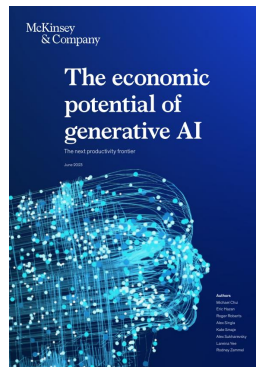


[Skip to content](#) Generative AI is poised to unleash the next wave of productivity. We take a first look at where business value could accrue and the potential impacts on the workforce.



The economic potential of generative AI: The next productivity frontier

[📄 \(68 pages\)](#)

AI has permeated our lives incrementally, through everything from the tech powering our smartphones to autonomous-driving features on cars to the tools retailers use to surprise and delight consumers. As a result, its progress has been almost imperceptible. Clear milestones, such as when AlphaGo, an AI-based program developed by DeepMind, defeated a world champion Go player in 2016, were celebrated but then quickly faded from the public's consciousness.

Generative AI applications such as ChatGPT, GitHub Copilot, Stable Diffusion, and others have captured the imagination of people around the world in a way AlphaGo did not, thanks to their broad utility—almost anyone can use them to communicate and create—and preternatural ability to have a conversation with a user. The latest generative AI applications can perform a range of routine tasks, such as the reorganization and classification of data. But it is their ability to write text, compose music, and create digital art that has garnered headlines and persuaded consumers and households to experiment on their own. As a result, a broader set of stakeholders are grappling with generative AI's impact on business and society but without much context to help them make sense of it.

About the authors

The speed at which generative AI technology is developing isn't making this task any easier. ChatGPT was released in November 2022. Four months later, OpenAI released a new large language model, or LLM, called GPT-4 with markedly improved capabilities.^[1] Similarly, by May 2023, Anthropic's generative AI, Claude, was able to process 100,000 tokens of text, equal to about 75,000 words in a minute—the length of the average novel—compared with roughly 9,000 tokens when it was introduced in March 2023.^[2] And in May 2023, Google announced several new features powered by generative AI, including Search Generative Experience and a new LLM called PaLM 2 that will power its Bard chatbot, among other Google products.^[3]

To grasp what lies ahead requires an understanding of the breakthroughs that have enabled the rise of generative AI, which were decades in the making. For the purposes of this report, we define generative AI as applications typically built using foundation models. These models contain expansive artificial neural networks inspired by the billions of neurons connected in the human brain. Foundation models are part of what is called deep learning, a term that alludes to the many deep layers within neural networks. Deep learning has powered many of the recent advances in AI, but the foundation models powering generative AI applications are a step-change evolution within deep learning. Unlike previous deep learning models, they can process extremely large and varied sets of unstructured data and perform more than one task.



Creating value beyond the hype

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Foundation models have enabled new capabilities and vastly improved existing ones across a broad range of modalities, including images, video, audio, and computer code. AI trained on these models can perform several functions; it can classify, edit, summarize, answer questions, and draft new content, among other tasks.

All of us are at the beginning of a journey to understand generative AI's power, reach, and capabilities. This research is the latest in our efforts to assess the impact of this new era of AI. It suggests that generative AI is poised to transform roles and boost performance across functions such as sales and marketing, customer operations, and software development. In the process, it could unlock trillions of dollars in value across sectors from banking to life sciences. The following sections share our initial findings.

For the full version of this report, download the PDF.

Key insights

Generative AI's impact on productivity could add trillions of dollars in value to the global economy. Our latest research estimates that generative AI could add the equivalent of \$2.6 trillion to \$4.4 trillion annually across the 63 use cases we analyzed—by comparison, the United Kingdom's entire GDP in 2021 was \$3.1 trillion. This would increase the impact of all artificial intelligence by 15 to 40 percent. This estimate would roughly double if we include the impact of embedding generative AI into software that is currently used for other tasks beyond those use cases.

About 75 percent of the value that generative AI use cases could deliver falls across four areas: Customer operations, marketing and sales, software engineering, and R&D. Across 16 business functions, we examined 63 use cases in which the technology can address specific business challenges in ways that produce one or more measurable outcomes. Examples include generative AI's ability to support interactions with customers, generate creative content for marketing and sales, and draft computer code based on natural-language prompts, among many other tasks.

Generative AI will have a significant impact across all industry sectors. Banking, high tech, and life sciences are among the industries that could see the biggest impact as a percentage of their revenues from generative AI. Across the banking industry, for example, the technology could deliver value equal to an additional \$200 billion to \$340 billion annually if the use cases were fully implemented. In retail and consumer packaged goods, the potential impact is also significant at \$400 billion to \$660 billion a year.

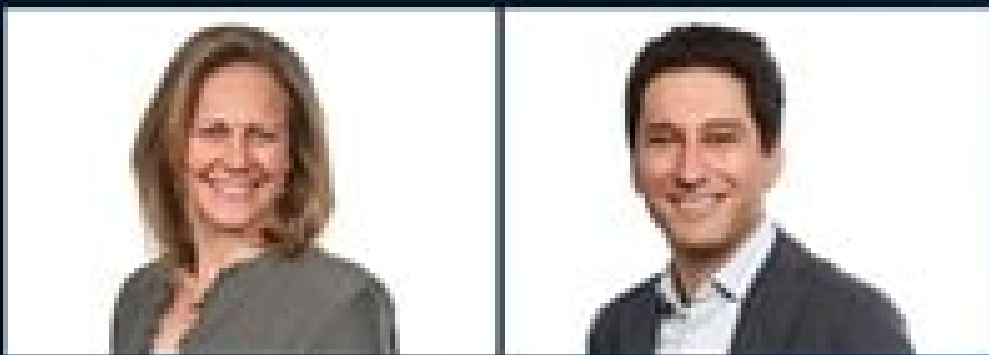
Generative AI has the potential to change the anatomy of work, augmenting the capabilities of individual workers by automating some of their individual activities. Current generative AI and other technologies have the potential to automate work activities that absorb 60 to 70 percent of employees' time today. In contrast, we previously estimated that technology has the potential to automate half of the time employees spend working.^[4] "Harnessing automation for a future that works," McKinsey Global Institute, January 12, 2017. The acceleration in the potential for technical automation is largely due to generative AI's increased ability to understand natural language, which is required for work activities that account for 25 percent of total work time. Thus, generative AI has more impact on knowledge work associated with occupations that have higher wages and educational requirements than on other types of work.

The pace of workforce transformation is likely to accelerate, given increases in the potential for technical automation. Our updated adoption scenarios, including technology development, economic feasibility, and diffusion timelines, lead to estimates that half of today's work activities could be automated between 2030 and 2060, with a midpoint in 2045, or roughly a decade earlier than in our previous estimates.

