aPriori

TECHNICAL REPORT

The AI Manufacturing Playbook: Using Data as a Force Multiplier to Drive AI Value

HOW FORWARD-THINKING MANUFACTURERS ARE TRANSFORMING PRODUCT DEVELOPMENT AND SUPPLY CHAINS WITH AI

Overview

Manufacturers are racing to translate the potential of Artificial Intelligence (AI) into profits. If deployed and managed effectively, AI can help companies tap new opportunities for growth and a competitive advantage. So, it's no surprise that three-quarters of manufacturers in a Bain survey report that adopting AI and related technologies is their top engineering and R&D priority.

Despite the hype around AI, early results are mixed. And missteps during this critical time could leave companies unable to catch their competitors or navigate new AI-driven market realities.

A BCG survey reveals that two-thirds of executives are ambivalent or dissatisfied with their AI progress. Research firm Gartner recently made the bold prediction that at least 30% of generative AI (gen AI) projects will be shut down by the end of 2025. The research firm cites poor data quality, rising costs, and challenges projecting business value as the major reasons why gen AI initiatives won't move beyond the pilot phase.

This strategic report provides a foundational background in AI, practical steps to advance your AI capabilities, and examples of forward-thinking manufacturers applying AI to gain business value.

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AI Defined for Manufacturers

AI simulates human intelligence by using software and data to perform tasks that previously required human input, such as identifying patterns, solving problems, and creating new content –from software code to new product designs. For simplicity, we've categorized AI into two general categories: traditional/deterministic AI and generative AI (gen AI).

Traditional AI/deterministic AI operates using pre-programmed logic and fixed rules, which is optimal for tasks requiring fast, structured decision-making based on defined criteria. Manufacturers use deterministic AI models to automate repetitive tasks, run simulations for product design, and provide predictive maintenance insights along with related data analytics.

More broadly, applications using deterministic AI include expert systems, decision trees, and natural language processing (NLP) for human language comprehension in search engines, chatbots, and machine translation systems.

Gen AI identifies data patterns to create new, unique outputs that mimic human creativity. ChatGPT may be the most well-known gen AI example. It's a large language model (LMM) AI chatbot that uses machine learning (ML) and deep learning (DL) to generate responses. (And it draws from data analytics and other deterministic AI capabilities.)

Data volume is central to LMM's success. TechTarget estimates that an LLM typically has one billion or more parameters (variables used to infer how to create new content through training). Gen AI technologies are also using retrieval-augmented generation (RAG) to expand their knowledge base beyond LMMs to increase the timeliness and accuracy of their outputs/responses.

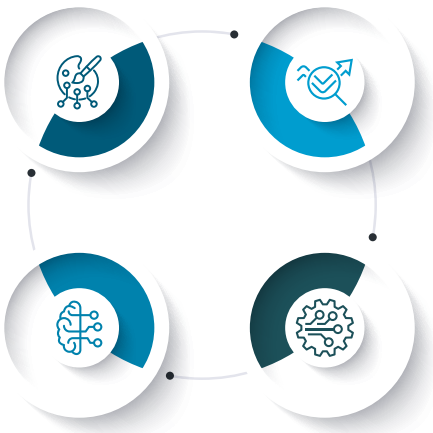
The Elements of AI (AI Chatbot Example)

GENERATIVE AI (GEN AI)

Creates new content – including text, images, code, and product designs – by applying what it's "learned" using ML/DL, LMMs, RAG, and other technology

DETERMINISTIC/TRADITIONAL AI

Applies rules and algorithms to solve well-defined problems and make "educated" predictions (e.g., decision trees, expert systems, and natural language processing [NLP])



MACHINE LEARNING (ML)/ DEEP LEARNING (DL)

Algorithms and technologies including neural networks that "learn" from data without explicit programming

ARTIFICIAL INTELLIGENCE (AI)

Technologies that simulate some cognitive problem-solving at lightning speed

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Data Quality and Integration: The Lynchpin for AI Success

How to establish a strong data foundation and create a force multiplier impact for AI

AI systems are only as effective as the data they are built on. And AI models depend on vast amounts of historical data to recognize patterns, make predictions, and produce accurate responses.

But using clean, accurate data across departments is an ongoing challenge. McKinsey reports that up to 70% of the effort in AI-driven projects involves data harmonization. A related 2024 Manufacturing Leadership Council (MLC) survey uncovered specific industry challenges using data for AI.

Let's examine how to address these data issues to capitalize on the benefits of AI.

