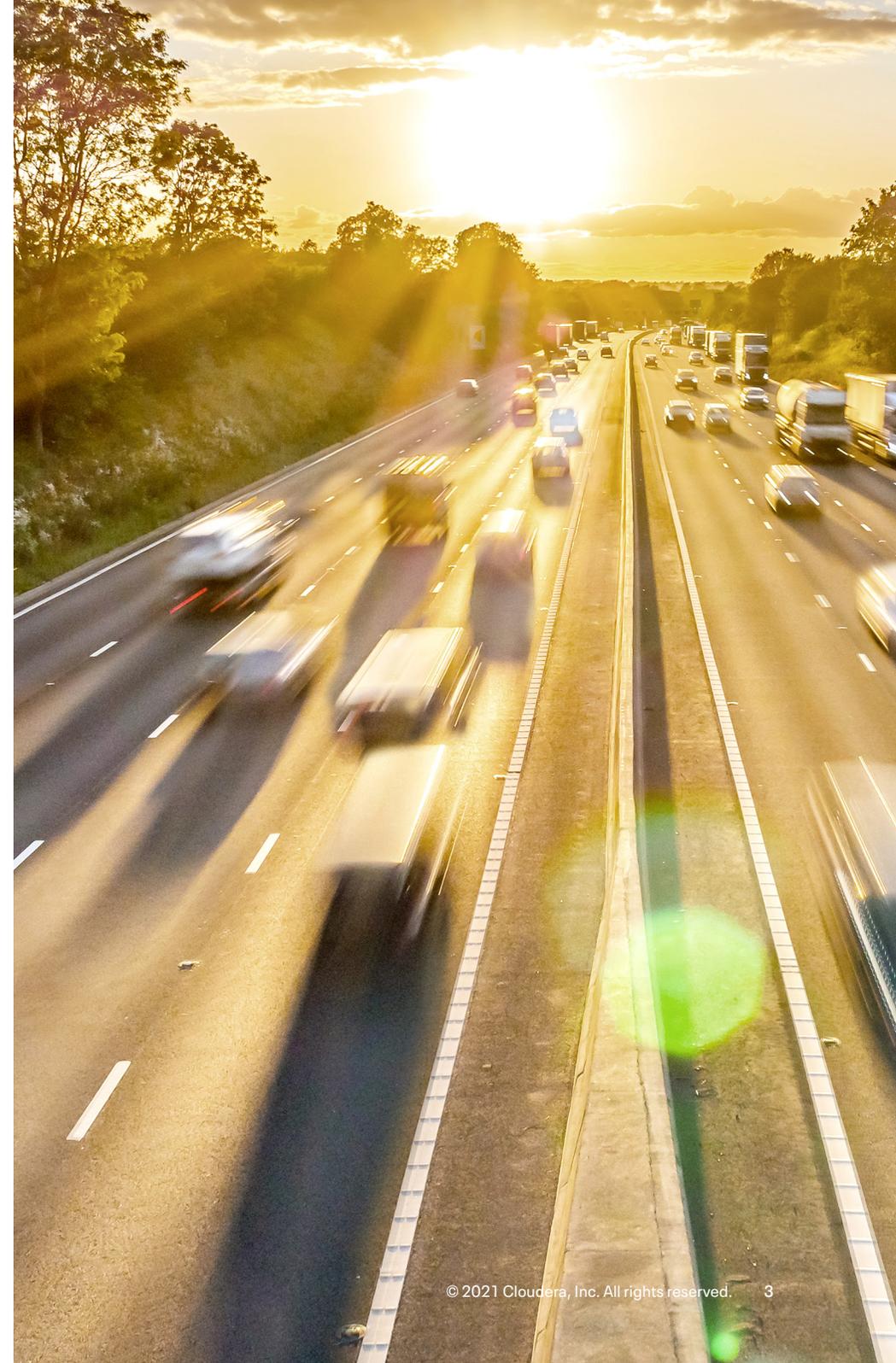
Introduction

The automotive industry has remained largely unchanged for the last century. Today, automakers face huge disruption, which brings with it exciting opportunities—electrification, driverless cars, and a new world of connected mobility.

Of course, the industry faces challenges, and many have been exacerbated by current events. Passenger car production in the EU has hovered around the 16 million mark for the last 10 years¹, yet dropped steeply 25% year on year from 2019², pressuring automakers in profitability and the deployment of capital. Meanwhile, EU-driven legislation, such as the Vision Zero³ initiative—a strategy to eliminate traffic fatalities and ensure equitable mobility—is accelerating the introduction of Advanced Driver Assistance Systems (ADAS), even if the transition to electric vehicles (EVs) has stalled.