Generative AI can substantially increase labor productivity across the economy, but that will require investments to support workers as they shift work activities or change jobs. Generative AI could enable labor productivity growth of 0.1 to 0.6 percent annually through 2040, depending on the rate of technology adoption and redeployment of worker time into other activities. Combining generative AI with all other technologies, work automation could add 0.5 to 3.4 percentage points annually to productivity growth. However, workers will need support in learning new skills, and some will change occupations. If worker transitions and other risks can be managed, generative AI could contribute substantively to economic growth and support a more sustainable, inclusive world.

The era of generative AI is just beginning. Excitement over this technology is palpable, and early pilots are compelling. But

a full realization of the technology's benefits will take time, and leaders in business and society still have considerable challenges to address. These include managing the risks inherent in generative AI, determining what new skills and capabilities the workforce will need, and rethinking core business processes such as retraining and developing new skills.



McKinsey Live Event: Capturing the power of productivity through tech investment with Olivia White and Rodney Zempel

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Where business value lies

Generative AI is a step change in the evolution of artificial intelligence. As companies rush to adapt and implement it, understanding the technology's potential to deliver value to the economy and society at large will help shape critical decisions. We have used two complementary lenses to determine where generative AI, with its current capabilities, could deliver the biggest value and how big that value could be (Exhibit 1).

1

The first lens scans use cases for generative AI that organizations could adopt. We define a “use case” as a targeted application of generative AI to a specific business challenge, resulting in one or more measurable outcomes. For example, a use case in marketing is the application of generative AI to generate creative content such as personalized emails, the measurable outcomes of which potentially include reductions in the cost of generating such content and increases in revenue from the enhanced effectiveness of higher-quality content at scale. We identified 63 generative AI use cases spanning 16 business functions that could deliver total value in the range of \$2.6 trillion to \$4.4 trillion in economic benefits annually when applied across industries.

That would add 15 to 40 percent to the \$11 trillion to \$17.7 trillion of economic value that we now estimate nongenerative artificial intelligence and analytics could unlock. (Our previous estimate from 2017 was that AI could deliver \$9.5 trillion to \$15.4 trillion in economic value.)

Our second lens complements the first by analyzing generative AI's potential impact on the work activities required in some 850 occupations. We modeled scenarios to estimate when generative AI could perform each of more than 2,100 “detailed work activities”—such as “communicating with others about operational plans or activities”—that make up those occupations across the world economy. This enables us to estimate how the current capabilities of generative AI could affect labor

productivity across all work currently done by the global workforce.

Some of this impact will overlap with cost reductions in the use case analysis described above, which we assume are the result of improved labor productivity. Netting out this overlap, the total economic benefits of generative AI—including the major use cases we explored and the myriad increases in productivity that are likely to materialize when the technology is applied across knowledge workers' activities—amounts to \$6.1 trillion to \$7.9 trillion annually (Exhibit 2).

2

How we estimated the value potential of generative AI use cases

While generative AI is an exciting and rapidly advancing technology, the other applications of AI discussed in our previous report continue to account for the majority of the overall potential value of AI. Traditional advanced-analytics and machine learning algorithms are highly effective at performing numerical and optimization tasks such as predictive modeling, and they continue to find new applications in a wide range of industries. However, as generative AI continues to develop and mature, it has the potential to open wholly new frontiers in creativity and innovation. It has already expanded the possibilities of what AI overall can achieve (see sidebar “How we estimated the value potential of generative AI use cases”).

In this section, we highlight the value potential of generative AI across business functions.

Generative AI could have an impact on most business functions; however, a few stand out when measured by the technology's impact as a share of functional cost (Exhibit 3). Our analysis of 16 business functions identified just four—customer operations, marketing and sales, software engineering, and research and development—that could account for approximately 75 percent of the total annual value from generative AI use cases.

3

Notably, the potential value of using generative AI for several functions that were prominent in our previous sizing of AI use cases, including manufacturing and supply chain functions, is now much lower.^[5] This is largely explained by the nature of generative AI use cases, which exclude most of the numerical and optimization applications that were the main value drivers for previous applications of AI.

In addition to the potential value generative AI can deliver in function-specific use cases, the technology could drive value across an entire organization by revolutionizing internal knowledge management systems. Generative AI's impressive command of natural-language processing can help employees retrieve stored internal knowledge by formulating queries in the same way they might ask a human a question and engage in continuing dialogue. This could empower teams to quickly access relevant information, enabling them to rapidly make better-informed decisions and develop effective strategies.

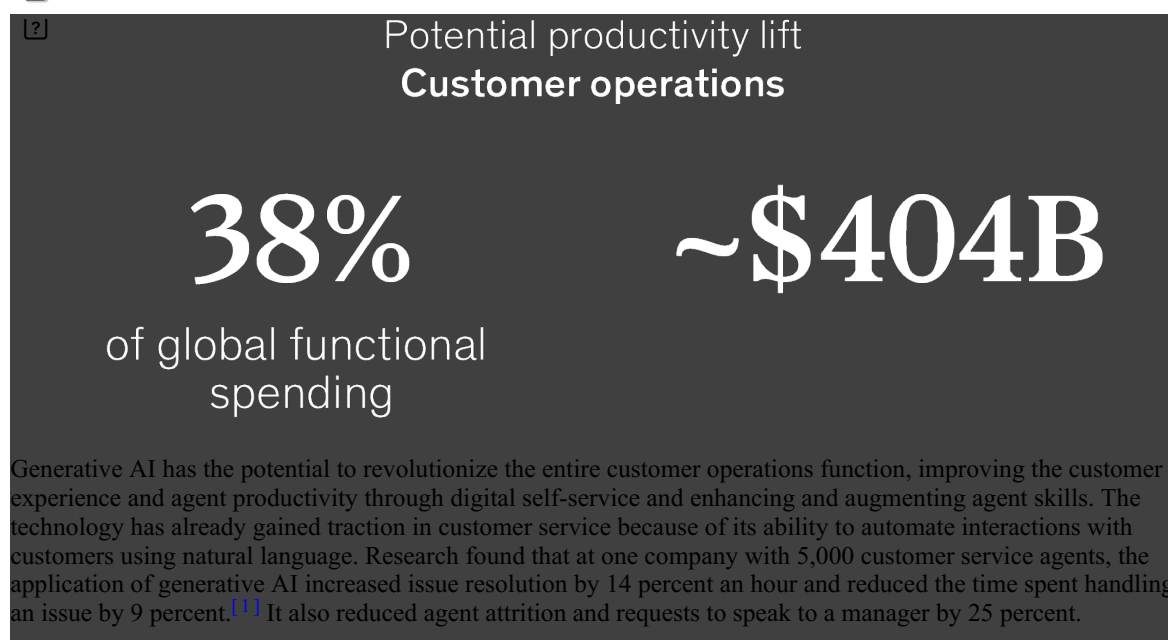
In 2012, the McKinsey Global Institute (MGI) estimated that knowledge workers spent about a fifth of their time, or one day each work week, searching for and gathering information. If generative AI could take on such tasks, increasing the efficiency and effectiveness of the workers doing them, the benefits would be huge. Such virtual expertise could rapidly “read” vast libraries of corporate information stored in natural language and quickly scan source material in dialogue with a human who helps fine-tune and tailor its research, a more scalable solution than hiring a team of human experts for the task.

