Goldman Sachs
Investment Banking

Navigating the AI Era

How Can Companies Unlock Long-Term Strategic Value?

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Executive Summary

AI has been advancing in its technical efficacy over recent decades, with key breakthroughs across its three primary components—compute, model architecture, and data—leading to the pivotal inflection point we're witnessing today. AI now surpasses key human benchmarks across reading comprehension, image and speech recognition, and language understanding. The usability and interface of early platforms have made the technology accessible to the imaginations of millions. The net result is a new technology era poised to transform nearly every industry, sector, and job function.

In our view, this is more than "business as usual" for decision makers, investors, and the broader public. The rapid rise and mass adoption of Generative AI in a relatively short amount of time—OpenAI's ChatGPT was introduced to the public in November 2022—have led to a velocity of fundamental shifts and strategic decisions we haven't witnessed since the advent of the Internet and mobile technology. In 2023, the total market cap for our basket of AI winners increased by 75%.[1] VCs are excited to invest in the next disruptive AI startup, public market investors are eager to understand how AI will impact every sector, and companies are working to understand how AI will fundamentally alter the strategic landscape.

Artificial Intelligence (AI) The intelligence of computers or software, especially to perform functions normally associated with human intelligence.

Generative AI (GenAI) AI for generating new content, including but not limited to text, pictures, video, and computer code.

[1] AI winners basket as denoted by GS FICC and Equities; FactSet market data priced as of 22-Sep-2023

A New Technology Era

Although corporate and consumer applications of GenAI are still in their infancy, we have observed several key themes that warrant further exploration.

Enterprise Transformation: AI will drive a new wave of enterprise transformation across all industries and almost all job functions over the next decade.

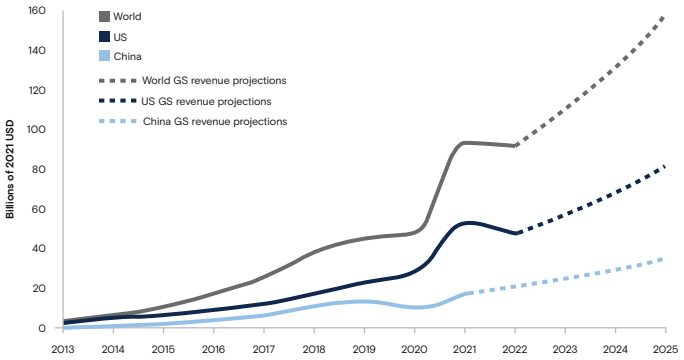
Public Investor Focus: While market value increases have been concentrated in a small number of public companies to date, investors are starting to think expansively about which public and private companies are best positioned to capture value for shareholders.

Emergence of Strategic Theses: Although the majority of M&A at this stage has been focused around a small group of early use cases and core-enabling infrastructure, key strategic M&A theses are beginning to form. Strategic investing has taken creative form, including in-kind investment by hyperscale cloud companies and asset-backed structures secured by GPUs and customer contracts.

As industry experts and stewards of the capital markets, we are uniquely positioned to provide thought leadership that addresses these key themes and provides our clients with a front row seat to the strategic landscape shifts of the AI Era.

AI Investment is Likely to Grow Over the Next 2–3 Years

Private AI investment (dotted lines show GS revenue projections*)



