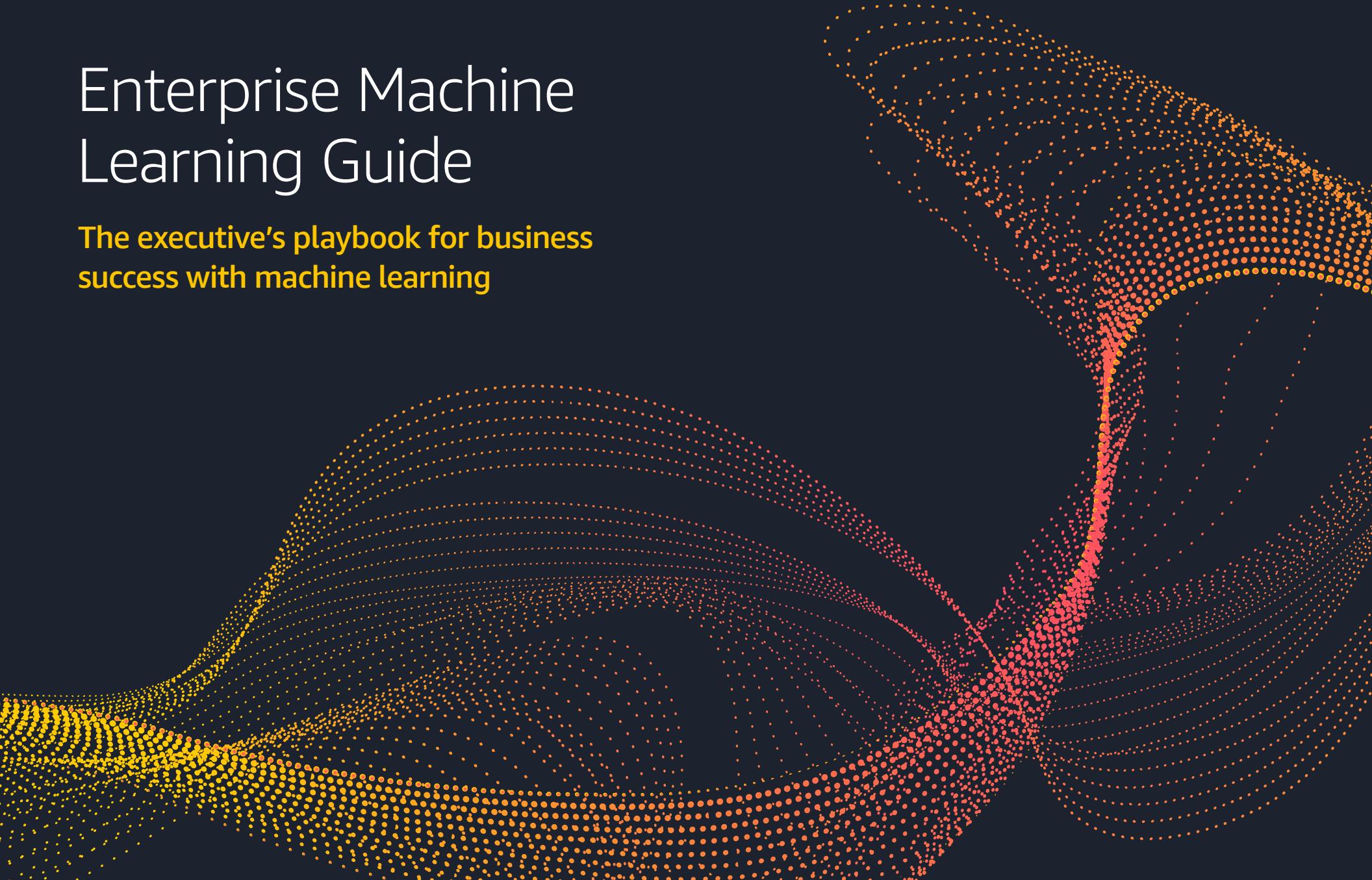




Enterprise Machine Learning Guide

The executive's playbook for business success with machine learning



Machine learning is quickly becoming a fundamental building block of business operations, providing real impact such as improved processes, increased efficiency, and accelerated innovation. Advances in machine learning technology have combined with high-performance compute options and an abundance of data to create a perfect storm to transform organizations of all sizes.