In other cases, generative AI can drive value by working in partnership with workers, augmenting their work in ways that accelerate their productivity. Its ability to rapidly digest mountains of data and draw conclusions from it enables the technology to offer insights and options that can dramatically enhance knowledge work. This can significantly speed up the process of developing a product and allow employees to devote more time to higher-impact tasks.

Following are four examples of how generative AI could produce operational benefits in a handful of use cases across the business functions that could deliver a majority of the potential value we identified in our analysis of 63 generative AI use cases. In the first two examples, it serves as a virtual expert, while in the following two, it lends a hand as a virtual collaborator.

Customer operations: Improving customer and agent experiences

[?]



Crucially, productivity and quality of service improved most among less-experienced agents, while the AI assistant did not increase—and sometimes decreased—the productivity and quality metrics of more highly skilled agents. This is because AI assistance helped less-experienced agents communicate using techniques similar to those of their higher-skilled counterparts.

The following are examples of the operational improvements generative AI can have for specific use cases:

- *Customer self-service.* Generative AI–fueled chatbots can give immediate and personalized responses to complex customer inquiries regardless of the language or location of the customer. By improving the quality and effectiveness of interactions via automated channels, generative AI could automate responses to a higher percentage of customer inquiries, enabling customer care teams to take on inquiries that can only be resolved by a human agent. Our research found that roughly half of customer contacts made by banking, telecommunications, and utilities companies in North America are already handled by machines, including but not exclusively AI. We estimate that generative AI could further reduce the volume of human-serviced contacts by up to 50 percent, depending on a company’s existing level of automation.
- *Resolution during initial contact.* Generative AI can instantly retrieve data a company has on a specific customer, which can help a human customer service representative more successfully answer questions and resolve issues during an initial interaction.
- *Reduced response time.* Generative AI can cut the time a human sales representative spends responding to a customer by providing assistance in real time and recommending next steps.
- *Increased sales.* Because of its ability to rapidly process data on customers and their browsing histories, the technology can identify product suggestions and deals tailored to customer preferences. Additionally, generative AI can enhance quality assurance and coaching by gathering insights from customer conversations, determining what could be done better, and coaching agents.

We estimate that applying generative AI to customer care functions could increase productivity at a value ranging from 30 to 45 percent of current function costs.

Our analysis captures only the direct impact generative AI might have on the productivity of customer operations. It does not account for potential knock-on effects the technology may have on customer satisfaction and retention arising from an improved experience, including better understanding of the customer’s context that can assist human agents in providing more personalized help and recommendations.

Marketing and sales: Boosting personalization, content creation, and sales productivity

[?]

[?]

Potential productivity lift
Marketing

10%

of global functional
spending

~\$463B

Sales

4%

of global functional
spending

~\$486B

Generative AI has taken hold rapidly in marketing and sales functions, in which text-based communications and personalization at scale are driving forces. The technology can create personalized messages tailored to individual customer interests, preferences, and behaviors, as well as do tasks such as producing first drafts of brand advertising, headlines, slogans, social media posts, and product descriptions.

Marketing

Introducing generative AI to marketing functions requires careful consideration. For one thing, mathematical models trained on publicly available data without sufficient safeguards against plagiarism, copyright violations, and branding recognition risks infringing on intellectual property rights. A virtual try-on application may produce biased representations of certain demographics because of limited or biased training data. Thus, significant human oversight is required for conceptual and strategic thinking specific to each company's needs.

Potential operational benefits from using generative AI for marketing include the following:

- *Efficient and effective content creation.* Generative AI could significantly reduce the time required for ideation and content drafting, saving valuable time and effort. It can also facilitate consistency across different pieces of content, ensuring a uniform brand voice, writing style, and format. Team members can collaborate via generative AI, which can integrate their ideas into a single cohesive piece. This would allow teams to significantly enhance personalization of marketing messages aimed at different customer segments, geographies, and demographics. Mass email campaigns can be instantly translated into as many languages as needed, with different imagery and messaging depending on the audience. Generative AI's ability to produce content with varying specifications could increase customer value, attraction, conversion, and retention over a lifetime and at a scale beyond what is currently possible through traditional techniques.
- *Enhanced use of data.* Generative AI could help marketing functions overcome the challenges of unstructured, inconsistent, and disconnected data—for example, from different databases—by interpreting abstract data sources such as text, image, and varying structures. It can help marketers better use data such as territory performance, synthesized customer feedback, and customer behavior to generate data-informed marketing strategies such as targeted customer profiles and channel recommendations. Such tools could identify and synthesize trends, key drivers, and market and product opportunities from unstructured data such as social media, news, academic research, and customer feedback.
- *SEO optimization.* Generative AI can help marketers achieve higher conversion and lower cost through search engine optimization (SEO) for marketing and sales technical components such as page titles, image tags, and URLs. It can synthesize key SEO tokens, support specialists in SEO digital content creation, and distribute targeted content to customers.
- *Product discovery and search personalization.* With generative AI, product discovery and search can be personalized with multimodal inputs from text, images, and speech, and a deep understanding of customer profiles. For example, technology can leverage individual user preferences, behavior, and purchase history to help customers discover the most relevant products and generate personalized product descriptions. This would allow CPG, travel, and retail companies to improve their e-commerce sales by achieving higher website conversion rates.

We estimate that generative AI could increase the productivity of the marketing function with a value between 5 and 15 percent of total marketing spending.

Our analysis of the potential use of generative AI in marketing doesn't account for knock-on effects beyond the direct impacts on productivity. Generative AI-enabled synthesis could provide higher-quality data insights, leading to new ideas for marketing campaigns and better-targeted customer segments. Marketing functions could shift resources to producing higher-quality content for owned channels, potentially reducing spending on external channels and agencies.

Sales

Generative AI could also change the way both B2B and B2C companies approach sales. The following are two use cases for sales:

- *Increase probability of sale.* Generative AI could identify and prioritize sales leads by creating comprehensive consumer profiles from structured and unstructured data and suggesting actions to staff to improve client engagement at every point of contact. For example, generative AI could provide better information about client preferences, potentially improving close rates.
- *Improve lead development.* Generative AI could help sales representatives nurture leads by synthesizing relevant product sales information and customer profiles and creating discussion scripts to facilitate customer conversation, including up- and cross-selling talking points. It could also automate sales follow-ups and passively nurture leads until clients are ready for direct interaction with a human sales agent.