Nevertheless, European automakers have embraced new technology and are paving the way in digital transformation, cloud computing and organisational change:

- **BMW:** BMW Group's #NEXTGen⁴ event premiered new additions to its portfolio defining 'the next chapter in the future of mobility', transforming to fully connected vehicles before 2025
- **Volkswagen:** VW aims to have 70 new fully electric models, and build 22 million vehicles on its EV platform, by 2028⁵
- **Renault-Nissan-Mitsubishi:** The alliance has expanded its use of global engineering and production platforms, with Chairman Jean-Dominique Senard stating it offers "a unique strategic and operational partnership in the automotive world, and gives us a strong edge in the ever-changing global automotive landscape."⁶



As of 2019, roughly 60 percent of all global patents in autonomous driving were filed by European organisations.⁷ In the UK, the overall economic and social benefit of connected and autonomous vehicles is projected to be around £51 billion per year by 2030.⁸ Similarly, the global ADAS market is projected to grow from \$27bn in 2020 to \$83bn by 2030, at a CAGR of 11.9%.⁹

However, for automakers to fully realise the potential of Connected Vehicles and Connected Manufacturing, data and analytics must be embraced. Innovations across Cloud, Edge and AI are powering the future of the automotive industry. Data is at the centre of everything because without it, Connected Vehicles are simply not possible. The only way to fully realise the potential of data and analytics is for automotive companies to address the full data lifecycle. This includes the following imperatives:

- To ingest huge volumes and variety of IoT data, from any source
- To manage the complex data in real-time
- To collate and enrich any data type from independent siloes
- To deliver predictive analytics to power advanced use cases
- To ensure security and governance of all data, from Edge to AI

Achieving this can be challenging because it means trying to integrate multiple technologies across each stage of the data lifecycle. For example, ingesting data from Edge devices through one platform and attempting to integrate it with another that data science teams use to build and deploy machine learning (ML) models. The platforms are likely to have different security protocols as data is often stored and managed in multiple environments, a mixture of public clouds, private cloud and on-premises hardware.

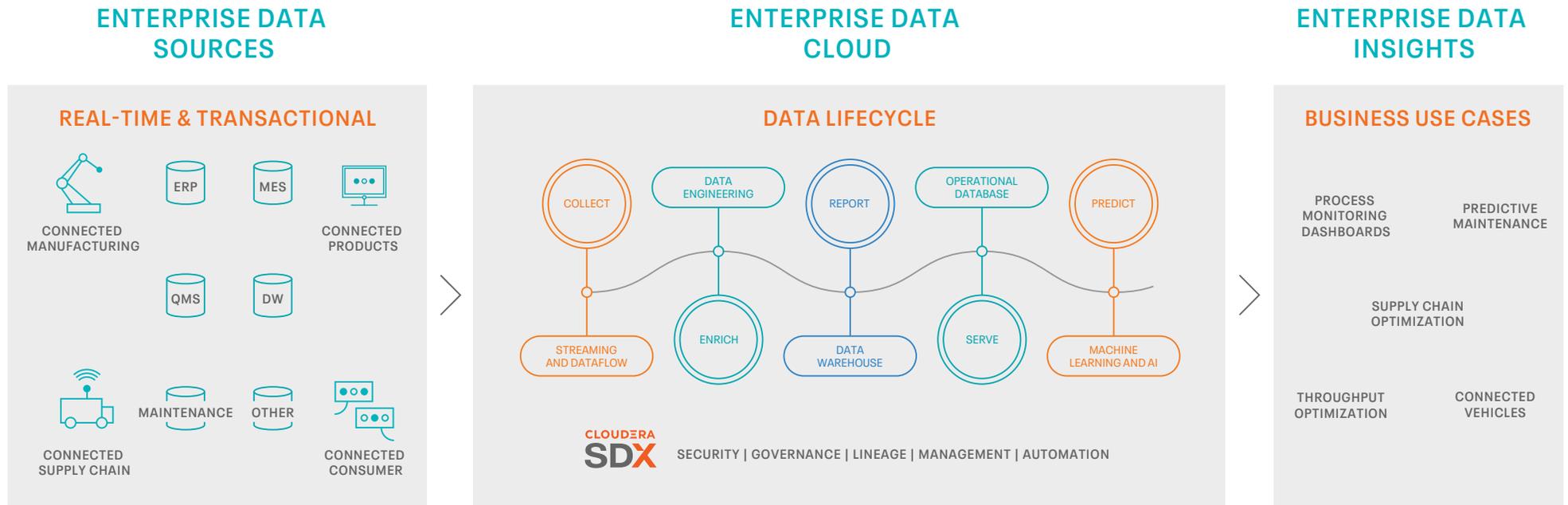
Social benefit of connected
and autonomous vehicles

£51 billion
per year by **2030**

What Does Cloudera Deliver?

