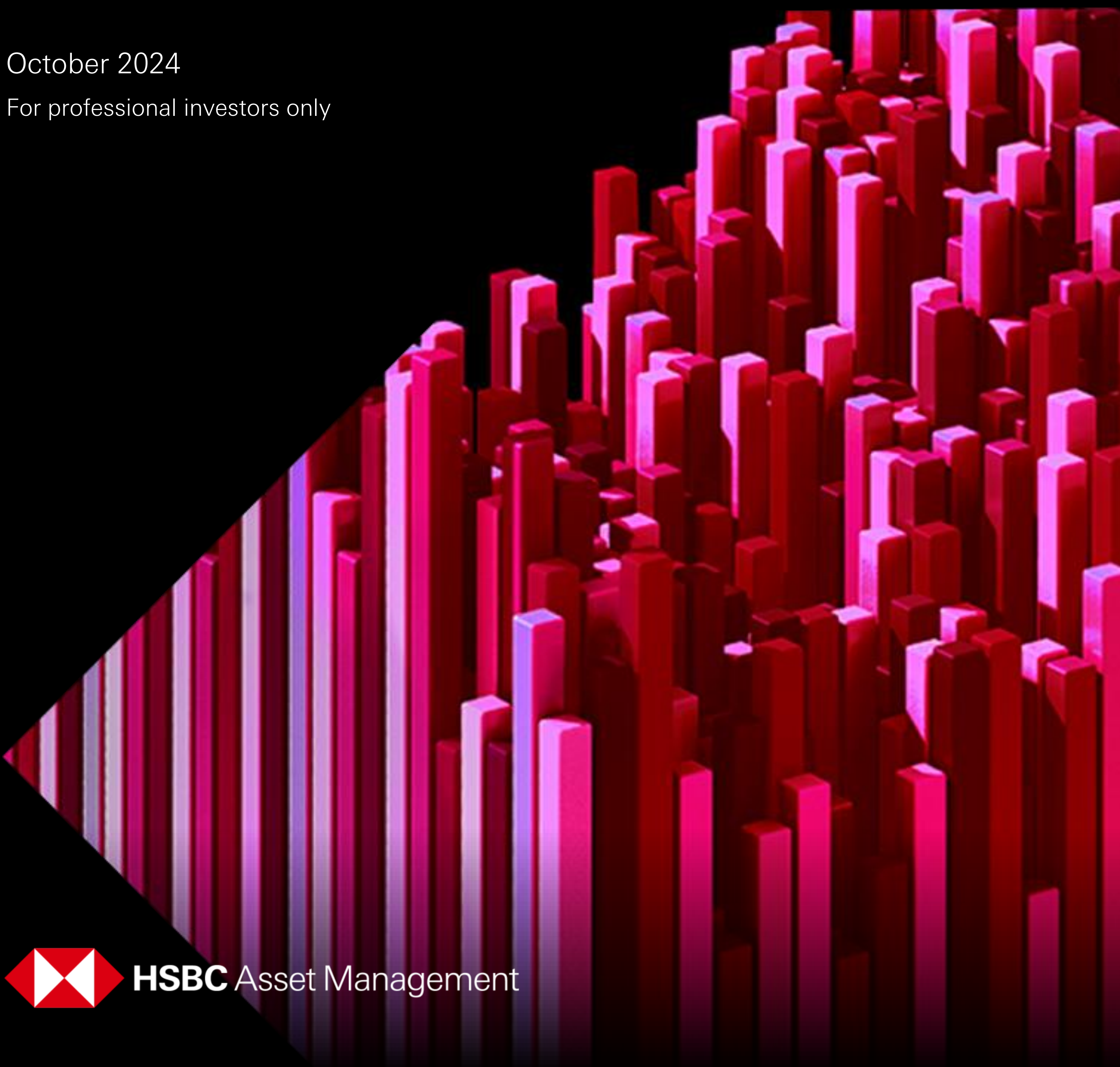
# Equity Insights

## Generative AI – a look back to understand what comes next

October 2024

For professional investors only



HSBC Asset Management

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# Foreword

> Generative AI is changing how we interact with technology, presenting clear potential to transform industries. For investors, longer-term implications expand far beyond today's well-known AI names.

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Welcome to our new Equity Insights series, in which we analyse key developments impacting equity markets, including long-term themes and megatrends.

We kick off the publication by taking a look at the most topical theme of today – artificial intelligence. In this edition, we seek to offer insights into what may come next in this technology platform shift by gleaning takeaways from the path of prior platform shifts.

Today, money is pouring into the semiconductor sector to drive the training of AI models by big tech hyperscalers. The investment appears warranted given potential for new applications is vast. However, we will consider the debate being held in many forums – will investment returns remain concentrated in the hardware build out, or will software and services become bigger beneficiaries of the platform shift underway, as they have in the past?