Our analysis suggests that implementing generative AI could increase sales productivity by approximately 3 to 5 percent of current global sales expenditures.

This analysis may not fully account for additional revenue that generative AI could bring to sales functions. For instance, generative AI's ability to identify leads and follow-up capabilities could uncover new leads and facilitate more effective outreach that would bring in additional revenue. Also, the time saved by sales representatives due to generative AI's capabilities could be invested in higher-quality customer interactions, resulting in increased sales success.

Software engineering: Speeding developer work as a coding assistant

[2]

Potential productivity lift Software engineering in corporate IT

31%

of global functional
spending

~\$485B

Software engineering in product development

32%

of global functional
spending

~\$414B

Treating computer languages as just another language opens new possibilities for software engineering. Software engineers can use generative AI in pair programming and to do augmented coding and train LLMs to develop applications that generate code when given a natural-language prompt describing what that code should do.

Software engineering is a significant function in most companies, and it continues to grow as all large companies, not just tech titans, embed software in a wide array of products and services. For example, much of the value of new vehicles comes from digital features such as adaptive cruise control, parking assistance, and IoT connectivity.

According to our analysis, the direct impact of AI on the productivity of software engineering could range from 20 to 45 percent of current annual spending on the function. This value would arise primarily from reducing time spent on certain activities, such as generating initial code drafts, code correction and refactoring, root-cause analysis, and generating new system designs. By accelerating the coding process, generative AI could push the skill sets and capabilities needed in software engineering toward code and architecture design. One study found that software developers using Microsoft's GitHub Copilot completed tasks 56 percent faster than those not using the tool.^[1] An internal McKinsey empirical study of software engineering teams found those who were trained to use generative AI tools rapidly reduced the time needed to generate and refactor code—and engineers also reported a better work experience, citing improvements in happiness, flow, and fulfillment.

Our analysis did not account for the increase in application quality and the resulting boost in productivity that generative AI could bring by improving code or enhancing IT architecture—which can improve productivity across the IT value chain. However, the quality of IT architecture still largely depends on software architects, rather than on initial drafts that generative AI's current capabilities allow it to produce.

Large technology companies are already selling generative AI for software engineering, including GitHub Copilot, which is now integrated with OpenAI's GPT-4, and Replit, used by more than 20 million coders.^[2]

Product R&D: Reducing research and design time, improving simulation and testing

[2]

Potential productivity lift Product R&D

12%

of global functional
spending

~\$328B

Generative AI's potential in R&D is perhaps less well recognized than its potential in other business functions. Still, our research indicates the technology could deliver productivity with a value ranging from 10 to 15 percent of overall R&D costs.

For example, the life sciences and chemical industries have begun using generative AI foundation models in their R&D for what is known as generative design. Foundation models can generate candidate molecules, accelerating the process of developing new drugs and materials. Entos, a biotech pharmaceutical company, has paired generative AI with automated synthetic development tools to design small-molecule therapeutics. But the same principles can be applied to the design of many other products, including larger-scale physical products and electrical circuits, among others.

While other generative design techniques have already unlocked some of the potential to apply AI in R&D, their cost and data requirements, such as the use of “traditional” machine learning, can limit their application. Pretrained foundation models that underpin generative AI, or models that have been enhanced with fine-tuning, have much broader areas of application than models optimized for a single task. They can therefore accelerate time to market and broaden the types of products to which generative design can be applied. For now, however, foundation models lack the capabilities to help design products across all industries.

In addition to the productivity gains that result from being able to quickly produce candidate designs, generative design can also enable improvements in the designs themselves, as in the following examples of the operational improvements generative AI could bring:

- *Enhanced design.* Generative AI can help product designers reduce costs by selecting and using materials more efficiently. It can also optimize designs for manufacturing, which can lead to cost reductions in logistics and production.
- *Improved product testing and quality.* Using generative AI in generative design can produce a higher-quality product, resulting in increased attractiveness and market appeal. Generative AI can help to reduce testing time of complex systems and accelerate trial phases involving customer testing through its ability to draft scenarios and profile testing candidates.

We also identified a new R&D use case for nongenerative AI: deep learning surrogates, the use of which has grown since our earlier research, can be paired with generative AI to produce even greater benefits. To be sure, integration will require the development of specific solutions, but the value could be significant because deep learning surrogates have the potential to accelerate the testing of designs proposed by generative AI.

While we have estimated the potential direct impacts of generative AI on the R&D function, we did not attempt to estimate the technology's potential to create entirely novel product categories. These are the types of innovations that can produce step changes not only in the performance of individual companies but in economic growth overall.

Industry impacts

Across the 63 use cases we analyzed, generative AI has the potential to generate \$2.6 trillion to \$4.4 trillion in value across industries. Its precise impact will depend on a variety of factors, such as the mix and importance of different functions, as well as the scale of an industry's revenue (Exhibit 4).

For example, our analysis estimates generative AI could contribute roughly \$310 billion in additional value for the retail industry (including auto dealerships) by boosting performance in functions such as marketing and customer interactions. By comparison, the bulk of potential value in high tech comes from generative AI's ability to increase the speed and efficiency of software development (Exhibit 5).

5

In the banking industry, generative AI has the potential to improve on efficiencies already delivered by artificial intelligence by taking on lower-value tasks in risk management, such as required reporting, monitoring regulatory developments, and collecting data. In the life sciences industry, generative AI is poised to make significant contributions to drug discovery and development.

We share our detailed analysis of these industries below.

Generative AI supports key value drivers in retail and consumer packaged goods

[?]

[2]



The technology could generate value for the retail and consumer packaged goods (CPG) industry by increasing productivity by 1.2 to 2.0 percent of annual revenues, or an additional \$400 billion to \$660 billion.^[1] To streamline processes, generative AI could automate key functions such as customer service, marketing and sales, and inventory and supply chain management. Technology has played an essential role in the retail and CPG industries for decades. Traditional AI and advanced analytics solutions have helped companies manage vast pools of data across large numbers of SKUs, expansive supply chain and warehousing networks, and complex product categories such as consumables. In addition, the industries are heavily customer facing, which offers opportunities for generative AI to complement previously existing artificial intelligence. For example, generative AI's ability to personalize offerings could optimize marketing and sales activities already handled by existing AI solutions. Similarly, generative AI tools excel at data management and could support existing AI-driven pricing tools. Applying generative AI to such activities could be a step toward integrating applications across a full enterprise.