At Cloudera, we provide an end-to-end data management platform for the entire data lifecycle. We offer enterprise-grade versions of open source software that enable automotive organisations to manage the full data lifecycle through one platform.

We will now explore how Cloudera addresses three areas that are front and centre of transformation in the automotive industry: Predictive Maintenance, Connected Vehicles and Supply Chain Optimisation.



Why Choose Cloudera?

- **Hybrid and multi-cloud:** run analytics on cloud platforms, and easily and securely move data between on-premises file systems and cloud object stores
- **Analytics, from Edge to AI:** apply real-time stream processing, data warehousing, and machine learning (ML) across shared data, at scale and securely
- **Security and governance:** a common security model with attribute-based access policies on any cloud
- **100% open:** open source, open compute, open storage, open architecture, open clouds. Ensuring integration, flexibility and agility across the data and analytics ecosystem



Predictive Maintenance: Maximising Uptime

Ninety one percent of automotive and discrete manufacturing companies identify reduced repair time and unplanned downtime as their primary priority.¹⁰ Advanced predictive analytics applied to maintenance and monitoring boosts operational performance often measured by Overall Equipment Effectiveness (OEE), by ensuring uptime and streamlined supply chains.

What Does Predictive Maintenance Mean for Automotive Manufacturers?

The inability to forecast when a part, process, or piece of equipment might fail—like an assembly welding robot or metal pretreatment and paint application process—has expensive implications. It is estimated that unplanned downtime costs automakers an average of \$22k per minute.¹¹

Automotive manufacturers can address these implications by continually monitoring real-time operational data from hundreds or thousands of IoT sensors on the plant floor. This data fuels predictive maintenance, enabling machine learning and advanced analytics to correlate trends from more dimensions than a person can comprehend. This includes recording and analysing information about the condition of parts or equipment to detect anomalies in operations, and possible defects in equipment and processes.

In addition to more accurately anticipating a failure and minimising downtime, predictive maintenance enables manufacturers to:

- Better schedule planned downtime to suit schedules
- Optimise equipment and manpower utilisation and uptime
- Reduce long-term maintenance spending by only performing predicted maintenance
- Improve equipment longevity by protecting from failure and downtime
- Maintain high quality products with smooth-running machinery

How Does the Cloudera Data Platform Enable Predictive Maintenance?

Developing an effective predictive maintenance platform has a number of requirements: machine learning models built on clean data; information collected from a multitude of sensors; robust historical records; and the ability to continually update and modernise the models as new process conditions are encountered.

Several examples of the applications of predictive maintenance being applied to the automotive industry include:

Predictive maintenance application	Data input sources (Operational Technology data)	Data input sources (Informational Technology and external data)	Value to business
Robotic welding and assembly	<ul style="list-style-type: none"> Hydraulic fluid temperature and pressure Electric motor electrical draw (amps) Weld location deviation Robot head speed 	<ul style="list-style-type: none"> Inventory stock levels of fluids Build forecast 	Improved weld accuracy, combined with optimised scheduled downtime
Body-in-white metal pretreatment	<ul style="list-style-type: none"> Bath temperature Pump speed Pump temperature Pump electrical draw (amps) Conveyor line motor electrical draw 	<ul style="list-style-type: none"> Inventory stock levels of pretreatment chemicals Demand forecast of autos Replacement part acquisition 	Align pretreatment downtime with stock levels of pretreatment chemicals and replacement parts for optimum downtime
Metal stamping	<ul style="list-style-type: none"> Hydraulic fluid temperature and pressure Electric motor electrical draw and temperature Die temperature 	<ul style="list-style-type: none"> Demand forecast of autos Replacement part acquisition 	Align die replacement and machine maintenance with availability of other stamping processes
The connected car real time monitoring	<ul style="list-style-type: none"> Engine performance (ICE or Electric) Transmission function 	<ul style="list-style-type: none"> Replacement loaner availability Loaner demand forecasting Weather Fleet performance 	Schedule service when it is optimal for the driver

Read More: [Using Data and Analytics to Drive Predictive Maintenance](#)



reduction in
maintenance costs¹²



reduction in
breakdowns¹³



of manufacturers who
deployed predictive
maintenance saw
improvements in one or
more key maintenance
value drivers¹³

Why Cloudera for Your Predictive Maintenance Solutions?

Machine learning model development, testing and deployment success is based upon a platform that can manage real-time data flow and ingestion, leveraging that into robust predictive maintenance applications. With the Cloudera Data Platform, manufacturers can:

- Ingest and manage complex, real-time data
- Merge operational data with enterprise data to manage replacement part supply chains
- Integrate data from across the enterprise and all connected machines to provide enterprise solutions

Case Study: Faurecia

Challenge

Faurecia has fully embraced Industry 4.0 by implementing predictive maintenance analytics through 300+ sensors that significantly reduced plant downtime and sought to deploy more use cases. The continued tough business environment has pressured the company to improve total customer satisfaction at lower cost.

