OSBORNE PARTNERS
Capital Management, LLC

The Artificial Intelligence Era

By: Ben Viemeister, CFA

January 2025

Assessing technological and market leadership changes.

Artificial intelligence (AI) was a 2024 leadership theme across asset classes. Whether it was data centers in real estate, energy assets powering data centers in natural resources, semiconductor companies fueling AI advancements in domestic and foreign equities, or mega cap U.S. technology companies, if it was related to AI, investors clamored to buy.

Leadership Changes

Before extrapolating recent results, let us recall that market leadership can change. And given that the global technology sector is now the largest global equity sector at 26% of the MSCI All Country World Index versus the next largest sector, financials, at 17%, let us focus on global technology sector leadership. The companies highlighted in green below are new to the top ten largest global technology companies versus the prior decade. On average, seven of the top ten changed from decade-to-decade. Extrapolating company leadership has not paid off over the long term.

TOP 10 MARKET CAP GLOBAL PUBLIC TECHNOLOGY COMPANIES

1980	1990		2000		2010		2024	
IBM	IBM	=	Microsoft	New	Microsoft	=	Apple	↑
Eastman Kodak	Pansasonic	New	Cisco Systems	New	Google/Alphabet	New	Nvidia	New
Xerox	Toshiba	New	Intel	New	Apple	New	Microsoft	↓
Hewlett Packard	NEC	New	Lucent Technologies	New	IBM	↑	Google/Alphabet	↓
Emerson Electric	Fujitsu	New	Nokia	New	Cisco Systems	↓	Amazon	New
Texas Instruments	Mitsubishi Electric	New	IBM	↓	Oracle	↑	Facebook/Meta	New
Motorola Solutions	Eastman Kodak	↓	Oracle	New	Hewlett-Packard	New	Tesla	New
Nortel Networks	Sanyo Electric	New	Nortel Networks	New	Intel	↓	Broadcom	New
Intel	Fujifilm Holdings	New	Sun Microsystems	New	Samsung	New	TSMC	New
Harris	Hewlett Packard	↓	Dell	New	Qualcomm	New	Netflix	New

Rank vs Previous Period = | Same | New | Higher | Lower

Source: OPCM, JPMorgan Asset Management, FactSet

Tech Evolutions

What is a major driver of leadership change? Technology evolution. New phases shift growth opportunities. Some companies positioned well for one era are not well positioned for the shift to the next. Market capitalization fluctuates based on changing growth outlooks.

Technology evolution since the 1950s has involved a few major eras – mainframe, personal computing, internet, mobility, cloud, and now, artificial intelligence. Within each era, there are phases – introduction, growth, maturity. And even within those phases, there are inflection points, some of which are highlighted in the following chart.

The Artificial Intelligence Era

TECH ERA INFLECTION POINTS

ERA	1970s	1980s	1990s	2000s	2010s	2020s
Mainframe	Batch processing early '70s					
Personal Computing	Kenbak first PC '71; Apple founded '76	Windows OS '85	IBM ThinkPad '92			
Internet		Protocol Born '83	Web '91; Netscape browser '95; Google '98			
Mobility			2G '91	3G '03; Blackberry '02; iPhone '07; App Store '08	5G '19	
Cloud				Amazon Web Services '06	Microsoft Azure '10	
Artificial Intelligence					OpenAI founded '15; Google Transformer Paper '17; OpenAI GPT-1 large language model '18	OpenAI Chat GPT '22; Claude and Google Gemini large language models '23; OpenAI reasoning model o1 '24

Source: OPCM

Although specific inflection points vary across eras, there is a common pattern. In the introduction phase, capital costs are elevated as infrastructure is built, while adoption is low. Over time, competition and innovation enhance the value (speed, power, functionality) provided by the new era's technology while reducing its cost. This helps the new technology's adoption to grow. Eventually, this enables the optimization and maturation of the technology era, helping set the groundwork for the next evolution.

Introducing the AI Era

So where might we sit today in the AI era? As shown in the earlier table, Google introduced the concept of generative pre-trained transformers (GPT) in 2017. To put it overly simplistically, GPT is a technology that can produce content based on computer models that were previously trained on parameters/variables to convert one type of input, such as a question/problem, into another type of output, such as an answer/solution. GPT underpins large language models (LLMs). OpenAI launched their first LLM, GPT-1, in 2018. Model iterations were punctuated by the breakthrough launch of OpenAI's Chat GPT in 2022.