Generative AI at work in retail and CPG

Reinvention of the customer interaction pattern

Consumers increasingly seek customization in everything from clothing and cosmetics to curated shopping experiences, personalized outreach, and food—and generative AI can improve that experience. Generative AI can aggregate market data to test concepts, ideas, and models. Stitch Fix, which uses algorithms to suggest style choices to its customers, has experimented with DALL·E to visualize products based on customer preferences regarding color, fabric, and style. Using text-to-image generation, the company's stylists can visualize an article of clothing based on a consumer's preferences and then identify a similar article among Stitch Fix's inventory.

Retailers can create applications that give shoppers a next-generation experience, creating a significant competitive advantage in an era when customers expect to have a single natural-language interface help them select products. For example, generative AI can improve the process of choosing and ordering ingredients for a meal or preparing food—imagine a chatbot that could pull up the most popular tips from the comments attached to a recipe. There is also a big opportunity to enhance customer value management by delivering personalized marketing campaigns through a chatbot. Such applications can have human-like conversations about products in ways that can increase customer satisfaction, traffic, and brand loyalty. Generative AI offers retailers and CPG companies many opportunities to cross-sell and upsell, collect insights to improve product offerings, and increase their customer base, revenue opportunities, and overall marketing ROI.

Accelerating the creation of value in key areas

Generative AI tools can facilitate copy writing for marketing and sales, help brainstorm creative marketing ideas, expedite consumer research, and accelerate content analysis and creation. The potential improvement in writing

and visuals can increase awareness and improve sales conversion rates.

Rapid resolution and enhanced insights in customer care

The growth of e-commerce also elevates the importance of effective consumer interactions. Retailers can combine existing AI tools with generative AI to enhance the capabilities of chatbots, enabling them to better mimic the interaction style of human agents—for example, by responding directly to a customer’s query, tracking or canceling an order, offering discounts, and upselling. Automating repetitive tasks allows human agents to devote more time to handling complicated customer problems and obtaining contextual information.

Disruptive and creative innovation

Generative AI tools can enhance the process of developing new versions of products by digitally creating new designs rapidly. A designer can generate packaging designs from scratch or generate variations on an existing design. This technology is developing rapidly and has the potential to add text-to-video generation.

Factors for retail and CPG organizations to consider

As retail and CPG executives explore how to integrate generative AI in their operations, they should keep in mind several factors that could affect their ability to capture value from the technology:

- *External inference.* Generative AI has increased the need to understand whether generated content is based on fact or inference, requiring a new level of quality control.
- *Adversarial attacks.* Foundation models are a prime target for attack by hackers and other bad actors, increasing the variety of potential security vulnerabilities and privacy risks.

To address these concerns, retail and CPG companies will need to strategically keep humans in the loop and ensure security and privacy are top considerations for any implementation. Companies will need to institute new quality checks for processes previously handled by humans, such as emails written by customer reps, and perform more-detailed quality checks on AI-assisted processes such as product design.

Why banks could realize significant value

[2]

[2]

Potential productivity lift

Banking

3-5%
of global industry
revenue

~\$200B–
\$340B

Generative AI could have a significant impact on the banking industry, generating value from increased productivity of 2.8 to 4.7 percent of the industry’s annual revenues, or an additional \$200 billion to \$340 billion. On top of that impact, the use of generative AI tools could also enhance customer satisfaction, improve decision making and employee experience, and decrease risks through better monitoring of fraud and risk.

Banking, a knowledge and technology-enabled industry, has already benefited significantly from previously existing applications of artificial intelligence in areas such as marketing and customer operations.^[1] “Building the AI bank of the future,” McKinsey, May 2021. Generative AI applications could deliver additional benefits, especially because text modalities are prevalent in areas such as regulations and programming language, and the industry is customer facing, with many B2C and small-business customers.^[2] *McKinsey’s Global Banking Annual Review*, December 1, 2022.

Several characteristics position the industry for the integration of generative AI applications:

- *Sustained digitization efforts along with legacy IT systems.* Banks have been investing in technology for decades, accumulating a significant amount of technical debt along with a siloed and complex IT architecture.^[3] “Why most digital banking transformations fail—and how to flip the odds,” McKinsey, April 11, 2023.
- *Large customer-facing workforces.* Banking relies on a large number of service representatives such as call-center agents and wealth management financial advisers.
- *A stringent regulatory environment.* As a heavily regulated industry, banking has a substantial number of risk, compliance, and legal needs.
- *White-collar industry.* Generative AI’s impact could span the organization, assisting all employees in writing emails, creating business presentations, and other tasks.

Generative AI at work in banking

Banks have started to grasp the potential of generative AI in their front lines and in their software activities. Early adopters are harnessing solutions such as ChatGPT as well as industry-specific solutions, primarily for software and knowledge applications. Three uses demonstrate its value potential to the industry.

A virtual expert to augment employee performance

A generative AI bot trained on proprietary knowledge such as policies, research, and customer interaction could provide always-on, deep technical support. Today, frontline spending is dedicated mostly to validating offers and interacting with clients, but giving frontline workers access to data as well could improve the customer experience. The technology could also monitor industries and clients and send alerts on semantic queries from public sources. For example, Morgan Stanley is building an AI assistant using GPT-4, with the aim of helping tens of thousands of wealth managers quickly find and synthesize answers from a massive internal knowledge base.^[4] The model combines search and content creation so wealth managers can find and tailor information for any client at any moment.

One European bank has leveraged generative AI to develop an environmental, social, and governance (ESG) virtual expert by synthesizing and extracting from long documents with unstructured information. The model answers complex questions based on a prompt, identifying the source of each answer and extracting information from pictures and tables.

Generative AI could reduce the significant costs associated with back-office operations. Such customer-facing chatbots could assess user requests and select the best service expert to address them based on characteristics such as topic, level of difficulty, and type of customer. Through generative AI assistants, service professionals could rapidly access all relevant information such as product guides and policies to instantaneously address customer requests.

Code acceleration to reduce tech debt and deliver software faster

Generative AI tools are useful for software development in four broad categories. First, they can draft code based on context via input code or natural language, helping developers code more quickly and with reduced friction while enabling automatic translations and no- and low-code tools. Second, such tools can automatically generate, prioritize, run, and review different code tests, accelerating testing and increasing coverage and effectiveness. Third, generative AI's natural-language translation capabilities can optimize the integration and migration of legacy frameworks. Last, the tools can review code to identify defects and inefficiencies in computing. The result is more robust, effective code.

Production of tailored content at scale

Generative AI tools can draw on existing documents and data sets to substantially streamline content generation. These tools can create personalized marketing and sales content tailored to specific client profiles and histories as well as a multitude of alternatives for A/B testing. In addition, generative AI could automatically produce model documentation, identify missing documentation, and scan relevant regulatory updates to create alerts for relevant shifts.

