AI Value in Manufacturing

How to maximize the AI opportunity and become the agile manufacturer of the future with the latest AI technologies

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Artificial intelligence and machine learning (AI/ML) have the potential to completely change the manufacturing industry as we know it. From R&D, supply chain, and production to sales and customer service, AI is already delivering value and transforming processes in the manufacturing industry.

AI has the power to turbocharge productivity and profitability. In fact, the 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.[1]

In this ebook, we'll explore how manufacturers 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 value chain, and learn how AI/ML can transform your business, starting today.

1 How AI Boosts Industry Profits and Innovation," Accenture, 2017.

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Caution: AI silos ahead

Efficient R&D, 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 manufacturing industry is extensive. But the full potential of AI cannot be achieved by AI silos. AI must be implemented at scale, and integrated into business processes.

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Millions of interactions throughout the product lifecycle generate data, from R&D to smart machines in factories, sensors within logistics, and connected products 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
Enhance OEE with AI-driven maintenance and quality inspections. Build resilient, adaptable supply chains to accommodate flexible manufacturing and global disruptions.

03 Sell
Personalize product sales through a deep understanding of customer or consumer preferences to anticipate opportunities and optimize multi-channel sales journeys.

04 Use
Expand revenue streams and opportunities by connecting smart products to personalize experiences and leverage IoT data to predict product demand,new feature requirements, and service needs.

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Create

AI empowers manufacturers with the ability to continually learn and adapt from the wealth of data generated by smart and connected products, amplifying R&D efficiency.

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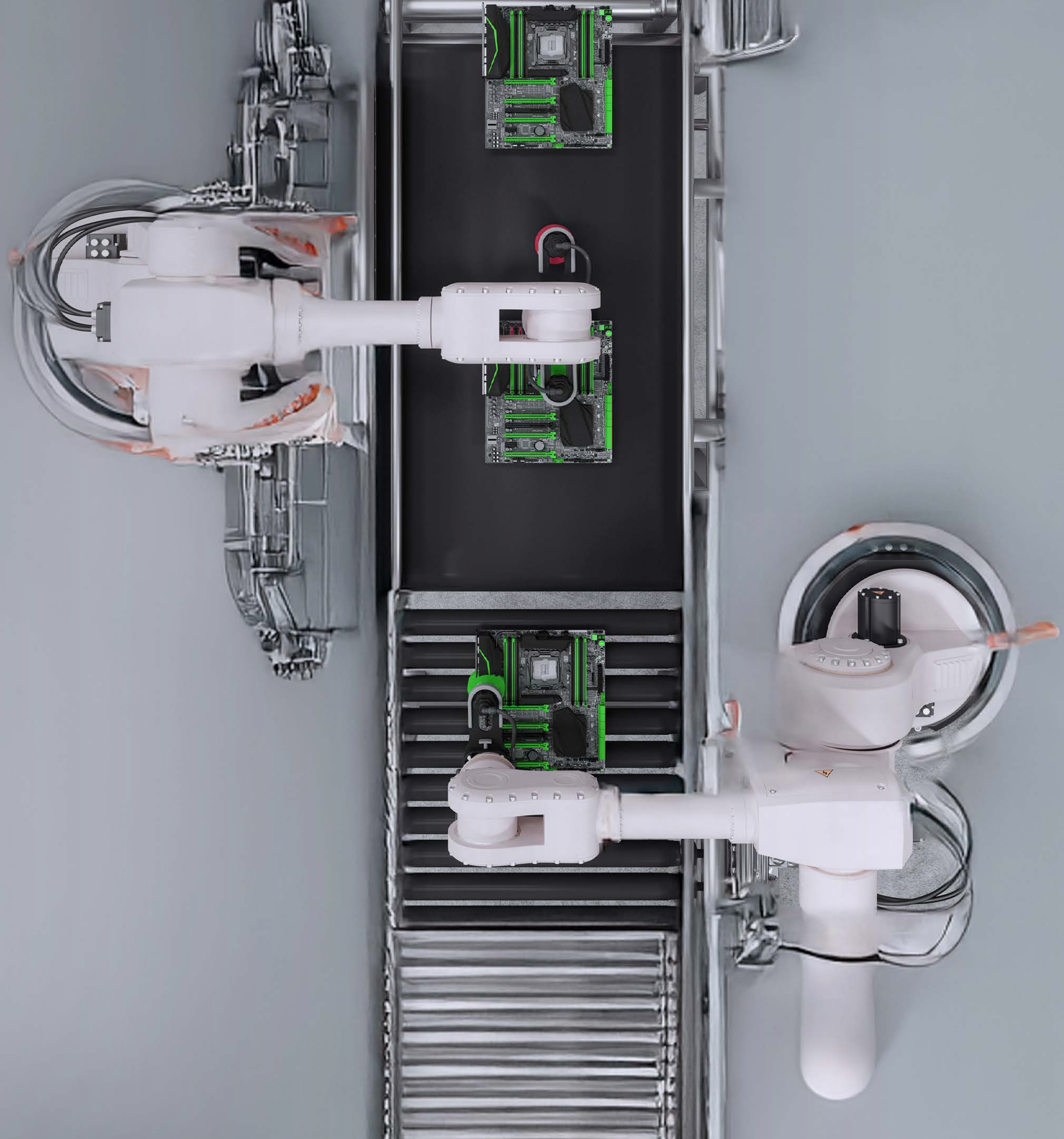
AI is increasingly embedded in products to enhance user experience, requiring continuous monitoring and retraining. The key to superior end-user functionality is an efficient model training process.