For enterprise leaders, the need to embrace machine learning capabilities is immediate. Gartner forecasts that AI-derived business values are projected to reach \$3.9 trillion in 2022.¹ As enterprises accrue data from numerous sources—ranging from customer feedback and sales logs to internal processes and financial forecasting—there is an opportunity to operationalize this often “dark data” into insights that can create new revenue streams.

¹ Petty, C., & van der Meulen, R. (Eds.). (2018, April).

39%

growth rate forecasted for global AI-derived business values in 2022¹





Impacting business goals

Companies are using machine learning across the organization to address business priorities. Some machine learning initiatives tackle incremental gains to automate processes to create efficiencies. Others are transformational initiatives aimed at innovation and competitive differentiation. While there are numerous applications of machine learning, enterprises already realize great value from use cases that provide new experiences for their customers and drive business growth.

² Worldwide Spending on Cognitive and Artificial Intelligence Systems Will Grow to \$19.1 Billion in 2018," March 22, 2018, IDC

³ Reworking the Revolution: Future Workforce," 2018, Accenture

Goals for machine learning innovation

- 1** Enable product and service innovation
- 2** Drive research and discovery
- 3** Enhance the customer experience
- 4** Modernize customer service
- 5** Increase efficiency and productivity
- 6** Improve security and compliance
- 7** Optimize operations
- 8** Enable agile decision making

1 Enable product and service innovation

Enterprises are already using machine learning pervasively to enable product and service innovation. They inform their product roadmap through intelligence extracted from customer feedback; drive the product development lifecycle, including DevOps and quality assurance through automation and intelligence; and infuse machine learning capabilities directly into new products that benefit the end user.

3 Enhance the customer experience

Across industries including financial services, healthcare, retail, and media and entertainment, targeted recommendations have become important for personalization that delights and engages customers. Epsilon research indicates 80 percent of consumers are more likely to make a purchase when brands offer personalized experiences.¹ Using voice-of-customer analytics to understand customer behavior and preferences, as well as recommendations engines to predict best matches, enterprises can push customized offers to location-based mobile services that offer real-time convenience and choice.

2 Drive research and discovery

In industries such as automotive, manufacturing, and energy and utilities, machine learning helps uncover new formulas, new materials, and new ways of thinking about age-old problems. It is especially relevant in industries such as healthcare and life sciences, where machine learning models can make predictions that drive research towards breakthroughs that lead to new and improved patient treatments.

4 Modernize customer service

Critical to every business is ensuring that various customer touch points—both internal and external—provide timely, accurate, and meaningful customer service. Machine learning technology such as conversational agents bridge the gap, modernizing the contact center to provide quick responses to customer calls and chat requests. In addition, text-to-speech and natural language processing capabilities can be applied to the streams of incoming customer data such as texts, voice messages, and customer service logs to better understand customer needs and sentiment to help improve the quality of customer service.

¹ Epsilon. "The Power of Me: The Impact of Personalization on Marketing Performance." Epsilon, us.epsilon.com/power-of-me.

5 Increase efficiency and productivity

Across business operations, the pervasive use of machine learning to automate and streamline processes has resulted in increased efficiency and reduced costs. For example, using automated media tagging and large-scale document recognition and analysis, machine learning can eliminate countless hours of labor. Machine learning can also analyze manufacturing incidents in real time, providing early warning of potential problems.

7 Optimize operations

From point of sale to freight delivery management to forecasting demand, machine learning plays a pivotal role across the supply chain. In demand planning, for example, machine learning algorithms can look at historical data as well as demand and other relevant data—such as product schedules, weather patterns, and competitor pricing—to determine when it's time to restock or end of life a product. Sophisticated machine learning models can predict weekly, daily, and even down-to-the-minute forecasts to help companies streamline supply chain management, save cost, and increase efficiency.