Factors for banks to consider

When exploring how to integrate generative AI into operations, banks can be mindful of a number of factors:

- *The level of regulation for different processes.* These vary from unregulated processes such as customer service to heavily regulated processes such as credit risk scoring.
- *Type of end user.* End users vary widely in their expectations and familiarity with generative AI—for example, employees compared with high-net-worth clients.
- *Intended level of work automation.* AI agents integrated through APIs could act nearly autonomously or as copilots, giving real-time suggestions to agents during customer interactions.
- *Data constraints.* While public data such as annual reports could be made widely available, there would need to be limits on identifiable details for customers and other internal data.

Pharmaceuticals and medical products could see benefits across the entire value chain

[?]

[?]

Potential productivity lift
Pharmaceuticals and medical products

3-5%	~\$60B–
of global industry revenue	\$110B

Our analysis finds that generative AI could have a significant impact on the pharmaceutical and medical-product industries—from 2.6 to 4.5 percent of annual revenues across the pharmaceutical and medical-product industries, or \$60 billion to \$110 billion annually. This big potential reflects the resource-intensive process of discovering new drug compounds. Pharma companies typically spend approximately 20 percent of revenues on R&D,^[1] and the development of a new drug takes an average of ten to 15 years. With this level of spending and timeline, improving the speed and quality of R&D can generate substantial value. For example, lead identification—a step in the drug discovery process in which researchers identify a molecule that would best address the target for a potential new drug—can take several months even with “traditional” deep learning techniques. Foundation models and generative AI can enable organizations to complete this step in a matter of weeks.

Generative AI at work in pharmaceuticals and medical products

Drug discovery involves narrowing the universe of possible compounds to those that could effectively treat specific conditions. Generative AI’s ability to process massive amounts of data and model options can accelerate output across several use cases:

Improve automation of preliminary screening

In the lead identification stage of drug development, scientists can use foundation models to automate the preliminary screening of chemicals in the search for those that will produce specific effects on drug targets. To start, thousands of cell cultures are tested and paired with images of the corresponding experiment. Using an off-the-shelf foundation model, researchers can cluster similar images more precisely than they can with traditional models, enabling them to select the most promising chemicals for further analysis during lead optimization.

Enhance indication finding

An important phase of drug discovery involves the identification and prioritization of new indications—that is, diseases, symptoms, or circumstances that justify the use of a specific medication or other treatment, such as a test, procedure, or surgery. Possible indications for a given drug are based on a patient group’s clinical history and medical records, and they are then prioritized based on their similarities to established and evidence-backed indications.

Researchers start by mapping the patient cohort’s clinical events and medical histories—including potential diagnoses, prescribed medications, and performed procedures—from real-world data. Using foundation models, researchers can quantify clinical events, establish relationships, and measure the similarity between the patient cohort and evidence-backed indications. The result is a short list of indications that have a better probability of success in clinical trials because they can be more accurately matched to appropriate patient groups.

Pharma companies that have used this approach have reported high success rates in clinical trials for the top five indications recommended by a foundation model for a tested drug. This success has allowed these drugs to progress smoothly into Phase 3 trials, significantly accelerating the drug development process.

Factors for pharmaceuticals and medical products organizations to consider

Before integrating generative AI into operations, pharma executives should be aware of some factors that could limit their ability to capture its benefits:

- *The need for a human in the loop.* Companies may need to implement new quality checks on processes that shift from humans to generative AI, such as representative-generated emails, or more detailed quality checks on AI-assisted processes, such as drug discovery. The increasing need to verify whether generated content is based on fact or inference elevates the need for a new level of quality control.
- *Explainability.* A lack of transparency into the origins of generated content and traceability of root data could make it difficult to update models and scan them for potential risks; for instance, a generative AI solution for synthesizing scientific literature may not be able to point to the specific articles or quotes that led it to infer that a new treatment is very popular among physicians. The technology can also “hallucinate,” or generate responses that are obviously incorrect or inappropriate for the context. Systems need to be designed to point to specific articles or data sources, and then do human-in-the-loop checking.
- *Privacy considerations.* Generative AI’s use of clinical images and medical records could increase the risk that protected health information will leak, potentially violating regulations that require pharma companies to protect patient privacy.

Work and productivity implications

Technology has been changing the anatomy of work for decades. Over the years, machines have given human workers various “superpowers”; for instance, industrial-age machines enabled workers to accomplish physical tasks beyond the capabilities of their own bodies. More recently, computers have enabled knowledge workers to perform calculations that would have taken years to do manually.

These examples illustrate how technology can augment work through the automation of individual activities that workers would have otherwise had to do themselves. At a conceptual level, the application of generative AI may follow the same pattern in the modern workplace, although as we show later in this chapter, the types of activities that generative AI could affect, and the types of occupations with activities that could change, will likely be different as a result of this technology than for older technologies.

The McKinsey Global Institute began analyzing the impact of technological automation of work activities and modeling scenarios of adoption in 2017. At that time, we estimated that workers spent half of their time on activities that had the potential to be automated by adapting technology that existed at that time, or what we call technical automation potential. We also modeled a range of potential scenarios for the pace at which these technologies could be adopted and affect work activities throughout the global economy.

Technology adoption at scale does not occur overnight. The potential of technological capabilities in a lab does not necessarily mean they can be immediately integrated into a solution that automates a specific work activity—developing such solutions takes time. Even when such a solution is developed, it might not be economically feasible to use if its costs exceed those of human labor. Additionally, even if economic incentives for deployment exist, it takes time for adoption to spread across the global economy. Hence, our adoption scenarios, which consider these factors together with the technical automation potential, provide a sense of the pace and scale at which workers’ activities could shift over time.

About the research

The analyses in this paper incorporate the potential impact of generative AI on today’s work activities. The new capabilities of generative AI, combined with previous technologies and integrated into corporate operations around the world, could accelerate the potential for technical automation of individual activities and the adoption of technologies that augment the capabilities of the workforce. They could also have an impact on knowledge workers whose activities were not expected to shift as a result of these technologies until later in the future (see sidebar “About the research”).

Automation potential has accelerated, but adoption to lag

Based on developments in generative AI, technology performance is now expected to match median human performance and reach top-quartile human performance earlier than previously estimated across a wide range of capabilities (Exhibit 6). For example, MGI previously identified 2027 as the earliest year when median human performance for natural-language understanding might be achieved in technology, but in this new analysis, the corresponding point is 2023.

6

As a result of these reassessments of technology capabilities due to generative AI, the total percentage of hours that could theoretically be automated by integrating technologies that exist today has increased from about 50 percent to 60–70 percent. The technical potential curve is quite steep because of the acceleration in generative AI’s natural-language capabilities.

Interestingly, the range of times between the early and late scenarios has compressed compared with the expert assessments in 2017, reflecting a greater confidence that higher levels of technological capabilities will arrive by certain time periods (Exhibit 7).