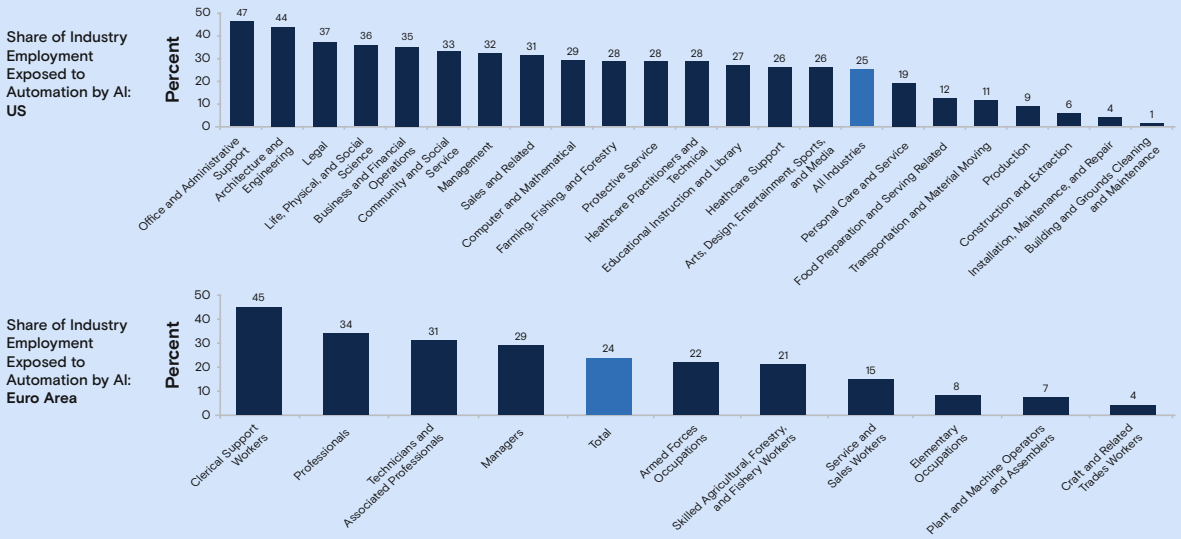
Source: Stanford Institute for Human-Centered Artificial Intelligence, Goldman Sachs Research

*Average of GS Research 2022–2030 revenue growth estimates for Microsoft Azure, NVIDIA, Google Cloud, and Amazon Web Services (when available)

"We need to think as big as we can … before AI thinks bigger than we do."

Marco Argenti
Chief Information Officer, Goldman Sachs

~25% of Current Work Tasks Could Be Automated by AI in the US and Europe



Source: Goldman Sachs Global Investment Research

More Than a Tech Revolution. A Productivity Transformation.

The clearest form of the potential of GenAI is the productivity gains it promises to realize across nearly every industry and job function. Total value creation from these productivity gains—efficiencies optimizing both the top line and costs—could be greater than $3tn across industries over the next decade.[2]

Across industries, management teams also perceive the AI opportunity positively, reflecting both reception and strategic prioritization. Based on conversations with corporate clients over the last several months, decision makers in sectors such as healthcare, real estate, and technology, media, and telecom anticipate high impact from GenAI to their core businesses, with a positive net impact to their industries.

Perspectives on GenAI Opportunities Across Industries

By Sector	% of Clients Inquiring About GenAI	Clients' Anticipated Impact From GenAI	Most Interesting Client Questions	2023+ Impact on Operating Profit From AI-Driven Cost Reduction*
Technology, Media, and Telecom	90%+	High	Does GenAI create fundamental risk/danger to human society and civilization?	**$860bn**
Consumer/ Retail	<10%	Moderate	How can GenAI drive enhanced personalization for the customer/ consumer experience?	**$390bn**
Healthcare	~50%	High	Which drug development companies will emerge as the "winners" of GenAI?	**$260bn**
Financial Institutions	~20–40%	Moderate	When will GenAI take out major parts of the financial services value chain—underwriting in particular?	**$340bn**
Real Estate	~10–20%	High	What are the practical RE use cases of GenAI?	**$330bn**
Natural Resources	<10%	Moderate	How do we get credit in our valuation for our GenAI capability set?	**$240bn**
Industrials	40%	Moderate	How will GenAI change the future of manufacturing and supply chains?	**$500bn**

Source: Analysis based on interviews with IB clients and internal GS stakeholders

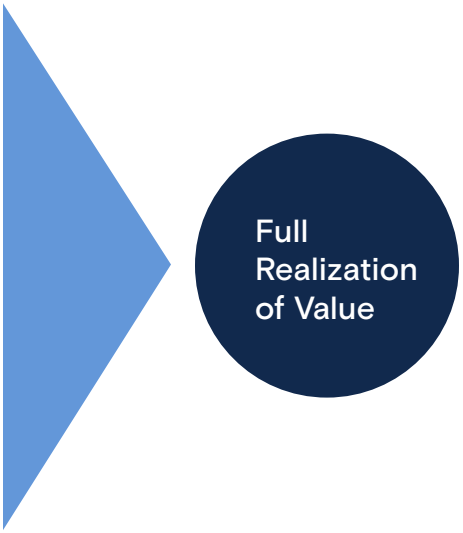
*2023+ Impact on Operating Profit from AI-Driven Cost Reduction from McKinsey Report on Economic Potential of Generative AI as of June 2023

[2] https://www.mckinsey.com/mgi/overview/in-the-news/ai-could-increase-corporate-profits-by-4-trillion-a-year-according-to-new-research

Where Are We in the AI Evolution?