6 Improve security and compliance

Use of machine learning across security, risk, and compliance use cases is a fast-growing trend, especially in the financial services sector. Fraud-detection models help to keep consumer data safe and prevent malicious attacks against bank accounts or even mobile endpoints. On the other end of the spectrum, machine learning automates mundane tasks such as financial-document analysis, reducing manual effort and allowing the workforce to focus on higher-value tasks.

8 Enable agile decision making

Machine learning-based predictions augment decision making across all functions of the organization and across use cases. These predictions produce continuous actionable insights that help leaders and teams tackle operational and business challenges. This can range from forecasting that impacts pricing optimization to predictions for autonomous vehicles to make informed choices. In healthcare, behind the scenes, machine learning is being used to analyze everything from x-rays to patients history data, helping clinicians make better and faster decisions.

Challenges of adoption

Machine learning is frequently the catalyst that turns business data into accurate predictions and actionable information, but as with many emerging technologies, there are challenges to adoption, including data, complexity, cost, and lack of skills.

Data ambiguity

Enterprises can struggle with various issues related to data. First and foremost, many are unaware of all their possible data sources that might hold hidden insights. Even when they've identified data, there's a lack of labeled data ready for machine learning. Furthermore, even labeled data can prove to be an issue where integrity is in question since data can often have hidden biases based on human labelers. Finally, enterprises often struggle with ensuring the right data management and governance policies are in place to allow the right people and processes to securely access, store, and manage the data.

Complexity

The machine learning workflow can be time-consuming and iterative, which leaves many organizations and developers thinking machine learning is complex and difficult to use. There are many steps involved, from prepping

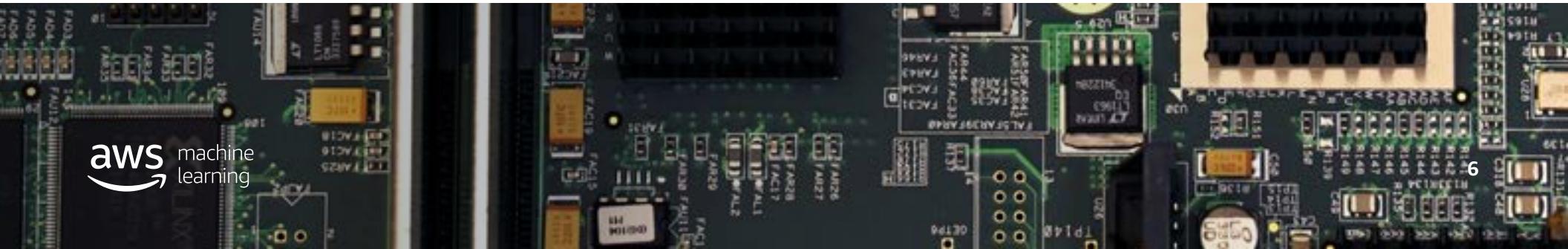
data and choosing algorithms to building, training, and deploying models... and iterating over and over again. There are decisions to be made about infrastructure—selecting the right compute for training and inference, considerations for cloud, on-premise, and edge deployments.

Cost inhibitors

Machine learning training and inference can be expensive, especially since models require iterations to improve the accuracy of predictions. Because embarking on machine learning initiatives is new to many companies, they also don't have the experiences or skills in-house and often have to rely on costly external resources to kick-start projects.

Lack of skills

Even when companies embrace new technologies like machine learning to drive business transformation, having the right skills is often a road blocker for getting started. Machine learning initiatives require machine learning expertise to build and train machine learning models—this includes the skills of machine learning developers, data scientists, and researchers to build algorithms and train models. These skills are not in great supply and are often unavailable in-house, which leaves businesses struggling to train or supplement skills with consultants and partners.



Getting started with machine learning

Machine learning presents new opportunities to realize foundational gains such as efficiency and cost saving, as well as higher-value gains such as product innovation and spurring discovery and research. But how do organizations get started? For many, machine learning adoption begins by considering all data sources and existing data strategies. They identify workflows and business processes that suffer from low efficiency. They consider all their data sources and existing data strategy. They determine the best cloud-based infrastructure and tools to scale machine learning. And last, they ensure that the right skills are on board for the machine learning initiative to be successful.