Our analysis of adoption scenarios accounts for the time required to integrate technological capabilities into solutions that can automate individual work activities; the cost of these technologies compared with that of human labor in different occupations and countries around the world; and the time it has taken for technologies to diffuse across the economy. With the acceleration in technical automation potential that generative AI enables, our scenarios for automation adoption have correspondingly accelerated. These scenarios encompass a wide range of outcomes, given that the pace at which solutions will be developed and adopted will vary based on decisions that will be made on investments, deployment, and regulation, among other factors. But they give an indication of the degree to which the activities that workers do each day may shift (Exhibit 8).

As an example of how this might play out in a specific occupation, consider postsecondary English language and literature teachers, whose detailed work activities include preparing tests and evaluating student work. With generative AI’s enhanced natural-language capabilities, more of these activities could be done by machines, perhaps initially to create a first draft that is edited by teachers but perhaps eventually with far less human editing required. This could free up time for these teachers to spend more time on other work activities, such as guiding class discussions or tutoring students who need extra assistance.

Our previously modeled adoption scenarios suggested that 50 percent of time spent on 2016 work activities would be automated sometime between 2035 and 2070, with a midpoint scenario around 2053. Our updated adoption scenarios, which account for developments in generative AI, models the time spent on 2023 work activities reaching 50 percent automation between 2030 and 2060, with a midpoint of 2045—an acceleration of roughly a decade compared with the previous estimate.

[6]

Adoption is also likely to be faster in developed countries, where wages are higher and thus the economic feasibility of

adopting automation occurs earlier. Even if the potential for technology to automate a particular work activity is high, the costs required to do so have to be compared with the cost of human wages. In countries such as China, India, and Mexico, where wage rates are lower, automation adoption is modeled to arrive more slowly than in higher-wage countries (Exhibit 9).

Generative AI's potential impact on knowledge work

Previous generations of automation technology were particularly effective at automating data management tasks related to collecting and processing data. Generative AI's natural-language capabilities increase the automation potential of these types of activities somewhat. But its impact on more physical work activities shifted much less, which isn't surprising because its capabilities are fundamentally engineered to do cognitive tasks.

As a result, generative AI is likely to have the biggest impact on knowledge work, particularly activities involving decision making and collaboration, which previously had the lowest potential for automation (Exhibit 10). Our estimate of the technical potential to automate the application of expertise jumped 34 percentage points, while the potential to automate management and develop talent increased from 16 percent in 2017 to 49 percent in 2023.

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Generative AI's ability to understand and use natural language for a variety of activities and tasks largely explains why automation potential has risen so steeply. Some 40 percent of the activities that workers perform in the economy require at least a median level of human understanding of natural language.

As a result, many of the work activities that involve communication, supervision, documentation, and interacting with people in general have the potential to be automated by generative AI, accelerating the transformation of work in occupations such as education and technology, for which automation potential was previously expected to emerge later (Exhibit 11).

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Labor economists have often noted that the deployment of automation technologies tends to have the most impact on workers with the lowest skill levels, as measured by educational attainment, or what is called skill biased. We find that generative AI has the opposite pattern—it is likely to have the most incremental impact through automating some of the activities of more-educated workers (Exhibit 12).

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Another way to interpret this result is that generative AI will challenge the attainment of multiyear degree credentials as an indicator of skills, and others have advocated for taking a more skills-based approach to workforce development in order to create more equitable, efficient workforce training and matching systems.^[7] Generative AI could still be described as skill-biased technological change, but with a different, perhaps more granular, description of skills that are more likely to be replaced than complemented by the activities that machines can do.

Previous generations of automation technology often had the most impact on occupations with wages falling in the middle of the income distribution. For lower-wage occupations, making a case for work automation is more difficult because the potential benefits of automation compete against a lower cost of human labor. Additionally, some of the tasks performed in lower-wage occupations are technically difficult to automate—for example, manipulating fabric or picking delicate fruits. Some labor economists have observed a “hollowing out of the middle,” and our previous models have suggested that work automation would likely have the biggest midterm impact on lower-middle-income quintiles.

However, generative AI's impact is likely to most transform the work of higher-wage knowledge workers because of advances in the technical automation potential of their activities, which were previously considered to be relatively immune from automation (Exhibit 13).

13

Generative AI could propel higher productivity growth

Global economic growth was slower from 2012 to 2022 than in the two preceding decades.^[8] Although the COVID-19 pandemic was a significant factor, long-term structural challenges—including declining birth rates and aging populations—are ongoing obstacles to growth.

Declining employment is among those obstacles. Compound annual growth in the total number of workers worldwide slowed from 2.5 percent in 1972–82 to just 0.8 percent in 2012–22, largely because of aging. In many large countries, the size of the workforce is already declining.^[9] Productivity, which measures output relative to input, or the value of goods and services produced divided by the amount of labor, capital, and other resources required to produce them, was the main engine of economic growth in the three decades from 1992 to 2022 (Exhibit 14). However, since then, productivity growth has slowed in tandem with slowing employment growth, confounding economists and policy makers.^[10] Turning around the productivity slowdown,” McKinsey Global Institute, September 13, 2022.

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The deployment of generative AI and other technologies could help accelerate productivity growth, partially compensating for declining employment growth and enabling overall economic growth. Based on our estimates, the automation of individual work activities enabled by these technologies could provide the global economy with an annual productivity boost of 0.5 to 3.4 percent from 2023 to 2040, depending on the rate of automation adoption—with generative AI contributing 0.1 to 0.6 percentage points of that growth—but only if individuals affected by the technology were to shift to other work activities that at least match their 2022 productivity levels (Exhibit 15). In some cases, workers will stay in the same occupations, but their mix of activities will shift; in others, workers will need to shift occupations.

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Considerations for business and society

History has shown that new technologies have the potential to reshape societies. Artificial intelligence has already changed the way we live and work—for example, it can help our phones (mostly) understand what we say, or draft emails. Mostly, however, AI has remained behind the scenes, optimizing business processes or making recommendations about the next product to buy. The rapid development of generative AI is likely to significantly augment the impact of AI overall, generating trillions of dollars of additional value each year and transforming the nature of work.

But the technology could also deliver new and significant challenges. Stakeholders must act—and quickly, given the pace at which generative AI could be adopted—to prepare to address both the opportunities and the risks. Risks have already surfaced, including concerns about the content that generative AI systems produce: Will they infringe upon intellectual property due to “plagiarism” in the training data used to create foundation models? Will the answers that LLMs produce when questioned be accurate, and can they be explained? Will the content generative AI creates be fair or biased in ways that users do not want by, say, producing content that reflects harmful stereotypes?

Using generative AI responsibly

There are economic challenges too: the scale and the scope of the workforce transitions described in this report are considerable. In the midpoint adoption scenario, about a quarter to a third of work activities could change in the coming decade. The task before us is to manage the potential positives and negatives of the technology simultaneously (see sidebar “Using generative AI responsibly”). Here are some of the critical questions we will need to address while balancing our enthusiasm for the potential benefits of the technology with the new challenges it can introduce.