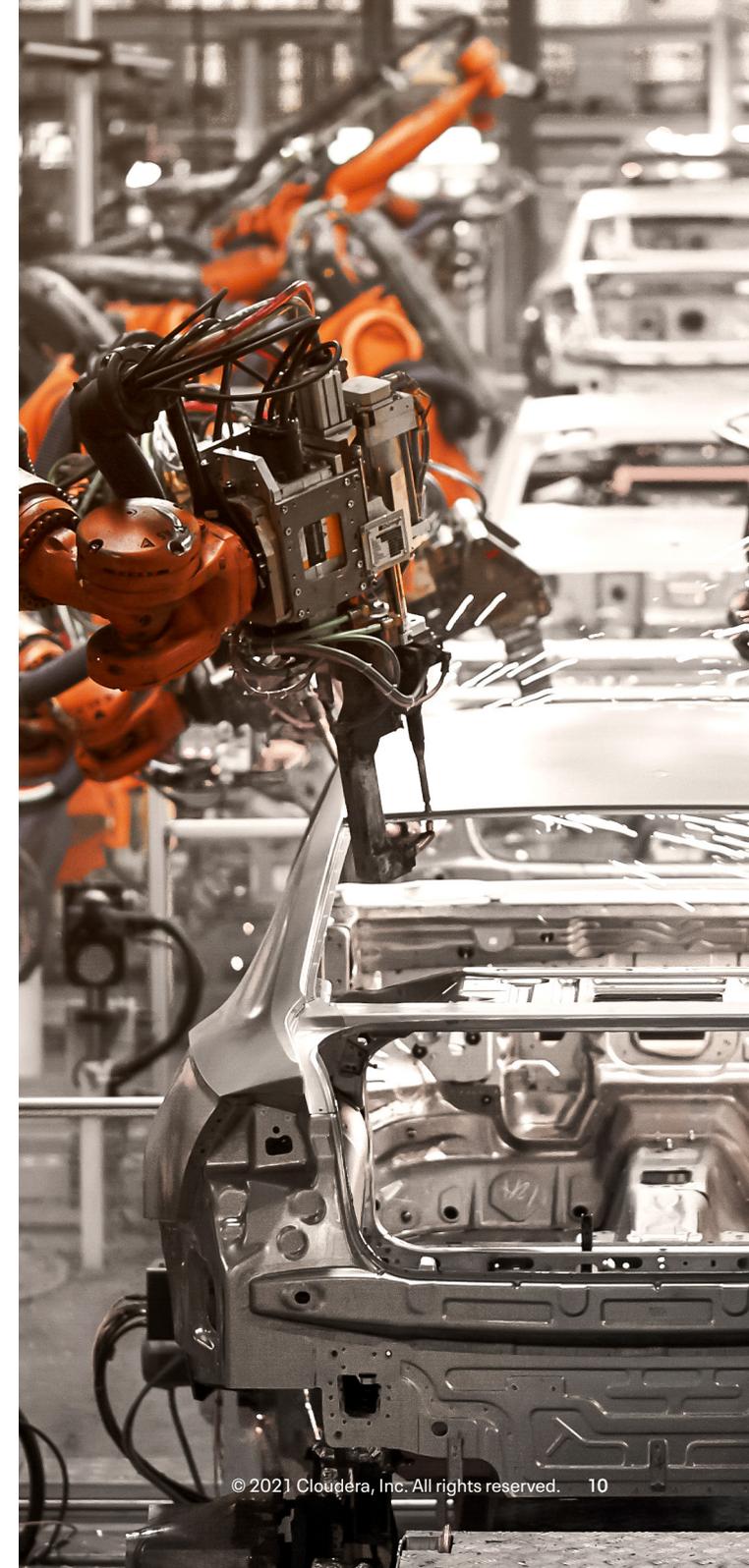
Solution

Faurecia focused on their transformative project, the 'Cockpit of the Future' and expanded the use of the Cloudera Data Platform running on Azure and is focusing on additional use cases centred on predictive maintenance and advanced analytics.

Benefits

Faurecia has expanded into Industry 4.0 across three IoT areas, that included use cases built on computer vision, process optimisation and predictive maintenance. Benefits include higher quality parts without production line stoppages and delays, and lowering manufacturing costs.

