



Industrial AI Accelerates Digital Transformation for Capital-Intensive Industries

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Executive Summary

From executive board rooms to plant floors, from remote oil fields to complex supply chains, and from industry veterans to new-age venture capitalists, artificial intelligence (AI) is one of the hottest topics in business. But you may wonder, is AI really anything more than the latest technology buzz? The answer is yes. AI might actually be the single biggest digital revolution — and disruption — that is set to dramatically accelerate the digital transformation of capital-intensive industries.

In fact, the recent Industrial AI Market Report 2020-2025 from IoT Analytics identified 33 different use cases that employ AI tools and techniques on connected data sources and assets of industrial enterprises. This study estimates the global Industrial AI market size will reach \$72.5B USD by 2025, up from just over \$11B USD in 2018.

Artificial intelligence is described as a collection of different technologies brought together to enable a system — a process, asset or machine — to mimic human reasoning.

If we extend this concept, then AI-enabled business applications allow a system to act intelligently by helping it sense, comprehend, perform and learn. Training a system through machine learning (ML) or deep learning to improve a specific task, process or workflow is a core part of what makes it intelligent — and this can be incredibly powerful in optimizing performance, accuracy and quality.

The Paradigm of Industrial AI

The key to making AI work in real-world applications is getting the learning right — and more importantly, making it valuable and actionable in an industrial business context. Therefore, the development of AI-enabled applications needs to be purposefully guided and augmented by domain knowledge to deliver true business value.

The paradigm of Industrial AI combines data science and AI with purpose-built software and domain expertise to deliver comprehensive outcomes for specific business goals within capital-intensive industries.



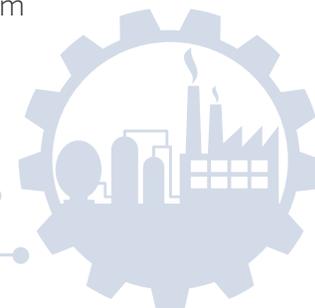
By combining first principles science with AI, Industrial AI ensures there are guardrails in place to inform safe, sustainable decisions. Business leaders can trust the insight that comes from these applications, which have incorporated fundamental scientific knowledge as a means to mitigate risk.

The industrial sector, and process manufacturing in particular, have been more cautious and slower to adopt new digital technologies than other industries. The same holds true for AI. Most industrial companies have invested millions — or even billions — of dollars in assets and equipment; they need to ensure these assets operate safely and sustainably. Given these concerns, a desire to avoid the risks inherent in new technologies seems reasonable. However, three compelling forces are accelerating AI implementation in process manufacturing:

- The rise of knowledge automation. Workforce shifts and the resulting loss of expertise are driving the need to automate knowledge-sharing across the process industries. Furthermore, this is creating a greater need for more intelligence-rich applications.

- Increased focus on capturing value from industrial data. This drives the need for multi-dimensional optimization, and it means AI-enabled decision-making and operational agility are becoming more critical to executives. To thrive in today's volatile market, companies must simultaneously optimize their assets and processes across business objectives such as margins, economics, sustainability and more.
- Digital transformation. Advanced technology unlocks the possibilities of new business models and is becoming integral to sustainability, competitive and corporate strategies.

The rapid evolution of AI is therefore coming at an ideal time for the asset-intensive process manufacturing industry. Industrial AI that draws on proven technologies has the potential to help these companies operate at unprecedented speed and scale, as well as facilitate reductions in costs, improve efficiency and transform operations for the better.



An Industrial AI Strategy: The New Business Imperative

The arrival of AI that can be implemented without data science experts means industrial organizations can open the door to new levels of safety and productivity in their operations. At AspenTech, we've seen what can happen when Industrial AI is targeted to meet specific business needs:

- Semi-autonomous and autonomous processes are created over time, as live data is collected, aggregated, conditioned and fed into digital models to evaluate scenarios, gain insight and drive continuous operational improvements.
- Cognitive guidance systems powered by AI and machine learning empower personnel across critical operations, extending their capabilities so they can make faster and more accurate decisions.
- Next-generation knowledge-automation applications drive greater levels of productivity throughout the workforce and open the pathway for a new generation of talented and ambitious individuals to gain knowledge and execute at high levels more quickly.