Of course, the broad application of AI has far-ranging implications across industries. While it may be too early to ascertain reliable estimates on the ultimate scale of the impact to growth and productivity across economies, the technology is being adopted across industries relatively quickly. Accordingly, while future editions of this series will explore broader themes and developments set to impact equity markets over the long term, we will also consider how AI is likely to play a role across themes.

This includes impacts to industries such as healthcare, where according to a McKinsey study, over 70% of respondents have either already implemented generative AI or are currently pursuing gen AI proofs of concept. Implications range from accelerating drug discovery to increasing efficiency of clinicians and healthcare systems – a vital need amidst aging populations and rising government debt.

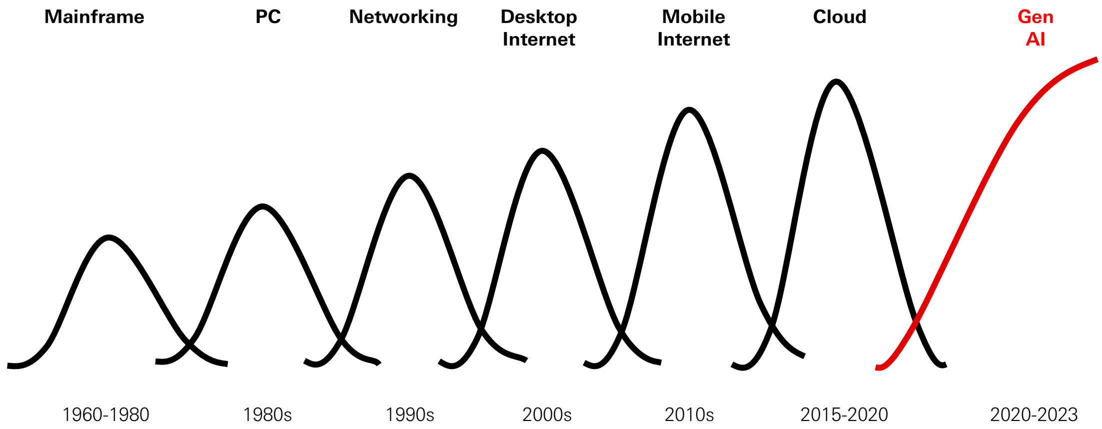
Similarly, there is much debate around the long-term sustainability of energy-hungry datacentres. We will explore the broader issue of management of natural resources and energy production, where AI can also play a role in improving resource efficiency across economies.

I look forward to exploring these matters in-depth and trust you will find our analysis interesting and useful.

# In a nutshell

- Throughout history the technology we use has been constantly changing and adapting. We are now going through a new reinvention phase with the rise of Generative AI – language models coupled with deep learning to generate natural language text. This is changing how we leverage and interact with technology.

- Looking at historical platform shifts, such as the mobile internet cycle, can help us understand what may lie ahead. In the spirit of AI, we can apply information from the past to anticipate the implications of this new technological platform. We thus compare the similarities and differences to today's stages of development.

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- While the semiconductor industry is currently benefitting from a flood of investment driven by the training needs of Generative AI models, impacts for the software sector are still in early stages. It remains to be seen whether existing software providers will accrue the lion's share of benefits or if a whole new set of companies will emerge.

- Tomorrow's winners may not be apparent today (think Meta or Amazon of prior platform shifts). Nonetheless, software and IT service companies are in line to benefit as they help enterprises navigate through a digital transformation process, while the emergence of Generative AI on edge devices can enable more direct benefits to be brought to consumers.



# Generative AI – a look back to understand what comes next

While every new technological development is unique, similarities in how new platforms shifts have progressed in the past make it important to analyse them in preparation for what we can expect going forward.

