Driving AI Across the Automotive Lifecycle

How to maximize the AI opportunity and build the automotive business of the future

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Artificial intelligence and machine learning (AI/ML) have the potential to completely change mobility as we know it. The car of the future will no longer have just an engine under its hood—it will be powered by data and AI. From R&D, supply chain, and production to sales and customer service, AI is already transforming value creation and delivery in the automotive industry.

AI has the power to turbocharge productivity and profitability. In fact, the automotive and manufacturing sector is forecast to reap tremendous financial benefit from AI adoption—with a gain of $3.8 trillion expected by 2035, according to Accenture. In this paper, we'll explore how automotive companies can deploy trusted AI across the product lifecycle to harness its potential. Our goal is to provide a roadmap for enhancing your business with applied AI solutions that deliver measurable value. Read on for an in-depth look at the opportunities, use cases, and capabilities required across the whole automotive lifecycle, and learn how AI/ML can transform your business, starting today.

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Caution:
AI silos ahead

Efficient R&D, autonomous vehicles, smart production, resilient supply chains, customer insights, connected services, and new business models: the list of opportunities for AI to drive competitive advantage in the automotive industry is extensive.

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Millions of interactions throughout the vehicle lifecycle generate data, from R&D to smart machines in factories, sensors in vehicles, and interactions between brands and customers. Yet the majority of this data sits in isolation. By integrating and harmonizing this data across your organization, you can find new ways to understand, engage, and delight your customers. But you'll need seamless data management, strong governance, democratized access, and powerful processing to drive the AI and analytics algorithms that deliver value.

In the next sections, we'll explore AI uses cases as they apply to the following four processes:

01 Create

Capture data from across your business, then deploy AI to continuously optimize design and delivery of new technologies and test product innovations in shorter R&D cycles.

02 Build

Capitalize on smart factory technologies to deliver OEE uplift through AI guidance on maintenance, operational settings, and data-driven inspection. Build resilient supply chains that adjust to the demands of flexible manufacturing and global disruptions.

03 Sell

Personalize vehicle sales by anticipating opportunities and customer preferences for an optimized digital sales journey through multiple ownership cycles.

04 Use

Expand business opportunities by connecting vehicle services, personalizing customer experience, and strengthening loyalty. Leverage vehicle data to provide early warning into warranty, and predict demand for parts, new features, and service offerings.

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Create

AI empowers manufacturers with the ability to continually learn and adapt from the wealth of data generated by vehicle sensors and driver behavior.

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AI is embedded in vehicles to enhance driver experience and safety, requiring continuous monitoring and retraining. The key to superior end-user functionality? An efficient model training process.

Today's R&D process has become a continuous learning process. Consumer expectations are met through agile development cycles for personalized optimization of vehicle performance—long after the vehicle leaves the showroom.

For today's connected consumers, personalized digital experiences have become the norm—and vehicles are no exception. AI is not a luxury, but rather a necessity to meet these demands. It's revolutionizing vehicle functionality and the R&D process itself.

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Harnessing AI for vehicle design and profitability

Vehicle design and manufacturing are complex processes. Manufacturers are pushed to create innovative, customer-pleasing vehicles with strong warranties at reasonable price points while meeting increasingly stringent regulatory requirements. Shareholders expect them to do so efficiently enough to maintain or grow profits. At the same time, they are forced to undergo a massive transformation in business model—from a traditional vehicle producer to a technology company that provides mobility solutions.

This is no easy task, which is why many analysts think implementing AI in R&D is a game-changer. According to a McKinsey survey, generative AI alone offers potential improvements of 10-20% overall and up to 70% in some tasks.[1]

AI can also enhance profitability by providing insights and detailed visibility into every component, part, and process, enabling accurate cost-based understanding. It can predict component pricing and illuminate vehicle usage and performance at the feature level, guiding and prioritizing development.

Three key steps to creating value from AI

Manage uncontrolled data growth
AI requires lots of high-quality data. AI can be deployed to speed the tasks of integrating and harmonizing data across the organization.