Key considerations

- Advance your data strategy
- Understand business objectives
- Leverage the cloud
- Enable your organization





- Data is gold for leaders who are looking to disrupt their industries

Advance your data strategy

Data is gold for leaders who are looking to disrupt their industries with machine learning. But many organizations don't have machine learning-ready data. Recognizing the importance of data and developing a plan to collect and use that data is critical for successful machine learning adoption, even at the proofs of concepts (PoC) stage.

All sources of data need to be uncovered, from structured data like billing and CRM to unstructured data like social media feeds, images, and forms. Then that data needs to be evaluated for quality and usefulness. Finally, data needs to be cleaned and accurately labeled for machine learning models to transform it into valuable insights.

Understand business objectives

Understanding the business benefits of machine learning adoption—in particular, the specific benefits relevant to your organization—is critical for enterprise success with machine learning. Once objectives are identified, it's important for business and technical leaders to understand and champion roles.

Select a targeted use case

When choosing a pilot, consider use cases where machine learning can have the most impact and those from which you can learn to scale enterprise deployment. Focus on how you can deliver a better experience for your customers and identify the business and operational outcomes desired. Then, establish one or two high-value PoC that can really make a difference to your organization and quickly demonstrate results. For the PoC to succeed, it's critical to have the right resources in place, including infrastructure, data, and capabilities.

Understand the impact

From the outset, consider the operational effect of new machine learning solutions. Machine learning can have a transformative impact, so it's important to plan in advance for what you want to achieve and measure. This can also help you determine how to measure success. Rather than aiming for a target financial ROI within a given time frame, you'll find more success by measuring the impact of machine learning initiatives in terms of business agility, competitive advantage, and risk tolerance.

Iterate and learn

Once you've proven the potential of machine learning, the next step is to move from pilot to production, which may include integrating the machine learning capability into a larger IT system. This move typically takes longer than the pilot process and can vary depending on the complexity of the overall system and how large-scale the production deployment will be.

Leverage the cloud

Successful machine learning initiatives need more than just the right tools. A comprehensive platform brings together data store, security, and analytics services, as well as compute resources for training and deployment. Turning to the cloud for these services brings a wide range of benefits, including speed, scalability, flexibility, resilience, security, and reduced cost.

Additionally, the cloud offers the widest range of high-performance CPU and GPU processor types, which are essential for large-scale training and for deployment in a production environment. Using cloud-based data lakes and storage also ensures that you can easily access and manage data so that machine learning initiatives are seamless, repeatable, and scalable.



- **Identify desired outcomes and deliver better experiences for your customers**

Enable your organization

Along with the right use cases, having the right skills to build machine learning applications and systems, as well as the right process and operating model, is essential to getting pilots off the ground and scaling enterprise machine learning.

Assemble the team

Assemble a team of machine learning developers and data scientists essential for a successful PoC, and train teams for future deployments. It's also important to involve subject matter experts who understand your business vernacular, especially for industry domains, to help you get to the ground truth with your data. Consider appointing a Chief Data Officer (CDO) to lead the charge on data strategy and governance, bring together interdisciplinary teams, and streamline data processes.