63%
Cited poor data quality

55%
Cited a lack of data contextualization

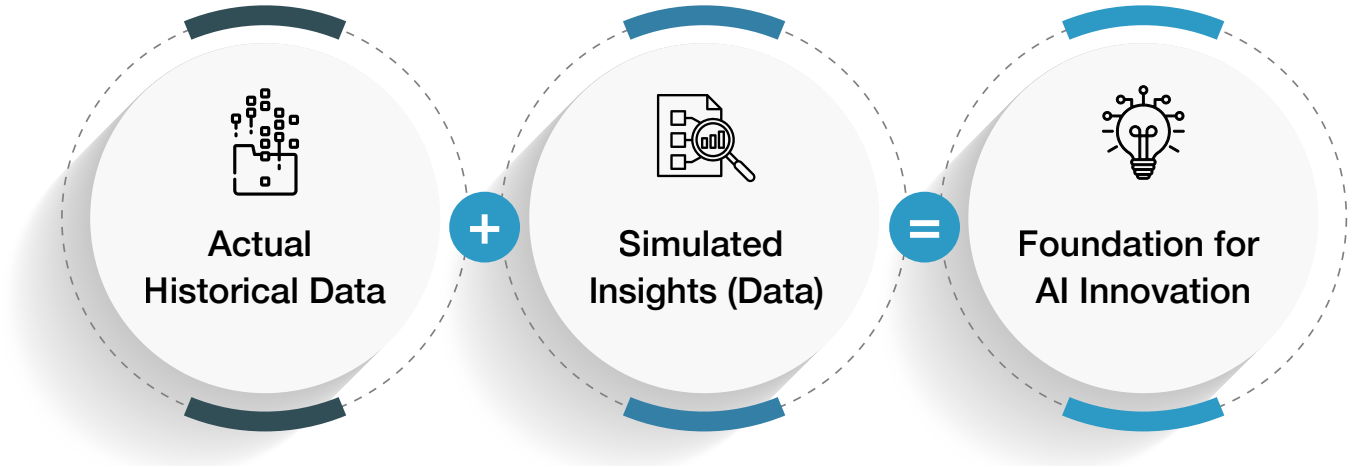
Improve Data Quality: Blend Actual Historical Information and Simulated Design Data

Manufacturers are addressing data quality challenges by combining actual historical product data with simulated insights (deterministic AI) to provide the foundation required to produce relevant generative AI responses (and to prevent inaccurate responses known as AI "hallucinations").

While a manufacturer's actual historical data provides a timeline of cost, production volume, etc., this information won't necessarily help you uncover areas that are costing you time, money, and customer satisfaction (e.g., how do you know if you're overpaying for a component if you only have quote and payment information?).

To gain these types of insights, manufacturers rely on simulation and modeling to identify opportunities for improvement across the organization – including design for manufacturing (DFM), cost modeling, sustainability insights, structural performance (FEA analysis), etc.

Manufacturing insights enable cross-functional teams to simulate multiple variables simultaneously to make data-driven decisions amid increasing design, supply chain, and manufacturing complexity. What used to take weeks or months to measure, report, and reduce product cost can now be done in seconds using AI technology.



Manufacturers who understand why there are discrepancies between actual historical data and insights from simulation applications can use this knowledge to build precise AI models based on the most accurate information and establish parameters from multiple types of data.

Combining actual historical product data and simulated insights expands AI's field of vision, unlocking new levels of innovation and competitiveness.

Expand Data Contextualization: Use Digital Twins/Digital Thread

Product design, sourcing, and manufacturing data sets often reside in individual departments (either in siloed systems or spreadsheets filled with supplier information that's not easily accessible).