The success of this launch, plus broader LLM technological advancements, helped catalyze an arms race among mega cap tech companies to build out infrastructure for LLM development. Capital expenditures by Amazon, Google, Meta, and Microsoft are estimated to leap to $254 billion in 2025, more than double the pre-Chat GPT level of $119 billion in 2021!

The Artificial Intelligence Era

The infrastructure investments have supported pre-training activity, where language models learn patterns and intake the vast amount of data available to them from the internet. Pre-training builds a foundation of model knowledge. Models went from using 117 million parameters in GPT-1 to over 1.7 trillion in GPT-4. These models helped drive growth in generative AI use cases. In late 2024, some debate began about whether pre-training improvements were plateauing as real-world data was tapped out.

If so, this may represent a new inflection point in the introductory phase of AI. More spending may go towards reasoning. Inference then is used to help extract value from the foundation of model knowledge built during pre-training. OpenAI introduced its first reasoning model called o1 in September and by the end of 2024 its o3 model was a major advancement in complex tasks that have objective, verifiable outcomes like computer coding and mathematics. Reasoning models would help support growth of agentic AI, which is contrasted with generative AI below.

AI INFLECTION?

Type	Purpose	Functionality	Autonomy	Decisions	Applications
Generative (Language Models)	Creates original content based on patterns learned from training data	Produces text, images, audio, in response to prompts	Limited; requires human input or specific triggers to generate output	Focused on content creation rather than autonomous decision-making	Content creation, product design, document processing, creative tasks, data synthesis and reporting, chat bots, search
Agentic (Reasoning Models)	Performs tasks and makes decisions autonomously	Analyzes environments, executes actions, and adapts to changing conditions	High; operates independently with limited human intervention	Employs complex algorithms for real-time, context-aware decisions	Robotics, autonomous vehicles, adaptive customer service, cybersecurity operations, supply chain optimization, task automation

Source: OPCM, Perplexity

2025 and Beyond

AI's evolution is dynamic, but here are some variables we are tracking:

- *Model Improvement* – Are language model gains plateauing? Do reasoning models advance enough to justify massive capital expenditure increases? Do new model developments impact technology provider margins in a way that causes a slowdown in investment?
- *Resource Intensity* – If model improvement dynamics now favor more reasoning and less pre-training, does the theory that reasoning takes less computing power than pre-training prove correct, thus impacting the intensity, variability, and distribution of the AI-driven power demand?

The Artificial Intelligence Era

This will have an impact on areas including the real estate and natural resources asset classes, as well as the global utility, industrial, and technology sectors.

- *Financial Rationality* – So far, most of the AI capital investment leaders have spent within their cash flow. This contrasts to the dot-com bubble when many had negative cash flow. Does this rationality continue?
- *Use Cases* – If use case adoption does not prove as robust as some expect, the revenue projected to justify massive capital expenditure investment may not materialize, leading to an investment slowdown. This would have an outsized impact on the global technology sector.
- *Costs* – Does the cost to use models continue to decline, raising the return on investment and incentivizing more enterprise adoption?
- *Productivity Gains* – History has shown major improvements in U.S. economic productivity from information technology in 1973-1990 versus 1948-1973 and 1995-1999 versus 1990-1995 as new technology eras were more widely adopted. Broader productivity gains may drive earnings growth for the broader market instead of recent trends where growth was dominated by a narrow group of technology companies.

While the Osborne Partners Investment Team believes the introduction of the AI technology era is an exciting time, the Team also holds it is important to minimize emotion and apply logic in assessing AI's continued development and its potential impact on leadership across asset classes, as leadership can shift more quickly than some expect. Consequently, the Team's approach to investing in AI across asset classes is one that seeks to more closely balance growth opportunities and valuations, avoiding the "invest at any price" mindset that we are seeing in pockets of the market today. We believe this approach, consistent with our long-standing investment discipline, will help better insulate our portfolios as we navigate the AI era.