We evaluate the evolution and adoption of GenAI in three distinct phases.

Phase 1	• Significant investment in GPUs • Evaluation of open source vs. proprietary models amid rapid evolution • AI trained on commoditized data • Identification of early use cases • Infusion of AI into existing software applications
Phase 2	• Supply/demand rebalancing • Increased importance of proprietary data • Establishment of monetization norms and practices • Proliferation of specialized apps
Phase 3	• Building momentum of AI-native companies, optimizing functions • Matured monetization and deployment of models • Inference surpassing training



While the AI phenomenon is still in Phase 1, developments are evolving quickly on the macro and micro scale. We continue to see massive investment in graphics processing units (GPUs)—the foundational enabling hardware of GenAI—as well as several prominent foundation models. We are observing early use cases around more specialized applications while corporates are simultaneously recognizing the importance of their proprietary data. With this recognition of proprietary data as a tool for training AI models and generating valuable and unique insights, corporates are focused on optimizing their data infrastructure to prepare for the AI Era.

Diving Deeper: AI in Healthcare

A look at the healthcare industry provides a tangible example of the importance and impact of GenAI proprietary datasets across multiple verticals within healthcare, including biopharma, LS/Dx, medical devices, and services. The industry has spent the last few decades developing and building early AI applications, so the potential is relatively well understood. Most notably on the biopharma side, AI helped develop the COVID-19 mRNA vaccines and continues to be actively used in drug design and development.

Over the long term, GenAI may become integral to drug discovery, optimization, and clinical trial design processes.[3] There are already more than 500 AI-enabled medical devices that are FDA-approved and sold in the United States.[4] This is likely just the beginning. In addition, GenAI can be leveraged in the near term to advance workflow optimization and automation, reducing physician burnout and driving greater patient-centric care.

GenAI can minimize administrative burden on the payer side as well, offering opportunities for providers and payers to communicate and collaborate more efficiently, as well as automate claims processing and customer service requests. Predictive analytics can aid in determining members and populations who may be vulnerable to certain illnesses, providing the opportunity for preventative treatment planning.

[3] https://www.bain.com/insights/getting-the-most-out-of-generative-ai-in-healthcare/
[4] https://www.fda.gov/medical-devices/software-medical-device-samd/artificial-intelligence-and-machine-learning-aiml-enabled-medical-devices

Public Investor Perspectives: A Snapshot

Today, public market opportunities to invest directly in AI are relatively scarce.[5] These opportunities are largely concentrated in Big Tech, where the infrastructure, talent, and resources allow for companies to invest in and quickly scale GenAI platforms. Based on the market share gains of Microsoft and NVIDIA this year, it's clear that the market has rewarded these investments. As a result, many companies across industries shifted their narrative to reflect how and why AI is a risk or opportunity for their business. Perceived "losers" have been impacted in the market.

Predicting "winners and losers" is far from straightforward though, particularly at this early stage in a new technology's life cycle. The dot-com boom provides a cautionary tale. While AI investor enthusiasm may not be quite at the level of late 1990s dot-com mania, high investor expectations should be tempered. There are myriad unknowns, complicated regulatory issues to unpack, and nascent monetization models still to prove. Most tangible today are issues around data ownership, the legal enforcement of copyrights, data integrity, and a focus on minimizing potential misinformation.[6]

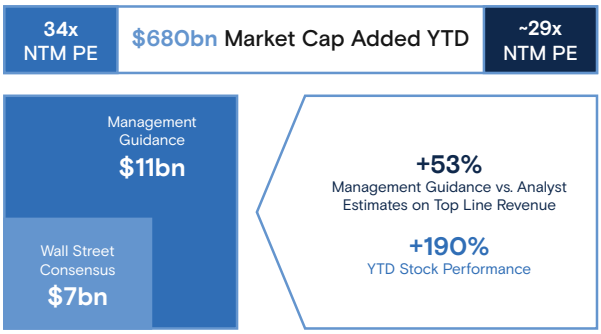
"Investors will be looking for clues about early signs of AI progress from companies—not necessarily in the form of revenue beats at this point, but more in the form of product initiatives (SKUs), pipeline builds, order trends, customer engagement, and/or other KPIs, helping to set the table for 2024 and beyond."