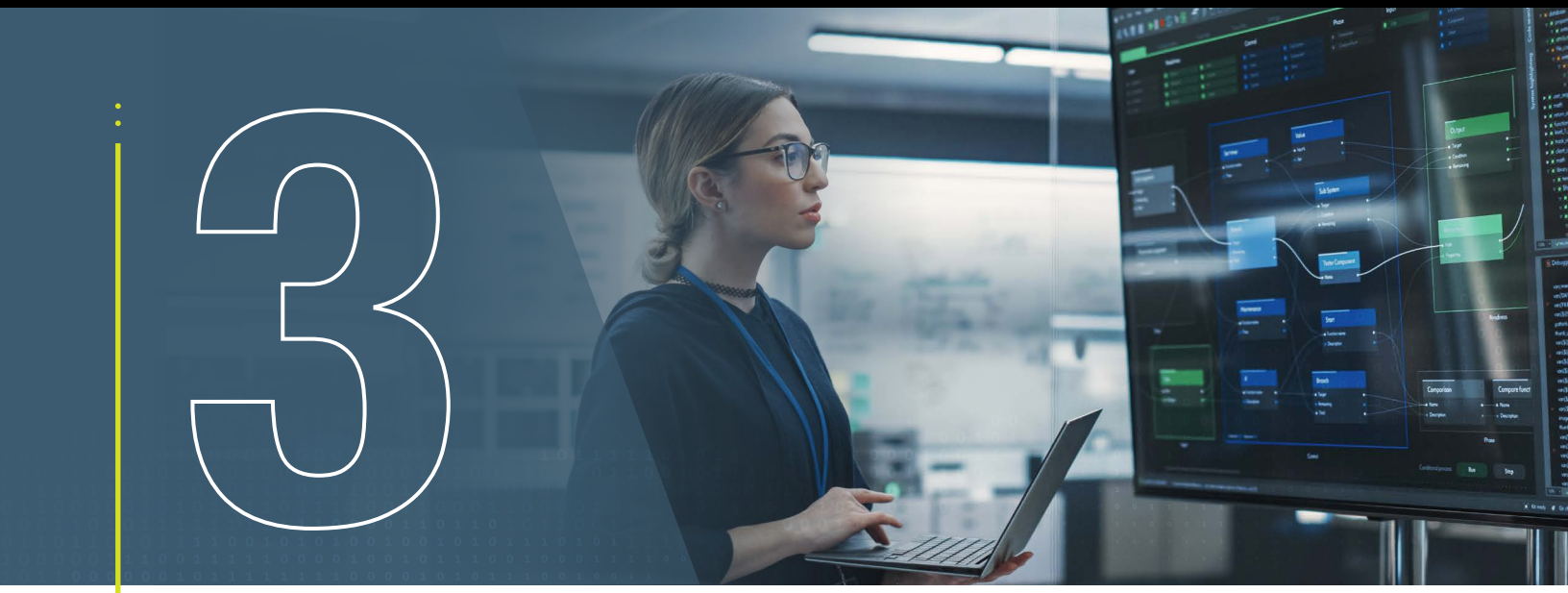
Manufacturers are using digitalization to connect data across multiple systems in real time to maintain a single source of product information. This provides cross-functional teams with the information to make decisions quickly and confidently – including product cost, weight, bill of materials (BOM), carbon footprint, and manufacturing processes.

This strategy uses 3D CAD models as a focal point because they can contain extensive product features and geometry data. The digital thread ties together data in 3D CAD files, product life cycle management (PLM), enterprise resource planning (ERP), and other systems.

Catherine Knicker, Chief Strategy, Marketing & Sustainability Officer at PTC, emphasizes the significance of extending product data beyond design. She noted during a recent aPriori podcast that: "A lot of people talk about the model-based enterprise, which starts with a 3D model. It's shocking that many companies only use 3D CAD as an efficiency tool for designing. But they're not using rich content from that model down into manufacturing and into service. 3D CAD models also support sustainability initiatives because data flows much smoother into downstream processes."*

Combining actual historical product data and simulated insights **expands AI's field of vision**, unlocking new levels of innovation and competitiveness

** Quote edited for clarity.*



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Using AI to Cut Product Development Costs and Increase Speed

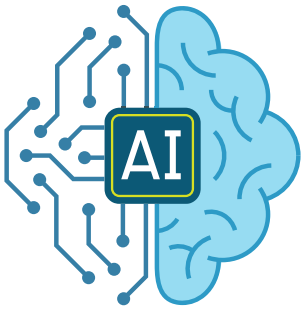
Spotlighting practical AI applications for product innovation

Product development is a labor-intensive process that traditionally requires multiple iterations before designs are ready for production. These steps are time-consuming and costly – especially when manufacturing teams discover errors or inefficiencies late in development.

AI capabilities can fundamentally redefine the product development process. With the aid of AI, product development teams can explore more design options and examine more possibilities that may not have been considered otherwise, leading to more efficient and dynamic solutions.

Gen AI algorithms can also be developed to identify optimal solutions based on feature requirements and constraints (e.g., cost and CO2e targets or sourcing alternative materials due to supply chain disruptions).

AI can automatically check product designs against predefined criteria to ensure they meet specifications and standards. Gen AI can cut product design time exponentially and accelerate time to market for a competitive advantage (and greater cash flow).