- Interiors—cycle time optimisation and injection moulding optimisation
- Seating—cycle time optimisation, computer vision final inspection
- Clean mobility



Supply Chain Optimisation: Improving Operational Agility

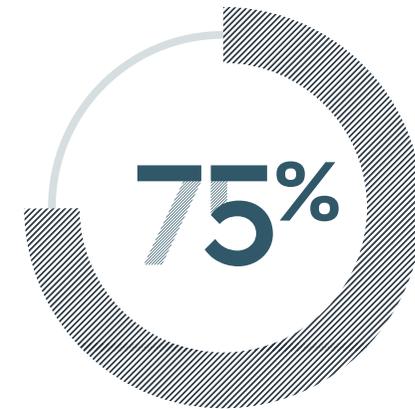
A typical car consists of over 30,000 parts, and the logistics to deliver and source parts are considerable considering auto manufacturing is a global venture. Presently, the automotive supply chain faces additional challenges, ranging from the impact of a global pandemic, geo-political issues, to shortages of components like semiconductor chips to power Connected Vehicles.

What Does Supply Chain Optimisation Mean for Automotive?

The process of transformation from raw material, to component, to installation at Volkswagen requires each material to pass through 15,000 stations in the course of product, treatment, finishing, and transportation.¹⁴ Automakers have to consider not only speed, cost, and efficiency, but also the sourcing and recycling of materials and environmental impact. Hence why BMW, Volvo, and Daimler have joined initiatives to ensure ethical conditions are met for the mining of cobalt, a toxic material for manufacturing lithium ion batteries.¹⁵

The interconnection of the supply chain, applying IoT, robotics, automation, and big data analysis can vastly optimise supply chain management. Integrating internal data sources (like warehouse stock levels and production run rates), external (including interest rates, weather, tax incentives, or road conditions), and real-time demand signals (open orders on the books) is crucial for realising a next-generation digital supply chain.

Supply Chain 4.0 has the potential to reduce lost sales by



deliver up to 30% fewer transport and warehousing costs, and decrease admin costs by 80%¹⁶

How Can the Cloudera Data Platform Support Supply Chain Optimisation Solutions?

Cloudera offers an end-to-end data management and analytics platform that enables automotive manufacturing organisations to ingest, process, analyse, and model both real-time and historical data to drive supply chain insights. With the Cloudera Data Platform, this can provide automakers with the ability to:

- **Access data for real-time connected supply chains**
 - Easily build data ingestion flow via intuitive visual UI
 - Aggregate, prioritise, compress, and encrypt supply chain data
 - Automatic handling of system interruptions, network issues, etc.
- **Store and process data**
 - Manage data lakes for all types of supply chain data (structured and unstructured)
 - Cloud, on-prem, hybrid deployment options
- **Conduct advanced data analytics**
 - Stream processing for actionable insights, rationalise movement of supply chain data
 - Develop, deploy and manage streaming analytics apps with drag and drop
- **Keep data secure**
 - Secure data acquisition and transport from Edge to Cloud and return

Read More: [How to Fight Supply Chain Whiplash with Supply Chain 4.0](#)



Why Cloudera for Automotive Supply Chain Optimisation solutions?

The Cloudera Data Platform aggregates structured and unstructured data across a variety of systems, delivering a solution for real-time, connected supply chains, bringing benefits that include:

- **Procurement and spend analytics**—aggregate and analyse purchasing data across systems to identify opportunities to reduce spend
- **Sourcing optimisation**—discover and monitor key variables to optimise current buy events, reduce purchasing spend and reduce supplier risk
- **Inventory visibility and tracking**—monitor, track and visualise inventory with location and sensor data to reduce lost inventory, reduce counterfeit risk, and increase agility
- **Demand analytics**—combine historical demand data with key variables and contextual factors, to shape demand for current conditions, reduce inventory costs, and improve service levels
- **Inventory optimisation**—combine and correlate historic inventory data with contextual variables in real-time to improve inventory placement and minimise disruptions and risk
- **Logistics route optimisation**—histories of time-stamped route data, and discover and monitor variables to reduce disruption, risk, and distribution costs, and minimise carbon footprint

Case Study: Intel

Challenge

Intel was facing a challenge with 'dead inventory' for its machine parts and was losing money scrapping parts it couldn't return. A lot of this inventory was kept onsite, adding warehouse space costs and operational costs. Intel needed to establish analytical capabilities that could account for:

- Forecasting the consumption of spares
- Supplier stock levels across the network
- Supplier SLA to deliver parts
- Criticality of parts

Solution

Data silos and inaccuracies in demand forecasting presented an environment for ML, big data, and statistical algorithms. Cloudera implemented a user-centred design with seamless cross functionality across organisations and suppliers, unlocking the value of data by leveraging analytical algorithms to deliver insights.