Build a flexible, open, and connected ecosystem
Whether you use a public or custom large language model (LLM), you need the freedom to use preferred tools and technologies without duplicating data.

Scale trusted and cost-effective AI
As AI is deployed across the enterprise, you need the capabilities to deliver accountability, security, and trust while controlling costs and increasing data scientist productivity.

1. Tesla AI and Robotics webpage

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Accelerating AI for ADAS

Modern vehicles are becoming increasingly reliant on code, and much of that code is AI. Tesla has stated that a full build of Autopilot involves 48 individual networks making decisions on a near continuous basis.[2]

These models must be evaluated and trained on a variety of detailed data from cameras, sensors, and GPS. By accelerating the data pipeline to build a multipurpose comprehensive dataset, engineers and data scientists can spend more time improving models. The result is faster innovation and a better customer experience.

2. Tesla AI and Robotics webpage

How to implement it

Target pricing and profitability

Automate and accelerate the process of component target pricing through clustering techniques and neural networks for price prediction.

Workforce productivity

Use generative AI to reduce the burden on engineers for documentation and audit preparation tasks.

Prototype productivity

Reduce prototyping costs by evaluating designs using data and anaytics before building a prototype.

Testing optimization

Reduce redundant physical component and sub-system testing using rapid surveys of tests already performed; customize test plans based on prior field failures.

ADAS

Accelerate ADAS AI learning cycles through efficient data harmonization across disparate datasets and types.

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Driving profits at DHL Express

DHL Express implemented a transformational project to modernize their costing system. They leveraged Teradata Vantage™ to create a single, unified analytical environment supporting cost, profit, and yield management with detail down to the route, service center, country, and region. This increased productivity of team members and identified 200 opportunities worth over $20M in savings.

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Build

Global supply shortages in 2020 and 2021 marked the beginning of a series of disruptions, including shipping interruptions, fluctuating tariffs, and geopolitical tensions. In general, inventory holdings have increased to buffer against disruption, but this solution is not sustainable. Continual disruptions imply the need for improved operational agility, which can only be driven by improved visibility across the inbound supply chain and production.

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Despite these challenges, automakers have achieved some progress towards deploying Industry 4.0. Yet realizing full value from Industry 4.0 and Industry 5.0 will require production data to be woven into a digital fabric that accurately represents the state of production of all individual components and vehicles. Success of both Industry 4.0 and supply chain agility hinge on the same requirement: a granular, integrated dataset capable of supporting the rigorous demands of multiple AI projects.

According to McKinsey, machine learning can make the greatest value contribution in the manufacturing process. "Up to $61 billion can be saved in production, for example through AI-based quality control," write the analysts. There is further potential in purchasing ($51 billion) through greater transparency in the supplier market and in intralogistics ($22 billion) through autonomous belt delivery.

The industry's exceptional record of efficiency is at risk due to ongoing supply chain disruptions since 2020. As a result, it's essential to increase process agility so we can continue to uphold high standards.

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Make your supply chains resilient

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The COVID-19 pandemic and subsequent global events have laid bare the vulnerabilities of global supply chains and shifted focus toward supply chain resilience. Automotive companies must strike a balance between agility, resilience, quality, service, and cost in today's increasingly dynamic world.

Traditionally, supply chains have been split into silos so humans could better manage their enormous complexity and scale. As a result, gaps exist in data, information, and visibility between silos. By combining and harmonizing data across silos, AI enables you to manage this complexity at an enterprise scale. The results are improved process efficiency through end-to-end visibility in near real time.

The right AI-enabled supply chain data platform can add crucial resilience to your business. It can offer early warnings about potential disruptions in production and strategies to minimize these risks. Working in concert with AI models, it helps your team make informed decisions in the moment and for long-term strategic supply chain planning.

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Scale the benefits of Industry 4.0

Harnessing Industry 4.0's full potential across factories is tough. Many organizations get stuck on the initial hurdles, like "pilot purgatory," where created a functional pilot but struggle to scale or integrate insights. Without a scalable data platform, "use case purgatory" may follow, where isolated projects build their own data pipelines, gobbling up resources and blocking the creation of other projects.