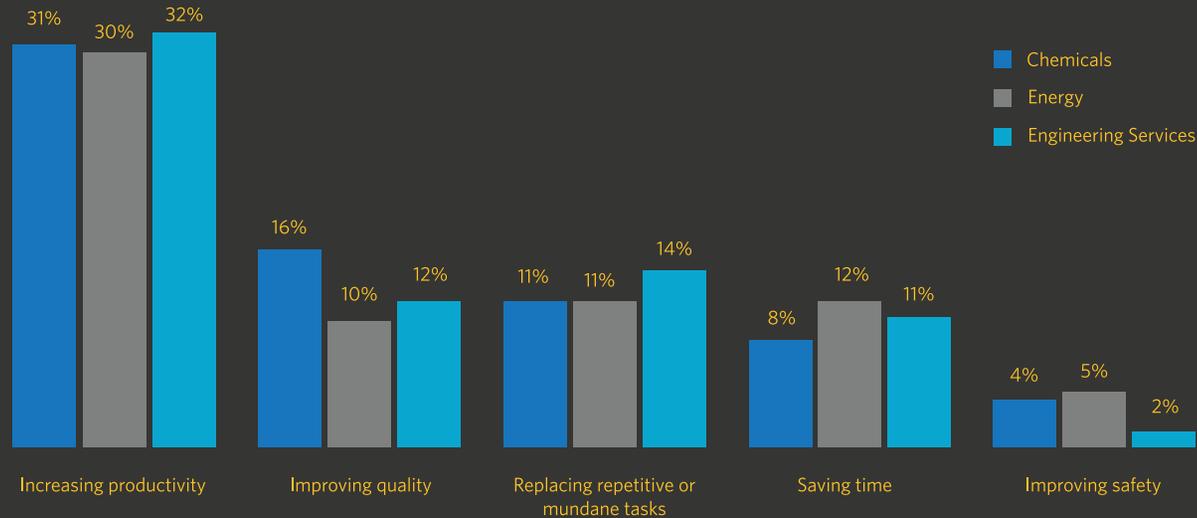
In addition to these operational benefits, AI presents an opportunity for leading organizations to gain a competitive advantage, even in volatile and unpredictable conditions — because while the vast majority of companies realize the transformative promise of AI, most have not yet tapped into its full potential.

We recently surveyed about 450 large industrial companies (see Figure 1), including chemical, energy and engineering companies from around the world, and found that 83% of respondents think AI will produce better results. **However, less than 20% have implemented AI in their operations.**



Increased Productivity is by far the biggest benefit of AI for all 3 industries

What do you anticipate being the biggest benefits from the adoption of Artificial Intelligence in your industry? (top 3)



Quality improvements more beneficial to the Chemical industry than to Energy or Engineering

Figure 1: Across all the industries surveyed, process automation, predictive maintenance and predictive analytics are seen as the most important applications of AI-enabled technologies.

Simply stated, if you can figure out where Industrial AI can transform your operations, you have the opportunity to move ahead of the vast majority of your competition. But with two-thirds of process industry organizations still trying to get their strategies off the ground, many companies are apprehensive about wider AI adoption.

Industrial AI helps companies get over adoption hurdles and ensures their efforts to solve critical business problems with AI succeed. AI embedded into familiar applications can overcome maturity limitations, allowing companies to implement new technology that focuses on real-world use cases and delivers measurable return on investment on AI-driven initiatives across the enterprise.