Benefits

- Dead inventory identified with **92% accuracy**
- Forecast modelling to consolidate demand signals across the supply chain
- Time to decision reduced from 6 months to 1 week
- **Saving of \$23m by selling back inventory**

Enabling Connected Vehicles: Intelligent Mobility Through Data

The global market for Connected Vehicles is expected to grow by 270% by 2022,¹⁹ with revenue projected to exceed \$24bn by 2025.²⁰ To play a part in the future of the industry, there are key challenges automakers need to address. McKinsey,²¹ for example, sees the increased need for global platform sharing, modular systems, and meeting environmental and safety regulatory standards as tools of success. Diverging markets should adapt to new needs and markets in order to meet consumers digital demands and restructure for a shifting industry landscape.

The latter—including developing alternative powertrains, active safety, infotainment, and connectivity—is vital for the future of the industry. These have little to do with vehicle assembly, and a lot to do with data. In particular, Connected Vehicles need to ingest, store, and analyse huge volumes of data to:

- Train autonomous vehicles to drive themselves
- Meet high bandwidth needs of data in motion
- Enable predictive maintenance and advanced vehicle diagnostics
- Power Advanced Driver Assistance Systems (ADAS)

What Do Connected Cars Mean for Automotive?

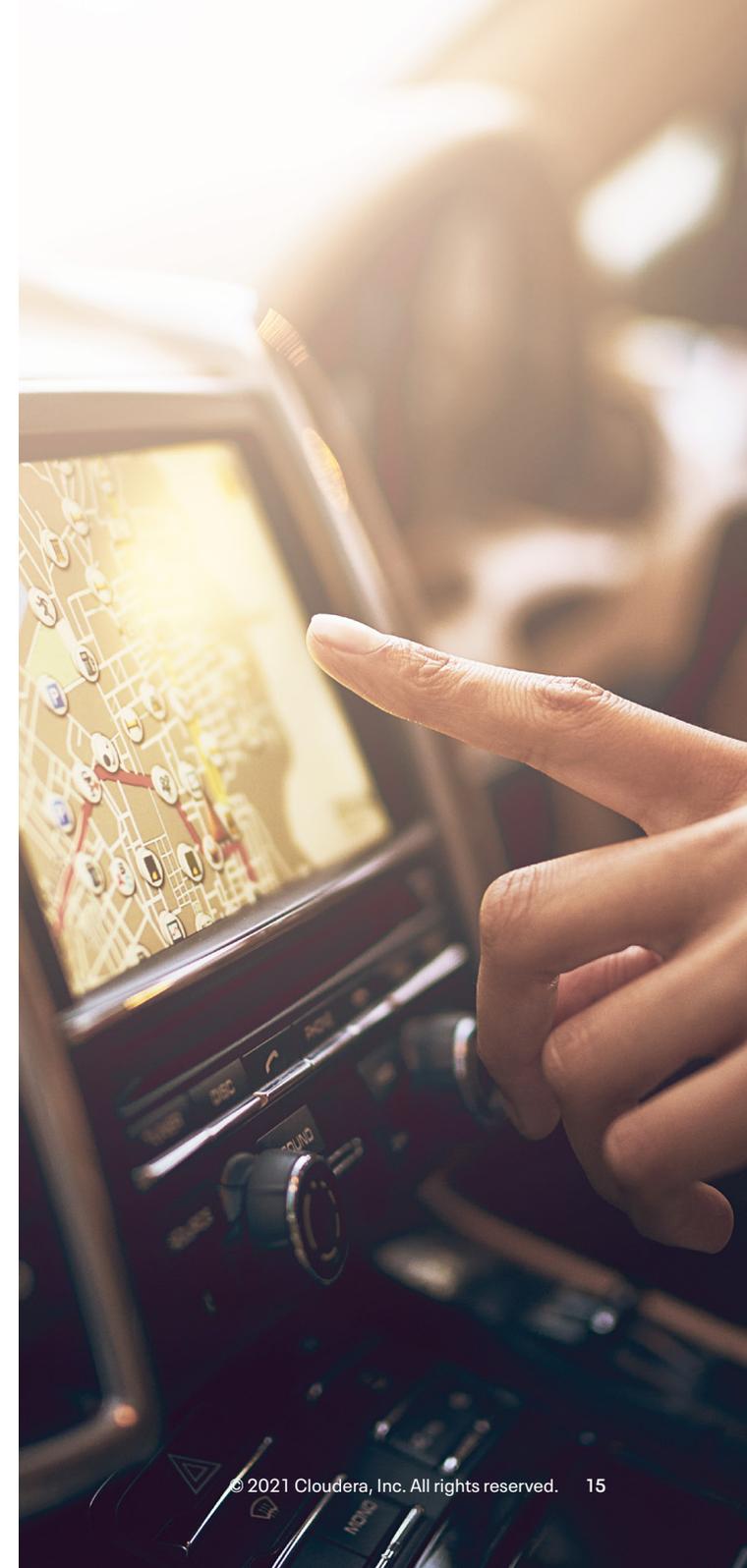
Machine learning models perform better when trained on large and varied datasets. However, as advanced Connected Vehicle use cases move forward, the existing infrastructure of connected cars is being stressed—too many wires, too many GPUs. Automakers have had a disjointed approach to data management within the machine learning lifecycle, along with limited ability to deploy and scale new use cases. Moreover, fragmented data across the ML lifecycle is limiting the ability to ingest and combine data, limiting the integration between platforms, and the ability to provide end-to-end data security. Critical to this reality is a high performance, scalable, and reliable data management platform.