 Today's R&D process has become a continuous learning process. Customer expectations are met through agile development cycles to optimize product performance—often long after the original purchase date.

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Personalized digital experiences have become the norm for today's connected customers — and all smart, connected products are included. AI is not a luxury, but rather a necessity to meet these demands.

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Harnessing AI for product design and profitability

Product design and manufacturing are often complex processes. Manufacturers are pushed to create innovative, customer-pleasing products to align to the brand's unique mix of value, quality, and reliability, often with 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—leveraging digital processes extensively, and from a traditional producer to an increasing portfolio of 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.[2]

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 usage and performance of digital and physical products at the feature level, guiding and prioritizing development.

Manage uncontrolled data growth
AI requires lots of high-quality data. It 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 open-source, commercial, or custom AI models, 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.

2 "The economic potential of generative AI: The next productivity frontier," McKinsey, 2023

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Accelerating embedded AI

Physical products are becoming increasingly smart and connected, frequently embedding AI code to improve functionality. These embedded AI models must be evaluated and trained on a variety of detailed data from a mix of voice, cameras, sensors, and positioning data. By accelerating the data pipeline to build a multipurpose comprehensive dataset, developers and data scientists can spend more time improving models. The result is faster product innovation and a better customer experience. Here's how to implement it.

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 analytics 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.

Acceleration of embedded AI

Accelerate AI learning cycles through efficent harmonization of data from smart, connected products across disparate datasets and types.

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Simplifying complex AI data pipelines using BYOM

A motor racing team wanted to enable a "live replay" environment to review vehicle and driver performance. This involved integrating GPS, video, and sensor data. Leveraging Bring Your Own Model (BYOM) and time-series capabilities, Teradata imported an open-source video analytics AI model to run in the team's Teradata platform. The model extracts features (camera angle and exact timestamp) from video streams. This efficient extraction of key video features enables synchronization and integration of all three primary data feeds, supporting live replays and further race analytics.

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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 isn't 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, manufacturers have achieved 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 products. 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).

Manufacturers' 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

The COVID-19 pandemic and subsequent global events have exposed the vulnerabilities of global supply chains and shifted focus toward supply chain resilience. In today's increasingly dynamic world, manufacturers must strike a balance between agility, resilience, quality, service, and cost. Traditionally, supply chains have been split into silos so humans can 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. An AI-enabled supply chain data platform is a proactive tool that can significantly enhance your business resilience. It provides early warnings about potential disruptions in production and offers strategies to minimize these risks, thereby strengthening your risk management capabilities. Working in concert with AI models 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 is challenging. Many organizations face "pilot purgatory," where a functional pilot was created but struggled to scale or integrate insights. Some experience "use case purgatory," where isolated projects build their own data pipelines, gobbling up resources and blocking the delivery of other projects. Even with advanced AI and lower compute costs, Industry 4.0's value hinges on creating an open data platform with a harmonized dataset. Success depends on efficient data harmonization and reuse across the tens of thousands of AI models[3] required for successful Industry 4.0 deployment.