Peter Callahan
Managing Director, US Technology, Media, and Telecom Sector Specialist, FICC and Equities, Goldman Sachs

If You Can Position Yourself as an AI "Winner," the Payoff Could Be Substantial*

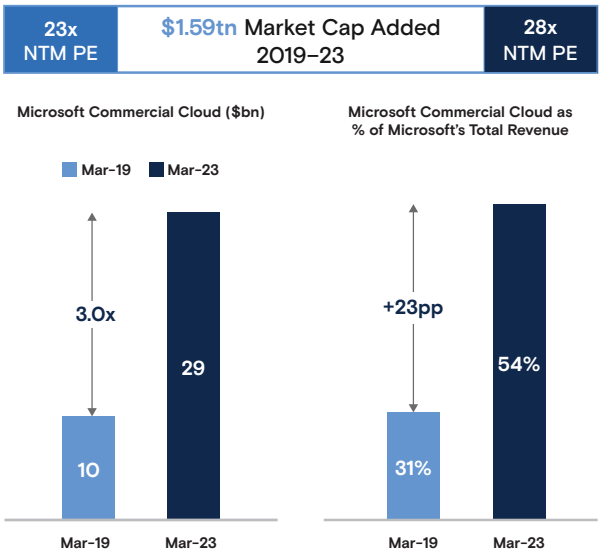
NVIDIA

2Q New Revenue Guidance Signaled NVIDIA's Strength at the Core Compute Layer



Microsoft

Microsoft's Cloud Business Emerged as One of the Key Winners in the AI Race



*past performance does not guarantee future results

Source: FactSet; market data as of 23-Sep-2023, public company filings. Microsoft Cloud revenue, which includes Azure and other cloud services, Office 365 Commercial, the commercial portion of LinkedIn, Dynamics 365, and other commercial cloud properties

[5] https://www.goldmansachs.com/intelligence/pages/top-of-mind/generative-ai-hype-or-truly-transformative/report.pdf
[6] https://www.gsam.com/content/gsam/us/en/advisors/market-insights/gsam-insights/perspectives/2023/artificial-intelligence-future.html

Public Investor Areas of Focus

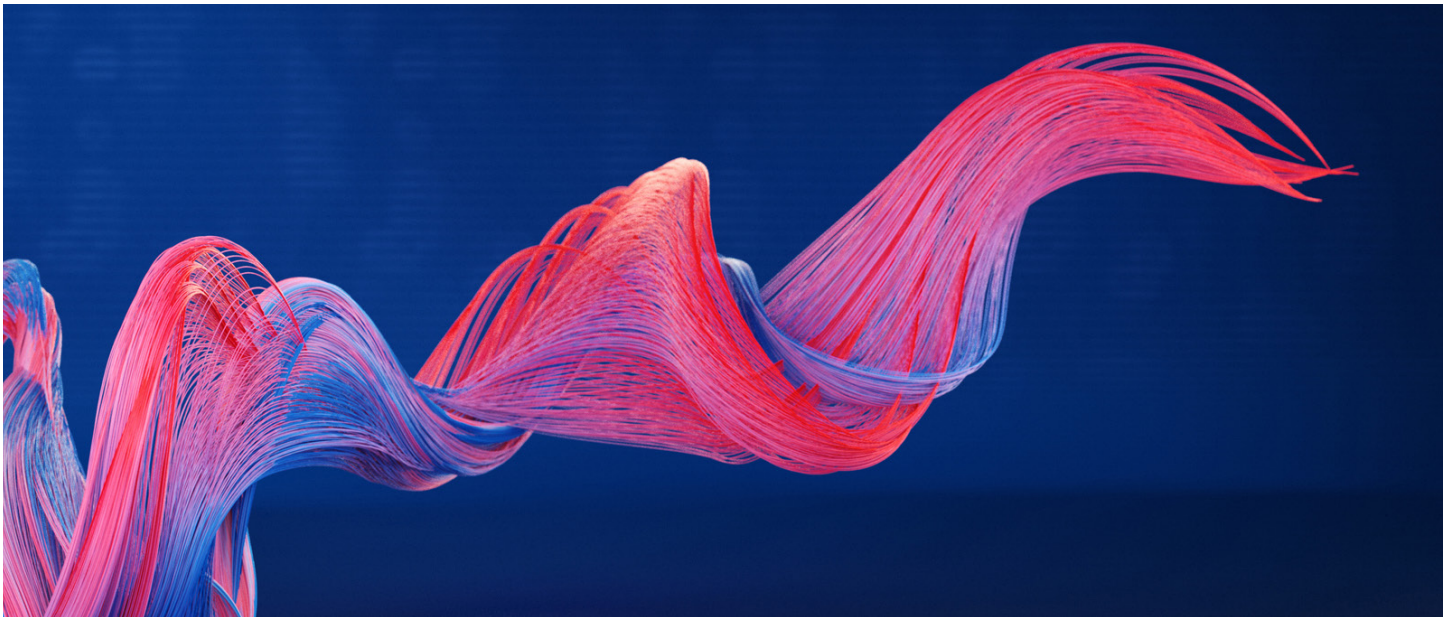
Public market investors are focused on a few core areas in particular, and many of the leading AI-native startups play directly or indirectly into these themes:

- **Hardware Growth:** GenAI is driving demand for GPUs, memory, and storage for AI servers
- **Labor Efficiency:** Massive potential productivity savings, with ~1/3[7] of labor costs that could potentially be reduced via GenAI
- **Enhanced Marketing:** Significant potential for improving creativity and optimizing marketing campaigns
- **Software:** Clear opportunity for infrastructure software, while the future of applications is less clear and likely more mixed
- **Targeted Advertising:** Social media companies to benefit through improvements to ranking and personalization

5 Key Considerations for AI Disruptors Entering the Public Markets

The rapid evolution of GenAI technology is measured in weeks, not months. The calibration of IPO timing in this startup landscape gains heightened significance, and we've identified five factors to consider when charting an IPO strategy course:

1. **Investor demand:** There is a meaningful opportunity to leverage current public investor appetite for AI and limited public investment options
2. **Positioning:** AI-centric narratives will help to demonstrate superior value proposition and stand out among the rest of the crowd seeking to tap public equity market
3. **Monetization:** Companies able to demonstrate successful monetization strategies will achieve premium valuation
4. **Timing:** First movers are at a significant advantage to tap built-up investment demand
5. **Partnerships:** Compute capacity through a commercial arrangement with a hyperscaler or other agreements could alleviate investor concerns around potential compute constraints



[7] McKinsey, https://www.mckinsey.com/mgi/our-research/generative-ai-and-the-future-of-work-in-america#/

AI and the Strategic Landscape

Microsoft's January 2023 investment in OpenAI was the inflection point that jump-started the corporate AI revolution. Following the announcement, there has been a flurry of strategic and investor activity, particularly among tech giants rapidly investing in or acquiring GenAI startups (both pre-revenue and acqui-hires).

We are confident that AI will drive a broader wave of strategic transformation across all industries, but M&A opportunities may be limited until AI businesses prove their potential.[8] There are specific factors that will catalyze the maturation of these businesses and potentially unlock a supercycle. These factors include:

- Enterprise customers evolving from proof-of-concept to production
- Model training evolving into ongoing inference as the key mechanism of meeting customer demands
- Maturation of legal and regulatory frameworks
- Greater clarity on the form and function of foundational models

As clarity is gained and AI use cases continue to evolve, the M&A landscape will shift. Specialized GenAI applications will emerge and buyers will likely go on the offensive, focusing on proven targets with demonstrated product-market fit.

In the meantime, investment opportunities will abound. We are witnessing the emergence of increasingly creative deal structures to support relatively large up-front investments in companies with intense compute needs and long potential paths to profitability.

What Will Unlock a GenAI M&A Supercycle?

[8] https://pitchbook.com/news/articles/AI-Goldman-Sachs-investments

Emerging M&A Theses

We see several nascent strategic theses emerging as companies adapt to GenAI:

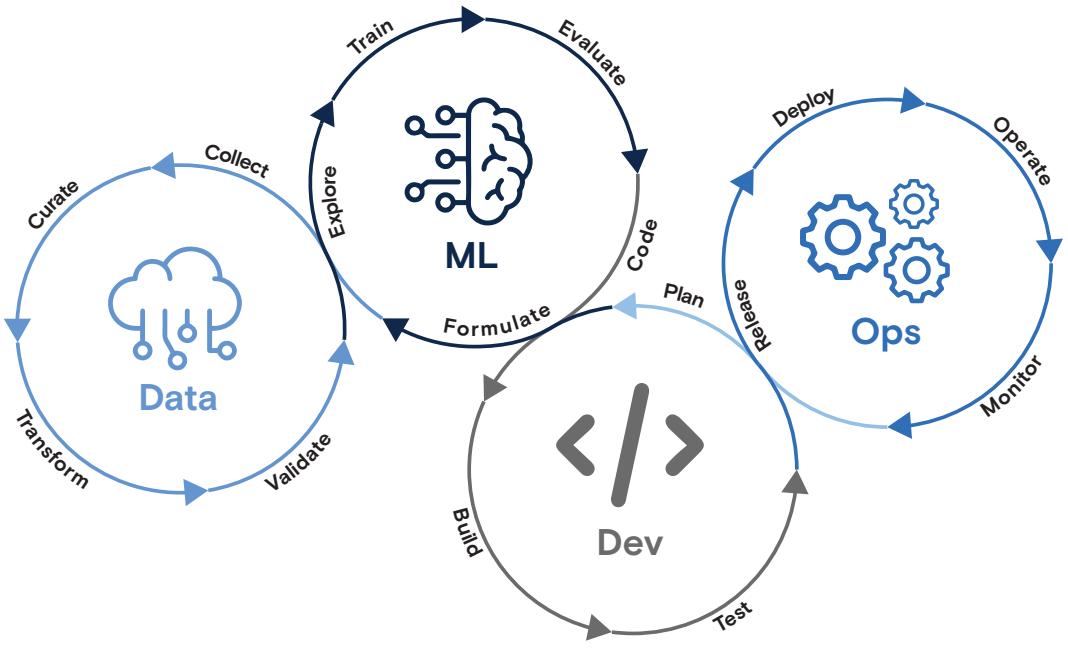
Intelligent Vertical Applications: Datasets in specific industries will yield intelligent capabilities, driving efficiency, bringing products to market faster, and optimizing the end-user experience. This disruption is already visible among companies in certain industries:

- Education—Learning tools are providing opportunities to shift learner focus areas from manual tasks to understanding and ideation
- Media—Democratization of advanced production tools is allowing for more efficient content creation and management
- Law—Early applications are improving attorney efficiency and broadening access to legal services that may currently be prohibitive to individuals or small businesses

Customer Support and Contact Center: Both empathetic and personalized experiences, as well as issue resolutions, are being delivered by GenAI instead of human reps.

The New Stack for Enterprise AI: Enterprise companies will replatform onto the foundation models and hyperscale clouds necessary for GenAI. In this connection, while technological transformation over the past 15 years has featured the 1bn+ user consumer Internet and "software eating the world" concept, the importance of infrastructure has restored the significance of silicon as a strategic control point. The linkages between semiconductors, software, and systems are becoming increasingly important, and vertical integration spanning semiconductor products, data center design, and software platforms and applications is being seen as increasingly valuable.

Analytics Platforms and DevOps-MLOps Convergence: Data science and analytics are central to machine learning and a critical part of the new enterprise tech stack. As data science and analytics become more central to enterprise computing, DevOps tools will combine with analytics platforms into cohesive systems.



A Closer Look: The New Stack for Enterprise AI

The most active theme in our strategic discussions today is likely the infrastructure that will underlie the technology. Investors have honed in on competitive areas, such as GPUs and LLMs, but playing out scenarios reveals further strategic possibilities:

Will another mega company try to capture a foundational model company?

AI model development companies that are creating the leading LLMs may become targets of Big Tech as they seek to maintain and extend their leadership positions of tech dominance.

Will there be a GitHub of foundation models?

Several leading AI-native startups have already built open-source models and enabling infrastructure. Similar to GitHub enabling open-source development, we may see robust ecosystems develop around tools for open-source model development.

Will a new enterprise operating system, software platform, or public cloud emerge?