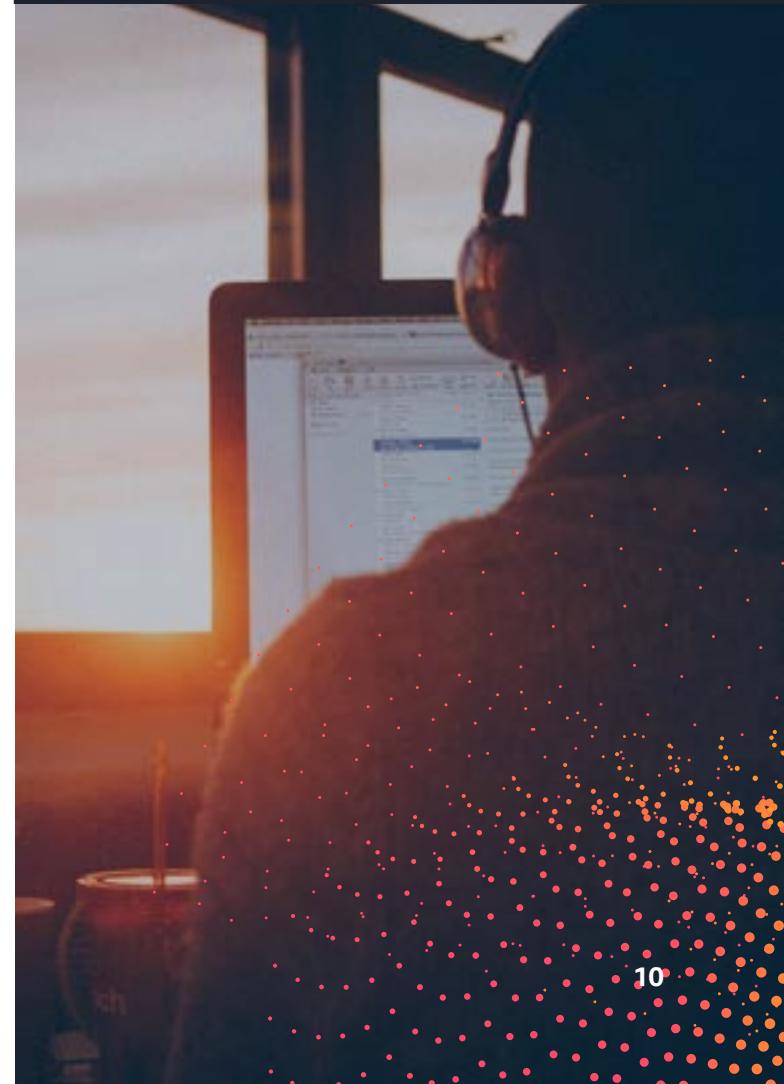
Create the process

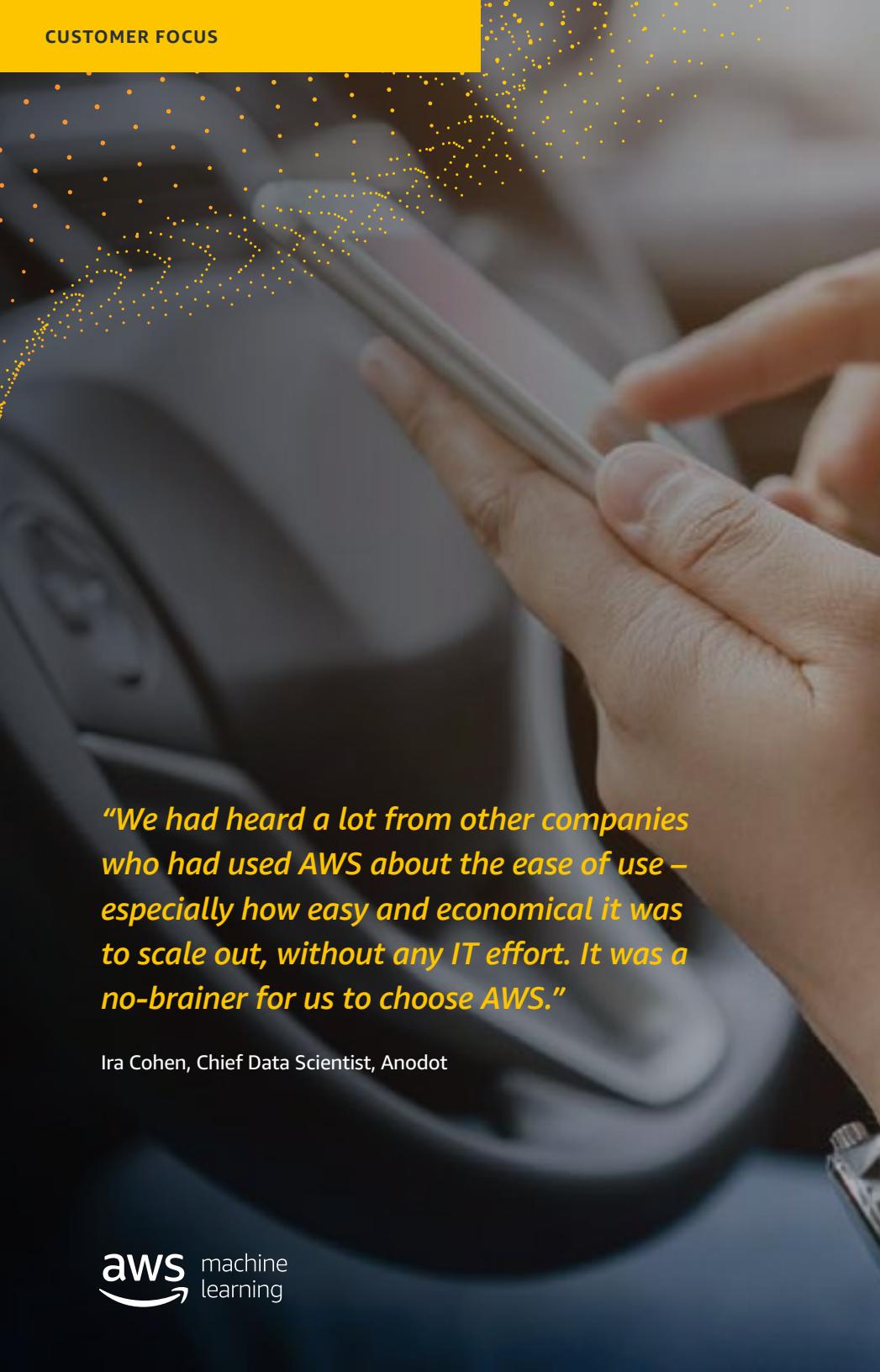
Machine learning may not bring the expected value if the results are not integrated with other areas of the organization. Operationalizing machine learning models is hard—as many as half of PoCs don't get deployed into production. Therefore, executive sponsorship to change business processes and alignment with application development is key. Successful teams create processes to align machine learning experts, data scientists, and developers with key business stakeholders. A well-defined process also helps ensure the final output is well integrated into business processes.