Connected car
shipments are expected
to rise to over
77 million
by **2025**,
up from 33 million
in 2017²³

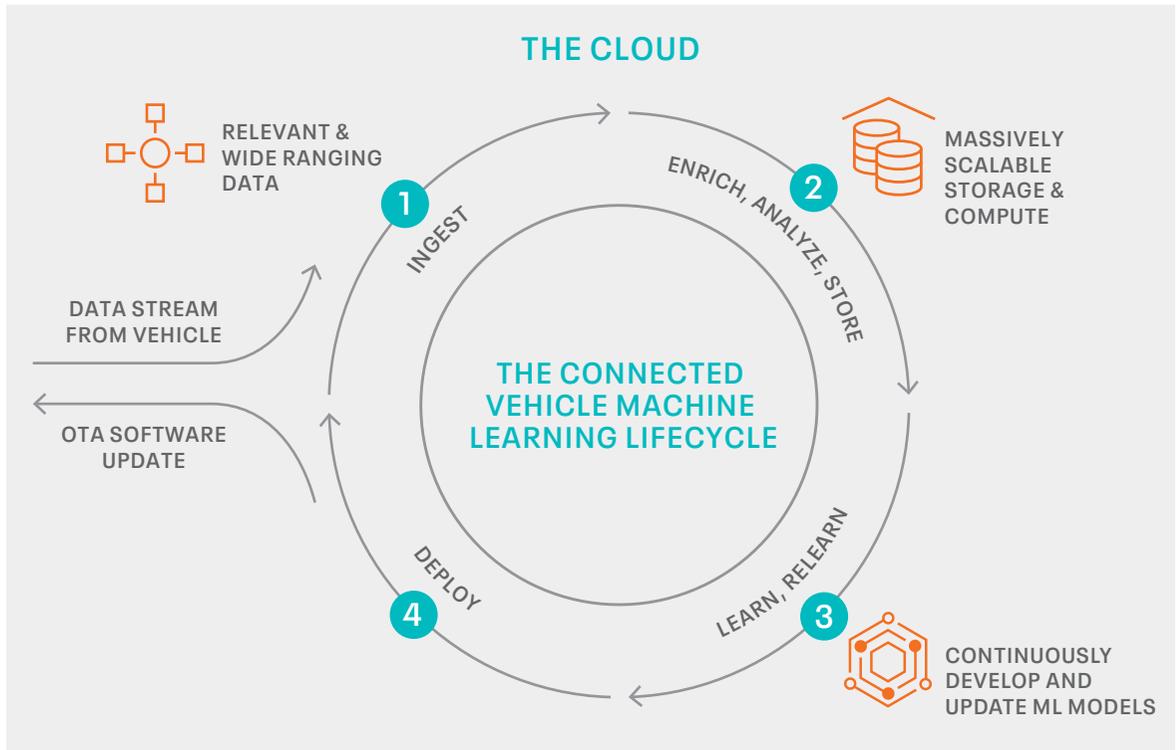
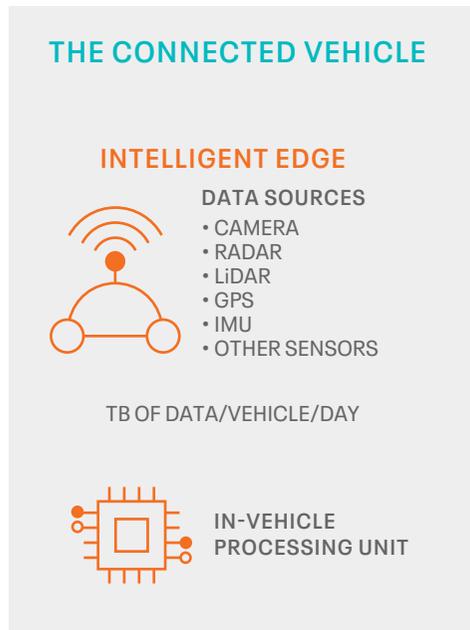
How Can the Cloudera Data Platform Support Connected Car Solutions?

The Cloudera Data Platform is a solution with an integrated set of capabilities that are able to ingest and process the volume, velocity, and variety of data required to support every phase of the data lifecycle for Connected Vehicles.