Even with advanced AI and lower compute costs, Industry 4.0's value hinges on the creation of a digital data fabric. Manufacturers must master efficient data harmonization and reuse across the tens of thousands of AI models required for successful large-scale Industry 4.0 deployment.[3]

3. Andrew Ng

How to implement it

Supply chain network design

AI algorithms can assist in data preparation, synthetic data creation, calculation and confirmation of planning parameter values, and conducting comparative simulations.

Live integrated business monitoring

AI can constantly compare actual performance against planning goals. It can predict KPIs and target achievement, thereby enabling agile adjustments when necessary.

Anonmaly detection

Using time series curve clustering, AI can identify patterns in machine sensor data that identify weak signals of quality drift. It can correlate production circumstances with outcome quality, fueling continuous process improvements.

Production efficiency

By creating an accurate historical timeline of all work orders and production units, factories can gain valuable insights into OEE improvement, increasing output and closely monitoring shop floor inventory.

Encoding product DNA

AI can encode patterns in machine sensor data during the production of individual items, building the foundation for full traceability and rapid, quality root-cause analytics.

Teaching LLMs the language of supply chain

A global, fast-moving consumer goods company with an existing supply chain data platform was able to train a large language model (LLM) on data from across their outbound supply chain. Using Teradata Vantage, they're able to continuously source and analyze complex supply chain data, then deploy generative AI models for optimal routings in real time.

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Enhancing process monitoring at Volkswagen

With "spot-welding analytics," an interdisciplinary team from Volkswagen, AWS, and Teradata has created an intelligent solution that enables greater transparency and efficiency in car body construction. The solution integrates and analyzes data generated by welding robots—a previously untapped source of manufacturing data. Spot-welding analytics is already in use today at the Volkswagen plant in Emden, Germany, where it is transforming the body shop into a digitized factory.

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"The use of process data for 100 percent process monitoring is a decisive step towards the smart factory and will be the basis for further applications that contribute to continuous improvement."

— **Mathias Boomgaarden,**
Project manager at Volkswagen's Emden plant

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Sell

Beyond the software-defined vehicle, AI is a key enabler for automotive brands to foster deeper connections with their customers. These connections can ensure more relevant experiences for individual customers, leading to increased loyalty and wallet share.

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AI uses data from all consumer touchpoints across an automotive brand to gain valuable insights into customer preferences, driving habits, and lifestyle choices. This data-driven approach enables a more personalized customer experience. And it creates a virtuous cycle where the more consumers interact with brands. The better automotive companies can create personalized experiences, vehicle features, and services consumers really want, the more vehicles and services they will sell.

Increasingly, new vehicle decisions are being made online with as little as one or two dealership visits to confirm and finalize option choices. Services and features available after purchase to improve the vehicle are offered digitally.

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Personalize the digital purchase journey

As customers continue to lean into online channels when making purchase decisions, brands are investing heavily in the online, in-vehicle and in-app sales journeys. To get the maximum return from this significant investment, organizations must understand the purchase journey.

The first step is integrating data from customer interactions during all parts of the sales cycle—dealership, vehicle, or aftermarket upgrades—to build individual customer profiles.