Delivering the Business Value of Industrial AI

Data Science Meets Domain Expertise

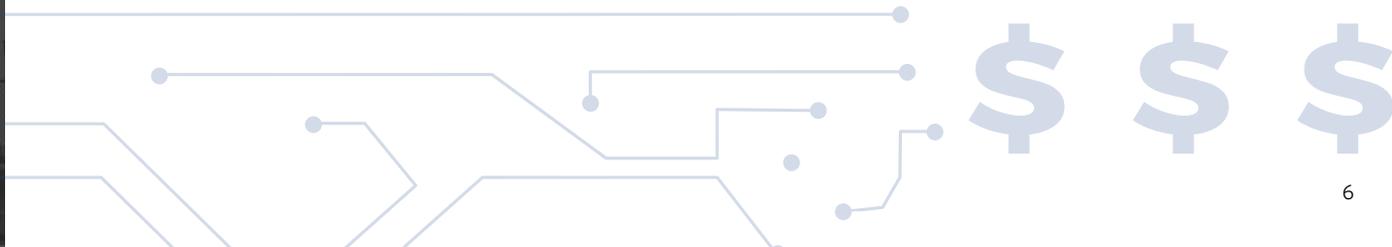
Industrial AI combines data science and AI with software and domain expertise in industrial operations and technologies to deliver comprehensive business outcomes tied to specific goals. To go a little deeper, Industrial AI can be defined as a systematic, collaborative and integrative discipline which focuses on developing, embedding and deploying various machine learning algorithms as fit for purpose, domain-specific industrial applications with sustainable business value for capital-intensive process industries.

The Industrial AI methodology brings together state-of-the-art modeling, the first principles of engineering, advanced AI/ML technology and a comprehensive portfolio of asset optimization solutions (see Figure 2). This unique combination allows organizations to seamlessly integrate computational models with physical systems — across the entire industrial asset lifecycle.

By implementing AI-powered technologies in a thoughtful way that targets specific business needs, companies gain the ability to optimize each critical asset — and the network — throughout the full lifecycle. For every piece of equipment, every system and every network, personnel can explore all the best design options, run assets at maximum productivity and safety, and create reliability strategies that reduce unplanned downtime to a minimum.

Embedding AI: Gain the Value, Mask the Complexity

Applications with embedded Industrial AI mask the technology's complexity, while also delivering the value of data science methods in existing workflows and industrial operations. This enables companies to:



The Unique Advantage of Industrial AI

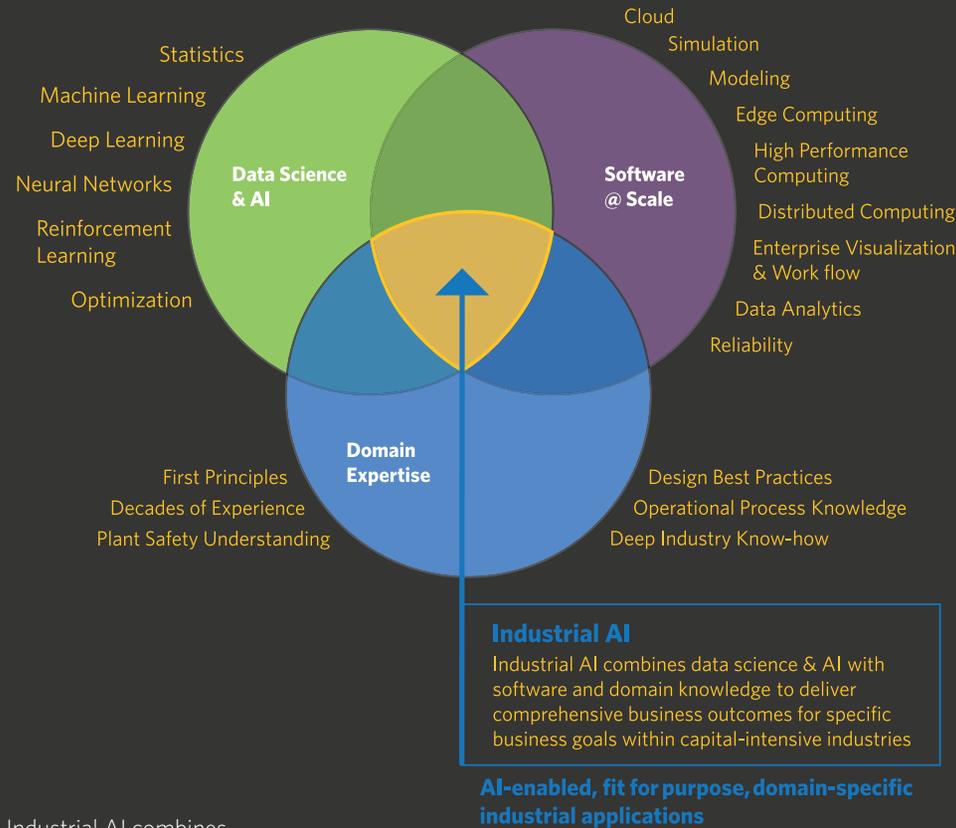


Figure 2: How Industrial AI combines the best of three critical areas.

- Lower the barriers to AI adoption through targeted applications
- Overcome a lack of skills by drastically reducing the need for a large number of data scientists
- Accelerate measurable return on investment by focusing in on real-world industrial use cases

Embedded AI applications allow users to efficiently and successfully

perform their domain-specific operations with increased accuracy, quality, reliability and sustainability of models throughout the asset lifecycle. Furthermore, this technology reduces the need for deep expertise to build and manage pertinent models. AI algorithms are embedded, developed and deployed as fit for purpose, domain-specific industrial models that are self-calibrating, self-adapting and self-learning, so they sustain and deliver maximum value over time.

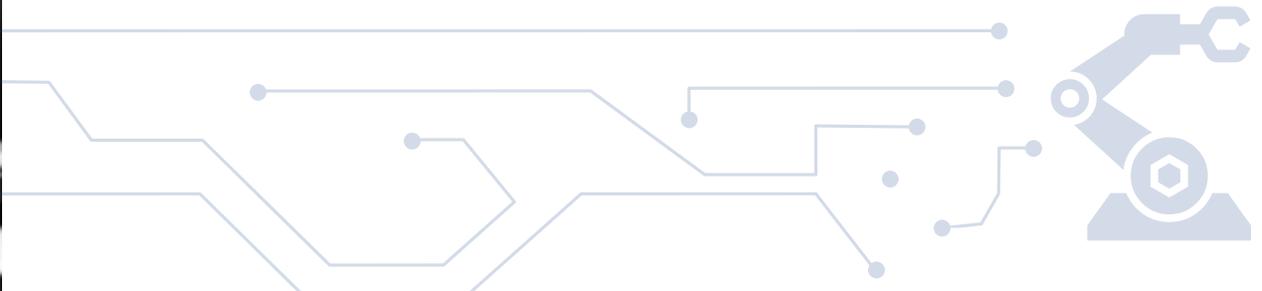
Domain Expertise is Critical to Unlock the Full Potential of AI

Domain expertise must be embedded into Industrial AI to provide guardrails that ensure the technology operates safely. A built-in understanding of equipment and process constraints mitigates risk for industrial companies that must meet strict safety and environmental regulations as well as rapidly shifting customer demands.

Industrial AI combines the first principles and deep domain knowledge of physics and chemistry that form the foundation of highly complex assets with AI/ML capabilities to transform how work is done and elevate the operational efficiencies that can be gained. Simply stated, one can think of Industrial AI as a strategic confluence of first principles, domain expertise and AI: the first two elements create the “infrastructure” for safe and efficient operations, with data science as the “enablers” or “accelerators” of semi-autonomous and autonomous processes.

In the process industries, the design characteristics and capacity (limits) of the asset define the rules of the road, which the asset model captures dictated by the physics and chemistry of the process. The AI, like previous multivariable and adaptive control capabilities, provides greater insights to operate the asset within the physics and chemistry of the process and the process design limitations.

For AI to be able to model and optimize the safer, greener, longer and faster operation of assets simultaneously, it must draw on real-world engineering principles to understand problematic or unsafe operations and predict corrective measures. Physics, chemistry and engineering principles will always be relevant, even with the deeper insights that AI can deliver. General AI algorithms will come up with spurious correlations unless properly operating within the domain expertise specific to each industry.