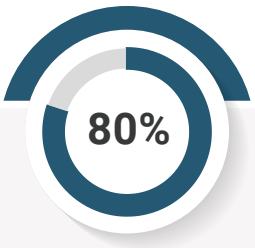
With the aid of AI, product development teams can explore more design options and examine more possibilities

HOW EATON CUT PRODUCT DESIGN TIME BY NEARLY 90%

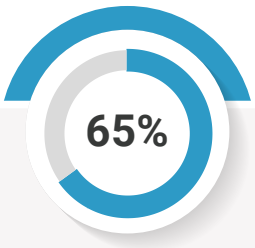
Eaton is a $23 billion intelligent power management solutions provider with a product portfolio ranging from passenger car valve stems to lighting fixtures. To accelerate product design, Eaton's gen AI solution combines actual historical product design data and insights from the company's simulation software portfolio – including aPriori for cost modeling, DFM, and sourcing. Eaton then creates detailed model-based design specifications and properties to support its Gen AI development.

With gen AI, Eaton runs thousands of design iterations in minutes (or less) and proposes the top-five generative designs for its digital design and engineering team to review.

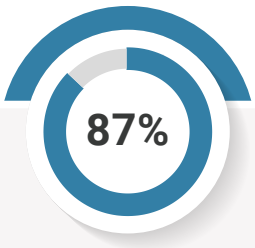
Select Eaton Results with Gen AI



Minimized the weight of a liquid-to-air heat exchanger



Lowered the design time for a high-speed gear



Reduced the design time for an automated lighting fixture

Eaton's gen AI capabilities support the company's goal to scale new product development and accelerate time-to-market to address customer needs. The technology could also support the company's goal to become carbon neutral by 2030.

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Using AI for Supply Chain Management

Gain new levels of speed and insights for data-driven decision-making across the supply chain

Supply chain management is one of the most complex aspects of manufacturing, involving coordination across global suppliers, logistics, and production facilities. AI is providing real-time insights and predictive analytics that enhance decision-making and operational efficiency.

Predictive Analytics for Risk Management

AI enables manufacturers to predict potential disruptions in their supply chains by analyzing trends and patterns in supplier performance, market conditions, and geopolitical factors. These insights allow companies to proactively manage risks, such as over-reliance on certain suppliers or regions. For example, AI can simulate alternative sourcing strategies in the event of a supplier shutdown, enabling manufacturers to adjust quickly and avoid delays.

Supplier Network Expansion

Diversify your supplier network with AI by identifying and qualifying new suppliers that meet specific criteria. Using digital factory simulations, manufacturers can evaluate potential suppliers based on factors such as cost, production capacity, and sustainability. This allows companies to scale their supplier base rapidly while maintaining high production standards.

Cost and Carbon Optimization

Evaluate cost, carbon impact, and manufacturability concurrently to consider the impact of trade-offs and other options. AI tools can evaluate multiple production scenarios to determine the most cost-effective and sustainable options. For instance, the European Union's carbon tax framework (CBAM) is levying a "carbon tariff" on carbon-intensive imports, and AI can help manufacturers adjust their sourcing strategies accordingly. By comparing different supply chain models, manufacturers can find the optimal balance between cost, speed, and sustainability.

The application of AI in supply chain management provides manufacturers with the tools to manage risk, improve efficiency, and make data-driven decisions that enhance their overall supply chain resilience.

AI is providing real-time insights and predictive analytics that enhance decision-making and operational efficiency

WOODWARD CUTS SUPPLIER RFQ NEGOTIATION TIME BY 90%

Woodward is a $3.2 billion developer of advanced energy control systems for commercial and military customers. The company's global commodity team uses aPriori's AI-powered technology to configure digital factories to reflect key suppliers' cost structures and capabilities down to the machine level. With this information, Woodward can simulate production across multiple supplier digital factories to identify the most appropriate supplier option.

Woodward uses its digital factories to power its self-quoting (Zero RFQ) initiative for key suppliers and to identify open capability and capacity. As a result, the company went from a 10-week supplier lead time to a one-week lead time.

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How aPriori Drives AI Capabilities in Manufacturing

Capitalize on two dimensions of AI with aPriori

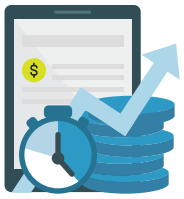
Deterministic AI delivers real-time insights and automation. And it provides a new level of data accuracy and detail to power gen AI.