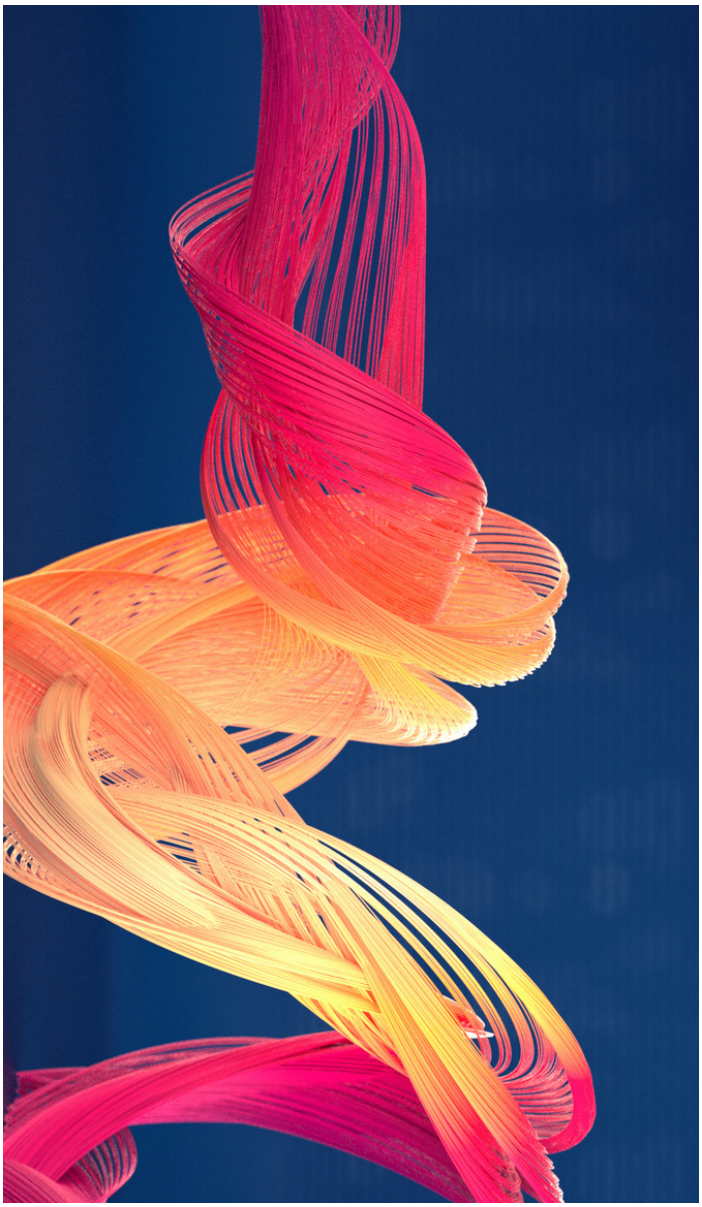
As supporting, scaled GenAI applications become increasingly important, current and emerging tech leaders are moving across boundaries that previously separated the semiconductor, software, and system layers.

Will there be a VMware of GPU workloads?

The virtual machines pioneered by VMware provided a software-defined abstraction layer for CPUs, giving life to a generation of enterprise workloads. Given the compute demands of the AI Era, there is potential for a new virtualization paradigm in utilizing a scaled base of accessible GPUs.

> "People will learn how to apply the technology to specific domains and become more efficient at using it, and that's going to lead to a mass democratization of [GenAI] technology."

Matt Lucas
Managing Director, Technology, Media, and Telecom, Investment Banking, Goldman Sachs



Looking Ahead

While early adoption and investment are already here, Goldman Sachs Research expects the material macro effects of GenAI are still a few years out.[9] As with all major tech disruptions, there is uncertainty as to the ultimate timeline of increased adoption. In past tech epochs, such as the advent of the PC, productivity effects only became markedly clear when roughly half of US businesses had adopted the technology.

The revolutionary capabilities of GenAI underscore its potential to fundamentally alter the long-term investment and economic landscape. As the technology matures, there will be elements that surprise, surpass, and even disappoint. Regardless of the specific outcomes, it is clear that this new technology will transform the world as we know it. GenAI is here to stay, the AI Era has officially begun, and it is rewriting the future with each new generative output.

The GenAI Opportunity: Key Considerations

1. **Have a strategy.** AI is a generational opportunity that can create tremendous value opportunities and disrupt existing market positions.
2. **AI will drive M&A.** M&A will be driven by a strategic need to enhance AI capabilities.
3. **Seize the moment.** Companies benefitting from tailwinds may consider acting while large acquirers face constraints.
4. **Public investors are supportive.** Strategics making AI-related acquisitions have received strong investor support and value creation.
5. **Consider the risks.** Proof points at scale in the enterprise may be years away.
6. **People matter.** Regardless of the AI path you forge, human expertise is essential.

[9] https://www.goldmansachs.com/intelligence/pages/ai-investment-forecast-to-approach-200-billion-globally-by-2025.html

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