From this base of understanding, brands can optimize campaigns and content, integrate online and offline portions of the journey, and guide customers in real time to improve conversion ratios.
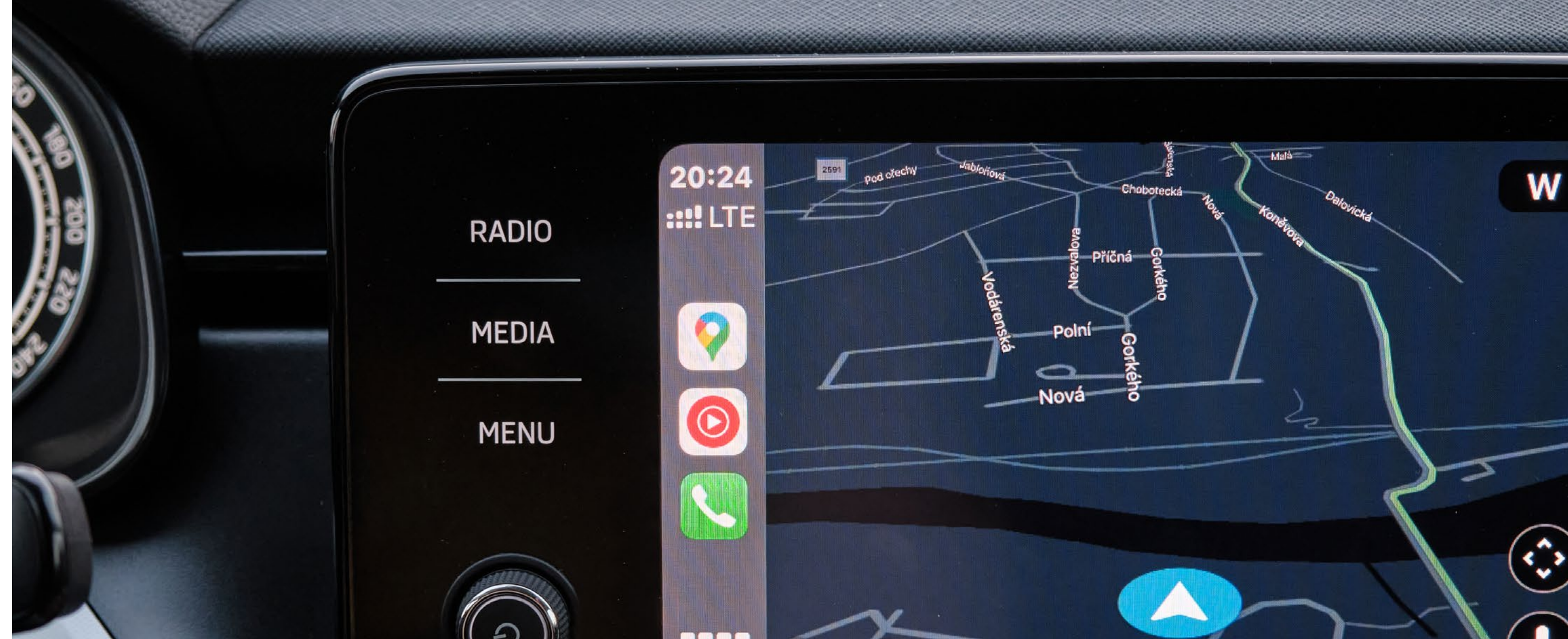
How to implement it

Hyper-personalized sales cycles

Individual customer profiles can feed generative AI algorithms via retrieval-augmented generation (RAG) to align explicit customer preferences with predicted interests.

Digitalized sales processes

Completed transactions—both vehicle sales and upgrades—can be compared with abandoned transactions. Path analytics can highlight common failure points in the sales journey, reducing friction.

Increased customer conversions

Guide customers down the path that increases the probability of a sale. Automate paths in real time through a website or deliver using sales tools and CRM platforms.

Deploying generative AI in shopping carts

A brick-and-mortar retailer collaborated with Teradata to introduce smart carts. These carts offer context-based product recommendations using a custom LLM. By using generative AI, the retailer can offer unprecedented personalization and upselling opportunities at scale while considering real-time factors such as stock levels and current promotions.

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Use

As we've seen, vehicle data doesn't only help sales understand customer behavior. It's a rich resource with multiple applications.

The software-defined vehicle and modern customer expectations are accelerating the vehicle development cycle. To ensure high-quality offerings amid faster development cycles, organizations will need visibility and insights into the usage and performance of new drivetrains, vehicle models, and digital service offerings.

Data-backed insights on customer usage patterns can foster the creation of vehicles that more closely align with customer needs. Vehicles can be pre-configured to individual preferences for returning customers, and all users can be subtly guided in their usage patterns to fully utilize features or services they might be unaware of.