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 business monitoring

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

Anomaly 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 identify patterns in machine sensor data during the production of individual items or batches and encode this to build the foundation for full traceability and rapid quality root cause analytics.

3 Andrew Ng, www.andrewng.org

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Enhancing automotive process monitoring

With "spot-welding analytics," an interdisciplinary team from a German auto OEM, AWS, and Teradata created an AI-powered 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 in the factory started with quality inspection. Thanks to the multipurpose data platform, it rapidly expanded to process improvement analytics, delivering ROI in 6 months.

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Integrating video into process efficiency analytics

Teradata customer and Industry 4.0 partner Telefonica helped Würth improve process efficiency by integrating video monitoring into their logistics operations. Video cameras monitor various sections of the warehouse in real time, with AI routines continuously providing immediate and relevant insights: monitoring occupancy rate on departure bays, auditing package contents, validating dispatches, and detecting boxes stuck on conveyors. Teradata created a data pipeline that included extracting features from videos using AI routines and integrating these features (e.g. stuck boxes) into dashboards, allowing employees to understand the frequency and severity of line stoppages and take appropriate actions to improve total throughput.

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Sell

AI is a key enabler for brands to foster deeper connections with their customers through smart, connected products, digital services, apps, and websites. These connections can ensure more relevant experiences for individual B2B and B2C customers, leading to increased loyalty and wallet share.

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AI uses data from all customer and end consumer touchpoints across product portfolios to gain valuable insights into customers. It can provide insight into individual consumer preferences, habits, and lifestyle choices. And it creates a virtuous cycle where the more consumers interact with their products and services, the better manufacturers can create personalized experiences, product features, and services their customers really want, and the more products and services they will sell. Sales and service transactions across B2B relationships can fuel insights that help anticipate demand, improving service delivery without increasing costs. This data-driven approach enables a more tailored customer experience.

Increasingly, consumers are expecting personalized experiences from brands they trust. B2B customers expect better informational flow across corporate boundaries to support their increasingly agile production needs.

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Personalize complete purchase journeys

As consumers continue to lean into online channels when making purchase decisions, brands are investing heavily in online sales journeys. To get the maximum return from this significant investment, organizations must understand the purchase journey to optimize customer experience. The first step is integrating data from customer interactions during all parts of the sales cycle—online, social channels, or in store—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.

Hyper-personalized sales cycles

Individual customer interactions with the brand, through any channel, can be fed into AI algorithms to predict propensity to purchase, next best action, and product / feature preferences.

Intelligent omni-channel sales journeys

Completed transactions—new product sales, spares, or 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.

Gen AI-enabled concierge services

Link LLM-driven chatbots using retrieval augmented generation (RAG) to customer insights to enable personalized, timely, and relevant conversations, actively promoting sales and brand engagement.

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Teaching LLMs the language of customer demand

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 it's sales and outbound supply chain. Using Teradata Vantage™, it's able to continuously source and analyze complex datasets, then deploy generative AI models to predict daily demand and deploy optimal routings in real time.

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Use

Data from smart, connected products and
apps doesn't only help sales understand customer
behavior. It's a rich resource with multiple
applications. Modern customer expectations are
accelerating the requirements for personalized
products and services and faster development
cycles for new features. To ensure high-quality
offerings amid faster development cycles,
organizations will need visibility and insights into
the usage and performance of their products,
apps, and service offerings.

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Delivering efficiency:
The role of AI in supporting
smart, connected products

Aftermarket services are increasingly important revenue streams. Services typically include ensuring product availability (maintenance packages) and the sales of consumables or spares based on actual and predicted product usage.

Advanced use cases extend into financial offerings—leveraging the understanding of the use of individual products to offer attractive usage-based financial contracts vs. outright sales of products—introducing new recurring revenue streams for manufacturers.

These services are significantly more attractive if fueled by the knowledge of individual products' usage environment and operational hours. This knowledge can be gained from an integrated set of data representing the usage location, product usage details, and app data for consumer products with paired applications.

Both commercial and consumer end users will embrace personalized services more readily than simple generic services—with consumers increasingly expecting highly personalized offers.

Grow aftermarket revenue streams
Leverage AI-driven insights to offer usage-based services and financial packages in addition to increasing aftermarket sales opportunities of parts and services.