Companies and business leaders

How can companies move quickly to capture the potential value at stake highlighted in this report, while managing the risks that generative AI presents?

How will the mix of occupations and skills needed across a company’s workforce be transformed by generative AI and other artificial intelligence over the coming years? How will a company enable these transitions in its hiring plans, retraining programs, and other aspects of human resources?

Do companies have a role to play in ensuring the technology is not deployed in “negative use cases” that could harm society?

How can businesses transparently share their experiences with scaling the use of generative AI within and across industries—and also with governments and society?

Policy makers

What will the future of work look like at the level of an economy in terms of occupations and skills? What does this mean for workforce planning?

How can workers be supported as their activities shift over time? What retraining programs can be put in place? What incentives are needed to support private companies as they invest in human capital? Are there earn-while-you-learn programs such as apprenticeships that could enable people to retrain while continuing to support themselves and their families?

What steps can policy makers take to prevent generative AI from being used in ways that harm society or vulnerable populations?

Can new policies be developed and existing policies amended to ensure human-centric AI development and deployment that includes human oversight and diverse perspectives and accounts for societal values?

Individuals as workers, consumers, and citizens

How concerned should individuals be about the advent of generative AI? While companies can assess how the technology will affect their bottom lines, where can citizens turn for accurate, unbiased information about how it will affect their lives and livelihoods?

How can individuals as workers and consumers balance the conveniences generative AI delivers with its impact in their workplaces?

Can citizens have a voice in the decisions that will shape the deployment and integration of generative AI into the fabric of their lives?

Technological innovation can inspire equal parts awe and concern. When that innovation seems to materialize fully formed and becomes widespread seemingly overnight, both responses can be amplified. The arrival of generative AI in the fall of 2022 was the most recent example of this phenomenon, due to its unexpectedly rapid adoption as well as the ensuing scramble among companies and consumers to deploy, integrate, and play with it.

All of us are at the beginning of a journey to understand this technology's power, reach, and capabilities. If the past eight months are any guide, the next several years will take us on a roller-coaster ride featuring fast-paced innovation and technological breakthroughs that force us to recalibrate our understanding of AI's impact on our work and our lives. It is important to properly understand this phenomenon and anticipate its impact. Given the speed of generative AI's deployment so far, the need to accelerate digital transformation and reskill labor forces is great.

These tools have the potential to create enormous value for the global economy at a time when it is pondering the huge costs of adapting and mitigating climate change. At the same time, they also have the potential to be more destabilizing than previous generations of artificial intelligence. They are capable of that most human of abilities, language, which is a fundamental requirement of most work activities linked to expertise and knowledge as well as a skill that can be used to hurt feelings, create misunderstandings, obscure truth, and incite violence and even wars.

We hope this research has contributed to a better understanding of generative AI's capacity to add value to company operations and fuel economic growth and prosperity as well as its potential to dramatically transform how we work and our purpose in society. Companies, policy makers, consumers, and citizens can work together to ensure that generative AI delivers on its promise to create significant value while limiting its potential to upset lives and livelihoods. The time to act is now.^[11]

Michael Chui is a partner in McKinsey's Bay Area office, where **Roger Roberts** is a partner and **Lareina Yee** is a senior partner; **Eric Hazan** is a senior partner in McKinsey's Paris office; **Alex Singla** is a senior partner in the Chicago office; **Kate Smaje** and **Alex Sukharevsky** are senior partners in the London office; and **Rodney Zimmel** is a senior partner in the New York office.

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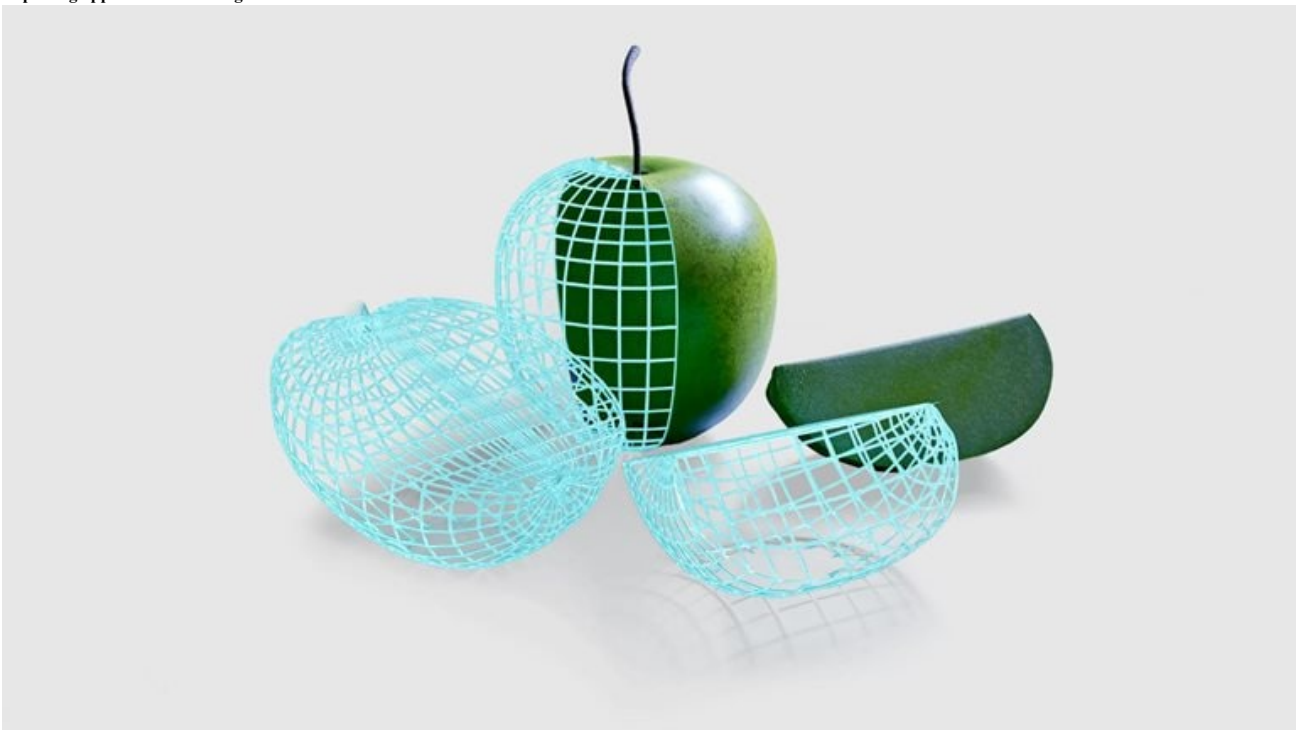
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