Gain Automated Insights with Deterministic AI

aPriori's AI-Powered Design & Sourcing Insights empower manufacturers to improve product profitability, manufacturability, sustainability, and time to market. aPriori's intelligence enables users to simulate multiple variables simultaneously to make data-driven decisions amid increasing design, supply chain, and manufacturing complexity.

aPriori's AI-powered insights can assess material choices, manufacturing processes, and factory options by supplier or geography to identify the most cost-effective options. What used to take weeks or months to measure, report, and reduce product cost can now be done in seconds using aPriori's AI technology. The benefits encompass the following AI technologies.

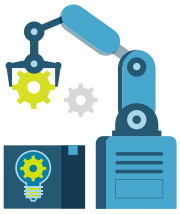
Deterministic AI delivers real-time insights and automation. And it provides a new level of data accuracy and detail to power gen AI



Increase Speed and Productivity

Capitalize on automated insights: With aPriori, manufacturers can unlock new insights from their existing systems with a click of a button. aPriori's digital thread ties multiple digital twins together to establish a "central source of truth" for product data in product lifecycle management (PLM) systems – including product weight, tolerance information, carbon footprint data, and more. By contrast, manual spreadsheet analysis is time-consuming, may be outdated/inaccurate, and may not have important information required to make informed decisions.

Streamline communication across teams: Centralizing product data has limited value if the relevant teams are siloed. aPriori's coworking application, aP Workspace, enables users to assign and manage tasks while also providing traceability across product design, cost engineering, sourcing, sustainability, and manufacturing teams.



Innovate Rapidly

Use updated cost, DFM, and sustainability data: Manufacturers often struggle to access up-to-date information required to make data-driven decisions. Each quarter, aPriori provides updated manufacturing, labor, and material cost data in nearly 90 regions globally. Additionally, aPriori continues to refine and expand its more than 440 manufacturing process models.

Innovate at scale: How long will it take you to optimize thousands of parts (scenarios) for cost, manufacturability, and sustainability? It can take weeks if you use spreadsheets and other traditional processes. But with aPriori automation, manufacturers can compare a range of complex scenarios at scale in real time.

Reduce Risk

Strengthen supply chain resiliency and antifragility: Automate the analysis of your current supply chain capabilities at scale to identify an overreliance on suppliers, evaluate cost vs. carbon sourcing options, and identify new suppliers to maintain supply chain agility.

Safeguard your intellectual property (IP): aPriori does not store customer data in its gen AI system (AI Engine). And unlike open/public gen AI tools such as OpenAI, aPriori does not automatically change its answers/outputs based on "learning" from customer data. Instead, aPriori's AI Engine generates results based on predefined rules –and we test to ensure high fidelity before launching updates.

aPriori **does not store customer data** in its gen AI system (AI Engine)

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Take the Next Step In Your AI Strategy

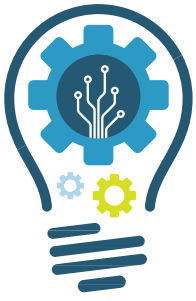
Manufacturers that capitalize on AI-powered capabilities will be well-positioned to operate at a new level of speed, efficiency, and innovation required in today's market. A strategic approach to rolling out new AI-based capabilities is critical – especially because the technology is evolving rapidly.

Manufacturers can take a multi-pronged approach to advance their AI capacity by simultaneously improving existing product manufacturing capabilities and also establishing the foundation needed for gen AI success.

Deterministic AI is pivotal to optimize existing products and those in development. Manufacturers can generate accurate, actionable data to address cost, risk, and more using deterministic AI capabilities, including simulation. Quality data is also a critical pillar for gen AI systems. Manufacturers can improve their data quality while building their gen AI capabilities (e.g., collecting/creating training datasets, developing/refining AI models, etc.).

Gen AI can apply actual historical and simulated data to present ideas and analysis at a speed and scale that can't be matched manually. But without accurate data, gen AI systems are prone to errors and inefficiencies that can derail innovation efforts.

The time is now for manufacturers to seize AI opportunities and propel their organizations into a new era of productivity and innovation to improve profit margins, unlock revenue growth, and minimize risk.



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Why aPriori?

aPriori provides unique AI-Powered Design & Sourcing Insights that unlock and identify new opportunities rapidly for reducing product cost & carbon footprint, optimizing manufacturing & supply chain risk, and improving design engineering & sourcing teams' productivity. According to Forrester, aPriori customers achieve a ~600% ROI within three years and payback within six months of adopting our Enterprise AI software.

Leading manufacturers use our automated Insights Platform to reduce time to market, meet sustainability targets, accelerate revenue growth, and increase profitability, all contributing to creating cash faster. To learn more about aPriori's cloud and on-premise solutions, visit www.apriori.com.

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