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Accelerate innovation. Data-backed insights on customer usage patterns can foster the creation of products that more closely align with customer needs. Complex products 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. Simpler products can be developed to be more closely aligned to regional usage patterns or preferences. Social media channels are a rich source of information that can help indicate these preferences and predict trends.

Proactively reduce warranty claims and recalls. When it comes to field defects or recalls, time really is money. Even with strong checks for quality, some defects may still occur, affecting physical products or presenting as software issues in the ever-increasing software or app component of products. Each day that a defect goes undetected increases the number of products at risk of reproducing the problem, leading to more warranty claims or broader recalls. The more quickly defects are found, and root causes established, the fewer products are affected, reducing potential warranty claims and narrowing the scope of product recalls.

Accelerate innovation and reduce warranty costs by leveraging product data.

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The high potential of data from smart, connected products

Teradata's extensive experience shows the immense value of well-managed data from smart, connected products. This data set can deliver significant annual value across various functions. Previous pages covered new services, accelerating innovation and reducing warranty claims. Additionally, product data serves as a:

- Highly reliable aftermarket supply chain demand signal

- Hyper-personalized customer lens, used for insights into customer experience, loyalty, and Net Promoter Score

- Enabler of supplier accountability for both software and hardware components

Automated IoT signal prioritization

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

Failure early warning automation

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.

Increase product availability

Using data on prior repairs and spare part demand forecasts, AI can predict customer demand for specific services and spare parts, enabling businesses to effectively meet service time and product availability.

Expanded service offerings

Establishing a high-volume, high-velocity data pipeline enables expanded offerings which rely on performance and usage monitoring or realtime alerting capabilities in addition to online diagnostics capabilities.

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AI enables new service and finance models

Siemens Healthineers is at the center of clinical decision-making across the full healthcare spectrum. The availability of its machines in a clinical setting is crucial to rapidly achieving life-saving diagnoses. Siemens Healthineers leverages the in-database AI/ML capabilities of Teradata to deploy predictive asset maintenance of medical equipment via IoT state-of-health data—predicting failure up to 21 days in advance to ensure well-managed maintenance interventions. Product data from machines enables new service and finance offerings, creating reliable revenue streams for Siemens Healthineers and valuable offerings for its customers.

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To achieve full potential from AI, manufacturers will need tens of thousands of models, being fed by a constant stream of high-quality data. This cannot be achieved by creating a myriad of data silos linked by complex data pipelines to feed individual projects. Teradata accelerates realizing value from AI projects by bringing the AI to the data, simplifying dataflows and enabling seamless integration of AI models into daily decision-making.

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Accelerate AI innovation with Teradata

Teradata bundles technology, IP, and 40 years of enterprise analytics experience to accelerate value from AI at scale. Reduce data overhead through seamless harmonization of high-quality IoT, OT, and IT data into a multipurpose, integrated dataset. Accelerate AI inferences and integrate model output into your business processes. Teradata's industry-leading VantageCloud platform, unparalleled Manufacturing Data Model, and embedded advanced analytics capabilities of ClearScape Analytics™ are available in the cloud and on premises.

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Scaling Trusted AI with Teradata

Harmonized data

Orchestrate harmonized data products from all your data sources: IT, sensor and machine, IoT, and third party.

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In-database analytics

Discover 150+ pre-built functions for statistics, advanced mathematics, and AI/ML, including Bring Your Own Model capabilities.

Optimized value and performance

Leverage leading automated load balancing to ensure users get the performance they need, even at extreme scale.

Open system, from BI to AI

Support multiple front ends for data access, serving all user profiles —reporting, exploration, or advanced coding.

Multiple deployment options

Deploy in the cloud with AWS, Microsoft Azure, or Google Cloud; on premises; or in hybrid ecosystems to comply with specific IT strategies or business needs.

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Learn more

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.

About Teradata

At Teradata, we believe that people thrive when empowered with trusted information. That's why we built the most complete cloud analytics and data platform for AI. By delivering harmonized data, Trusted AI, and faster innovation, we uplift and empower our customers—and our customers' customers—to make better, more confident decisions. The world's top companies across every major industry trust Teradata to improve business performance, enrich customer experiences, and fully integrate data across the enterprise.

Learn more at teradata.com

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