Proactively reduce warranty claims

When it comes to field defects, time really is money. Even with strong checks for quality, some defects may still occur, affecting physical components or presenting as software issues in the ever-increasing software component of vehicles.

Each day that a defect goes undetected increases the number of cars at risk of reproducing the problem, leading to more warranty claims. The more quickly defects are found and fixed, the fewer vehicles are affected, and the fewer possible warranty claims.

Accenture predicts revenues from digitally enabled services is set to rise to $3.5 trillion by 2040.[4] To earn their share, automotive brands must harness vehicle data to enhance the customer experience, improve operational efficiency, and create new revenue streams.

4. "Moving into the software-defined vehicle fast lane," Accenture, 2022

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Driving efficiency: The role of AI in commercial fleet services

The fleet management services market, spanning from vans to long-haul trucks, is highly competitive. Established brands increasingly offer comprehensive service solutions alongside their vehicles. Meanwhile, new entrants, despite not manufacturing vehicles, are leveraging applied AI technologies to disrupt the industry by offering aftermarket fleet services.

Most service offerings rely on vehicle data, with GPS and telematics playing a central role. Here, vehicle manufacturers hold an advantage due to default access to vehicle data and the ability to seamlessly integrate services into their vehicles' infotainment systems and paired apps.

However, new market entrants excel in agility and perceived innovation, adapting swiftly to evolving market demands without legacy IT constraints.

Empower confident decision-making

Leverage AI-driven insights for better fleet capacity management, live routing optimization, and fleet financial planning.

The urgency lies in seizing early success and agility. As the commercial vehicle service market evolves, rapid adoption of your services translates to deeper customer insights. In turn, these insights can feed increasingly advanced AI applications that allow you to offer increasingly personalized and differentiated services, building a powerful network effect.

To remain agile in providing competitive solutions, organizations must establish efficient data preparation processes. Leveraging AI and analytic tools, organizations can extract essential features from the high-volume, high-velocity data streams generated by vehicles. This pipeline becomes the backbone for agile service offerings.

How to implement it

Signal prioritization

To save engineers time, ML techniques can be used to sift through massive volumes of data, highlighting key information and potential fault indicators.

Early failure warning

AI can help predict failures, providing insights on safety concerns, failure rates, and repair costs that enable the finance team to more effectively manage warranty reserves.

Failure hypothesis reduction

AI aids in narrowing down potential causes of failures. Tools like decision trees are particularly useful in this context.

Vehicle availability

More accurately predict availability by running models at the component level and considering complete vehicle service history and operating context.

Service contracts

Using data on prior repairs and spare part demand forecasts, AI can predict a shop's demand for service techs, enabling them to effectively to meet service-time guarantees.

Expanded service offerings

Establishing a high-volume, high-velocity data pipeline enables expanded offerings like performance and usage monitoring and real-time alerting.

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Unleashing AI productivity at a leading Asian bank

A bank with an established AI practice was limited to deploying an average of 6 models in production per year. Their deployment was limited by a one-pipeline-per-process methodology and architecture, severely restricting their ambitions and value delivery.

By implementing a feature store to break down pipelines and leveraging Teradata's Bring Your Own Model capabilities to reduce data movement, the bank realized a 50x improvement in AI productivity.

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Unleash AI innovation with Teradata

To achieve full potential from AI, automotive manufacturers will need tens of thousands of models. To scale and manage this volume of data and models, organizations need Teradata VantageCloud, the most complete cloud analytics and data platform for AI.

Teradata enables businesses to drive value from trusted and cost-effective AI across the enterprise. Our industry-leading platform and advanced analytics capabilities, ClearScape Analytics, are is trusted by the world's largest automotive manufacturers to enable:

- Seamless orchestration and preparation of IoT, OT, and IT data for AI use cases

- Unsurpassed workload efficiency to deliver long-term sustainable performance

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Contact a Teradata expert to discuss how we can help your organization overcome common data challenges and develop an AI strategy that can help you lead the AI-driven future.

Learn more at teradata.com.

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