Build the culture

To help realize its potential, there needs to be cultural acceptance that machine learning is an important part of business and operations. Some initiatives may require information from across these domains, so it's important to understand all the stakeholders who need to be involved, and bring together stakeholders who can champion adoption.

- Enlist the right stakeholders and skills to get pilots off the ground and scale





"We had heard a lot from other companies who had used AWS about the ease of use – especially how easy and economical it was to scale out, without any IT effort. It was a no-brainer for us to choose AWS."

Ira Cohen, Chief Data Scientist, Anodot

AWS is helping customers transform business with Machine Learning

Companies across a variety of industries choose AWS to unleash the latest advances in machine learning, creating new revenue streams, improving operational efficiency, and reducing business risks.

Lyft identifies business risks with ML

Lyft collects millions of data points and metrics from its application operating on multiple timescales: seconds when matching passengers and drivers; minutes when calculating pricing; hours when measuring market levers; and days or weeks for budgeting. But with multiple geographic dimensions on top of that, Lyft simply didn't have the resources to manually monitor every metric it gathered to detect anomalies in its data.

To accurately detect anomalies at scale that could signal larger problems and require immediate attention, Lyft turned to the automation and machine learning capabilities of AWS and Anodot, an AWS Partner Network (APN) Advanced Technology Partner, and AWS ML Competency Partner.

Read how that combination has enabled Lyft to detect business incidents quickly to understand the scope and root causes of issues across millions of metrics.

[Read how Lyft leverages machine learning to detect business incidents quickly »](#)

Formula 1 accelerates cloud transformation with ML

Formula 1 is a data-driven sport: Each race, 20 sensors on each car generate 3 GB of data, and 1,500 data points are generated each second. Using Amazon SageMaker, Formula 1's data scientists are training deep-learning models with 65 years of historical race data to extract critical performance statistics, make predictions, and give fans insight into the split-second decisions and strategies adopted by race teams.

By streaming real-time race data to AWS using Amazon Kinesis, Formula 1 can capture and process key performance data for each car during every twist and turn of the Formula 1 circuits. Sharing these insights through television broadcasts and digital platforms allows Formula 1 to give fans access to the inner workings of their favorite teams and drivers.