- **Data collection:** Connected Vehicle telemetry data, in addition to ADAS related data sources and ultrasonic sensors is collected, creating real-time data streams
- **Machine learning:** leveraging histories of Connected Vehicle data, machine learning models are generated and continuously updated for use cases ranging from emergency and location-based services to ADAS
- **Data storage and processing:** data is collected and processed across on-premise data centres, or cloud platforms, providing elastic storage and compute resources that are scalable to demand, enabling data storage, processing and self-service analytics incorporating petabytes of data
- **Edge processing and analytics:** within the vehicle, Edge processing of vehicle data, leveraging the execution of intelligent AI/ML inference models, is applied to data streams. Next, data is intelligently filtered, prioritised and securely and reliably transmitted to the Cloud
- **Deployment of models:** rapid remote deployment of new or updated applications and services, machine learning models, and security and safety patches are provided via over-the-air (OTA) software updates



The Connected Vehicle Machine Learning Lifecycle



Read More: [Winning in Autonomous Driving with Cloudera Data Platform](#)

Why Cloudera for Your Connected Car Solutions?

Cloudera has collaborated with Airbiquity, NXP, Teraki and Wind River on The Fusion Project—an integrated solution to define, implement, and offer a data lifecycle platform enabling and optimising future connected and autonomous vehicle systems. This platform includes Intelligent Edge network processing, embedded edge operating systems, over-the-air updates, and advanced analytics and machine learning. It allows automotive organisations to choose and train their own ML models **10x faster**. Other benefits of this solution include:

- **End-to-end data management:** platform enables automakers to efficiently collect, analyse, and manage Connected Vehicle data for continuous feature development, deployment, and evolution.
- **Production grade:** pre-integrated platform makes it easier for automakers to conduct technical evaluations and introduce the solution into the current vehicle production process.
- **Openness and flexibility:** automakers can conceptualise, create, improve, and own their own ML algorithms and become 'IP-independent' of ADAS/AD software suppliers.
- **Scalability:** platform can be used to enable multiple wide ranging use cases across connected intelligent vehicles, thereby amortising your technology investment
- **Security:** data security throughout the data lifecycle from in-vehicle to cloud and return

Read More: [Enabling intelligent connected vehicles with a connected data lifecycle](#)

Case Study: Navistar

Challenge

Unconnected vehicles were limiting new business opportunities and triggered high fleet and maintenance costs. Navistar needed Cloudera to deliver IoT-enabled predictive maintenance, vehicle diagnostics and management, and route optimisation to help fleet and truck owners minimise vehicle downtime.

Solution

Cloudera created new business using IoT as a PaaS. The platform brings in over 70 telematics and sensor data feeds from more than 375,000 Connected Vehicles, including engine performance, speed, acceleration, coolant temperatures and brake wear. This data is correlated with other Navistar and 3rd party meteorological, geolocation, traffic information, and more. The solution's roots are predictive maintenance, but by leveraging external data, they have created a new business segment with clear benefits to their customers

Benefits

- Helped fleet and vehicle owners **reduce maintenance costs by more than 30%**
- Predictive maintenance and logistics as a service **reduced maintenance costs from \$.12-.15 per mile to \$.03 per mile**

Conclusion

At Cloudera, we believe that data can make what is impossible today, possible tomorrow. Whether your organisation wants to power Connected Vehicles, optimise your supply chain, embrace predictive maintenance—or leverage data and analytics to grow, protect or connect your business—we are here to help.

Cloudera Data Platform (CDP) is an enterprise data cloud for any data, from any source, that runs in any cloud, on-premises or hybrid environment. CDP provides enterprise-grade data governance and security that allows for Information Technology and Operational Technology data convergence. This brings data that runs the business and data generated from the manufacturing process into one platform where enterprise-wide use cases can be leveraged for real time business insights and decisions.

Cloudera is deeply involved in the transformation of the automotive industry. The case studies in this eBook are just a sample of the work we are doing in Predictive Maintenance, Supply Chain Optimisation and Connected Vehicles. If you are seeking support in any of these areas or simply want to better understand how Cloudera can support you with data management and analytics, get in touch today.

Further Reading

[Cloudera Connected Manufacturing Resource Kit](#)

[Cloudera Connected Vehicle Resource Kit](#)

[The Fusion Project](#)

Learn More

About Cloudera

At Cloudera, we believe that data can make what is impossible today, possible tomorrow. We empower people to transform complex data into clear and actionable insights. Cloudera delivers an enterprise data cloud for any data, anywhere, from the Edge to AI. Powered by the relentless innovation of the open source community, Cloudera advances digital transformation for the world's largest enterprises.

Learn more at cloudera.com | US: +1 888 789 1488 | Outside the US: +1 650 362 0488

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