Industrial AI in Action

Next-generation, AI-powered applications augment the value of existing software solutions and help companies transcend functional silos within the enterprise to drive greater productivity, efficiency and reliability across their operations. These are some examples of how companies can leverage Industrial AI solutions:

- A refinery could apply Industrial AI technology to **simultaneously evaluate thousands of different scenarios** to identify the optimum crude oil slate for processing. Coupled with the cognitive capabilities to improve decision-making and ease-of-use, the technology would free up planning personnel to focus on more strategic tasks.
- A process plant could deploy an advanced class of Industrial AI-enabled models that combine machine learning and first principles to **deliver more comprehensive, more accurate and more performant models**. And it could all be done quickly — without requiring the user to have decades of modeling expertise or become an AI expert. These models will democratize AI across asset optimization applications to optimally design, operate and maintain assets and provide a better representation of the plant, which keeps the model more relevant over a longer period of time.
- A chemical plant could leverage Industrial AI to **gain real-time demand insights from customers** to boost its supply chain networks. Supply chain and operations technologies could be seamlessly linked together to create a system that detects changes in market conditions and automatically adjusts the operating plan and schedule in response.
- Another class of Industrial AI capabilities could **act as a virtual expert assistant to validate the quality and efficiency of a plant's operating plan**. And furthermore, with AI-enabled cognitive guidance, companies can reduce their reliance on domain experts to make complex decisions. This technology can institutionalize best practices and reduce expertise barriers by using structured and validated historical decisions.



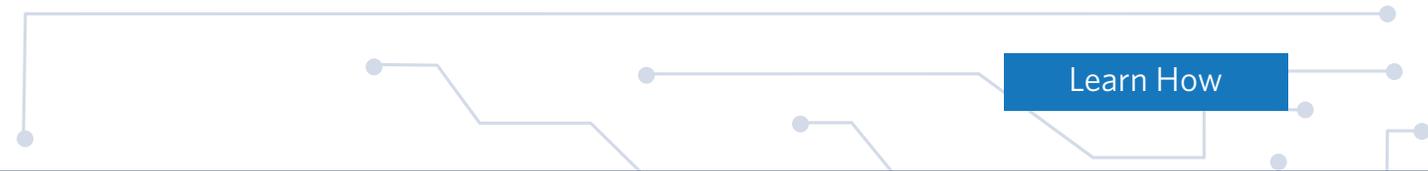
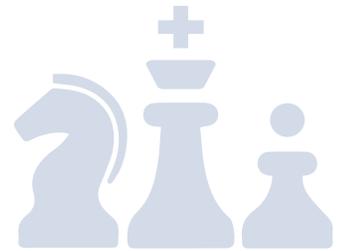
Conclusion

In light of the tectonic workforce shifts and unprecedented market volatility happening now, industrial organizations will need the capabilities to derive business outcomes from Industrial AI applications to remain relevant in the future. They will also have to implement semi-autonomous or autonomous systems to act on those outcomes, along with advanced decision-support capabilities to enable greater agility.

More importantly, Industrial AI as a driver of operational excellence will facilitate the successful transition to the new business models that will be necessary to remain competitive. Process industry companies need to adapt to a world where oil is increasingly used to produce chemicals and the need to recycle plastic waste is ever more pressing. Accelerated digitalization will be required to address these two disruptors, and Industrial AI can enable that acceleration.

When thoughtfully applied, AI combined with domain expertise will empower organizations to capture and share the knowledge of their experts, accelerate decision-making across the business, drive organizational alignment and leverage advanced operational insights throughout the organization. This is the real-world potential of Industrial AI - and we're realizing this vision with the release of aspenONE® V12.

[Learn How](#)



About AspenTechnology

Aspen Technology (AspenTech) is a global leader in asset optimization software. Its solutions address complex, industrial environments where it is critical to optimize the asset design, operation and maintenance lifecycle. AspenTech uniquely combines decades of process modeling expertise with artificial intelligence. Its purpose-built software platform automates knowledge work and builds sustainable competitive advantage by delivering high returns over the entire asset lifecycle. As a result, companies in capital-intensive industries can maximize uptime and push the limits of performance, running their assets safer, greener, longer and faster.

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