"AWS outperforms all others in speed, scalability, reliability, global reach, partner community, and breadth and depth of cloud services," said Pete Samara, director of innovation and digital technology at Formula 1. "By leveraging Amazon SageMaker and AWS's machine learning services, we are able to deliver these powerful insights and predictions to fans in real time."

[Learn more about Formula 1 and AWS machine learning services »](#)



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Kia uses ML to improve driver experiences and safety

Machine learning is transforming the automotive industry. Kia Motors builds more than 3 million vehicles a year for customers in 180 countries. In addition to external-facing sensors that assist with automatic braking and lane departure warnings, Kia is using computer vision inside the cabin to better understand and assist drivers.

Kia uses machine learning technology like Amazon Rekognition to create a highly personalized driver experience, using advanced image and video analysis to offer driver-assistance features like personalized mirror and seat positioning for different people behind the wheel.

Beyond personalization, Kia is also applying machine learning to improve driver and road safety. With computer vision embedded directly in the in-car system, image and video data about the driver's condition, as well as environmental data, is analyzed in real time.

Learn how Kia is aiming to use machine learning technology to help reduce fatality rates »

"Recognizing who the driver is and who the passenger is, and then automatically creating their vehicle preferences is a simple way for Kia to use AWS and artificial intelligence in new ways."

Hyungjoon Oh, Researcher, Kia Motors R&D





"We want to use the AWS platform to scale to as many algorithms as we can. The more intelligence we can put into medical devices and applications, the more we can increase the quality. It's going to improve access, it's going to improve efficiency and it's going to reduce costs all at the same time."

Keith Bigelow, General Manager of Analytics, GE Healthcare

GE Healthcare drives better outcomes with ML

The healthcare sector is poised to benefit significantly from the innovations of big data, machine learning, and artificial intelligence. Leading the way is GE Healthcare, which has partnered with the University of California, San Francisco to create a library of deep learning algorithms centered around improving traditional x-ray imaging technologies like ultrasounds and CT scans.

The goal is to allow physicians to treat patients more quickly, not only cutting costs but also improving outcomes. Behind it is GE Healthcare's partnership with AWS, which provides the ability to deploy machine learning solutions at scale through the Amazon SageMaker machine learning platform.

[Read how GE Healthcare and AWS have partnered to make goals a reality »](#)

AWS ML and AI Services

AWS has the broadest and deepest set of machine learning (ML) and AI services for your business. On behalf of our tens of thousands of customers, we are focused on solving some of the toughest challenges that hold back machine learning adoption.

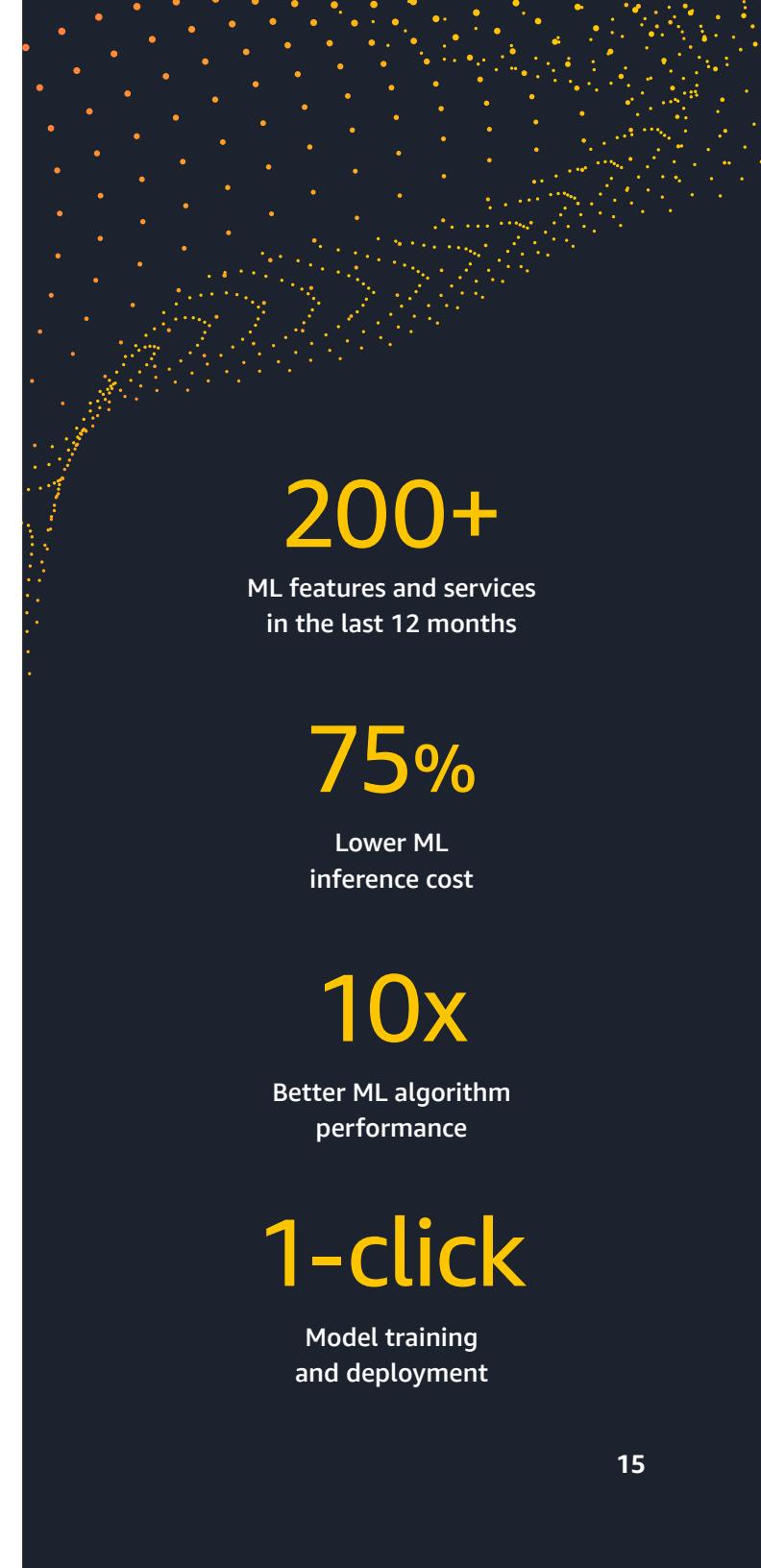
Choose from pre-trained machine learning services such as Amazon SageMaker to build and scale machine learning, or build custom models with support for all the popular open-source frameworks. AWS machine learning capabilities are built on a comprehensive cloud platform, optimized for machine learning with high-performance compute, security, and analytics.

ML Services

Amazon SageMaker provides every developer and data scientist with the ability to build, train, and deploy machine learning models quickly, without needing data engineers or DevOps. Amazon SageMaker is a fully-managed service that covers the entire machine learning workflow to label and prepare your data, choose an algorithm, train the model, tune and optimize it for deployment, make predictions, and take action. Your models get to production faster with much less effort and lower cost.

AI Services

AWS pre-trained AI Services provide ready-made intelligence for your applications and workflows. AI Services easily integrate with your applications to address common use cases such as personalized recommendations, modernizing your contact center, improving safety and security, and increasing customer engagement. Because we use the same deep learning technology that powers Amazon.com and our Machine Learning Services, you get quality and accuracy from continuously learning APIs. And best of all, AI Services on AWS don't require machine learning experience.



Amazon ML Solutions Lab

The Amazon ML Solutions Lab combines hands-on educational workshops with advisory professional services to help you "work backward" from business challenges, and then go step-by-step through the process of developing machine learning-based solutions. You'll be able to take what you have learned through the process and use it elsewhere in your organization to apply machine learning to business opportunities.

AWS Machine Learning Competency Partners

AWS Machine Learning Competency Partners offer a range of services and solutions to help you create intelligent solutions for your business. From concept development through execution, partner solutions offer tools and expertise to help with the entire machine learning workflow.

Training and education

Start training on machine learning on AWS with courses based on the same material used to train Amazon's developers through the combination of foundational knowledge and real-world application. Developers, data scientists, data platform engineers, and business decision-makers can use this training to learn how to apply machine learning, AI, and deep learning to their businesses.

**Learn how to put machine learning
to work for your business »**