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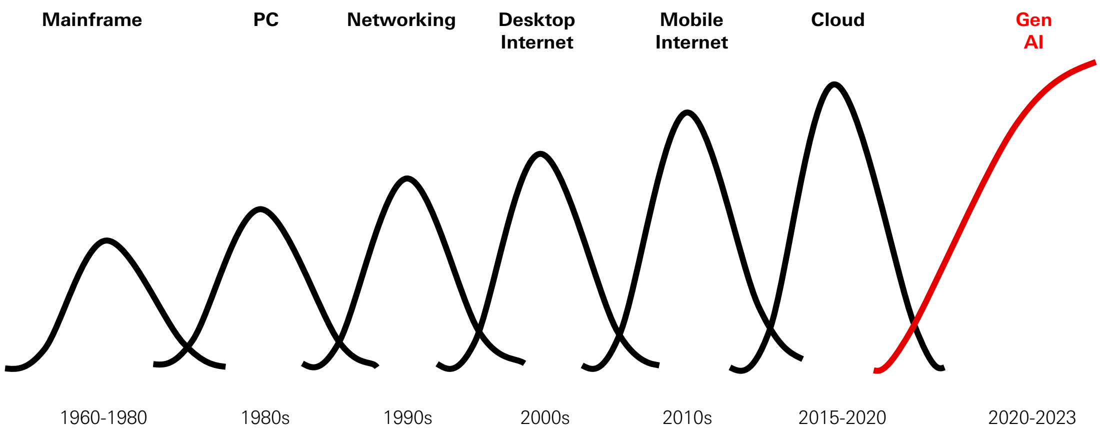
Some 2500 years ago the Greek Philosopher, Heraclitus, is quoted as saying "there is nothing permanent except change". This is applicable today as it was back then and will continue to stay relevant forever.

In the IT sector, the idea that nothing is permanent is particularly relevant – the industry is constantly changing, disrupting and reinventing itself. Today the technology landscape is going through another of its reinvention phases with the rise of the next platform shift around Generative AI. In this article we look at historical shifts to help guide us in preparing for what may lie ahead, examining not only the similarities but also differences.

## Every platform shift has had profound implications

We have witnessed many platform shifts throughout the years, with the mainframe era perhaps being the first one, starting back in the 1960s and continuing through the 80s. This was the first time that enterprise computing really came into existence, with advancements in microprocessor design and storage capacity. Rolling on through the decades and subsequent platform shifts, like the PC era, the mobile and more recently cloud era, we find ourselves potentially in the midst of the next platform shift - Generative AI.

Figure 1: Platform shifts




Source: HSBC Asset Management. For illustrative purposes only.

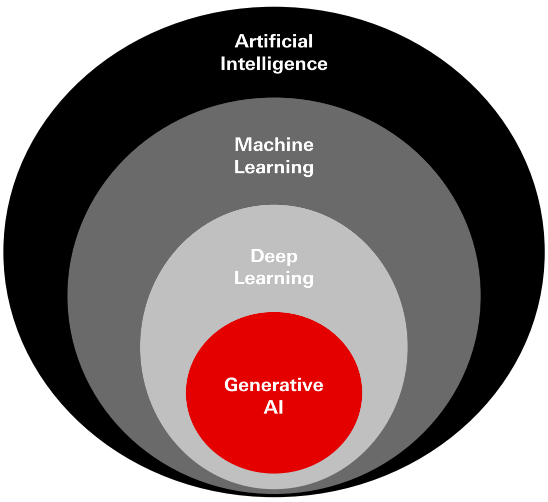
The belief in artificial beings with super intelligence goes back thousands of years, including the Greek mythology of Heraclitus' time. The modern day understanding of Artificial Intelligence (AI) can be traced more recently to Alan Turings seminal 1950 paper, "Computing Machinery and Intelligence" which proposed the question "Can machines think?". The actual term 'Artificial Intelligence' did not come into being until John McCarthy proposed the idea for a workshop held at Dartmouth College in 1956[1]. Since then, the field of AI has progressed in leaps and bounds, not least because of the significant improvement that has been made in semiconductors.

Rapid Gen AI adoption has led to the capex of cloud infrastructure providers such as AWS and Microsoft roughly doubling since 2020.[3]

In 2017, a group of researchers at Google introduced a new deep learning architecture known as the transformer model in their paper "Attention is all you need". This groundwork led to perhaps the most well-known of all these new models – the Generative Pre-Trained Transformer (GPT), of ChatGPT fame – developed by OpenAI in 2018[2].

This subset of AI – Generative AI – uses state of the art language models coupled with deep learning to generate natural language text. So why is this so important and why do many believe this is a whole new technological platform shift? In essence, this new technology is changing how we interact with technology - it has unlocked the human language. Rather than interfacing via prompts and choice words we can now use natural language to ask questions and receive answers. Moreover, these language models have become multi-modal and now span not just text but also video, audio, images and code. This is leading to Generative AI being applied to multiple applications and industries. Just like the other platform shifts we highlighted earlier, we think Generative AI will transform industries and create entirely new ones.

Figure 2: AI Landscape




Source: HSBC Asset Management, Medium, September 2024. For illustrative purposes only.

1 - https://home.dartmouth.edu/about/artificial-intelligence-ai-coined-dartmouth

2 - https://cdn.openai.com/research-covers/language-unsupervised/language_understanding_paper.pdf

3 – HSBC Research, 2H24 Technology Outlook, July 2024

### Past platform shifts tell us to expect new stock leadership ahead

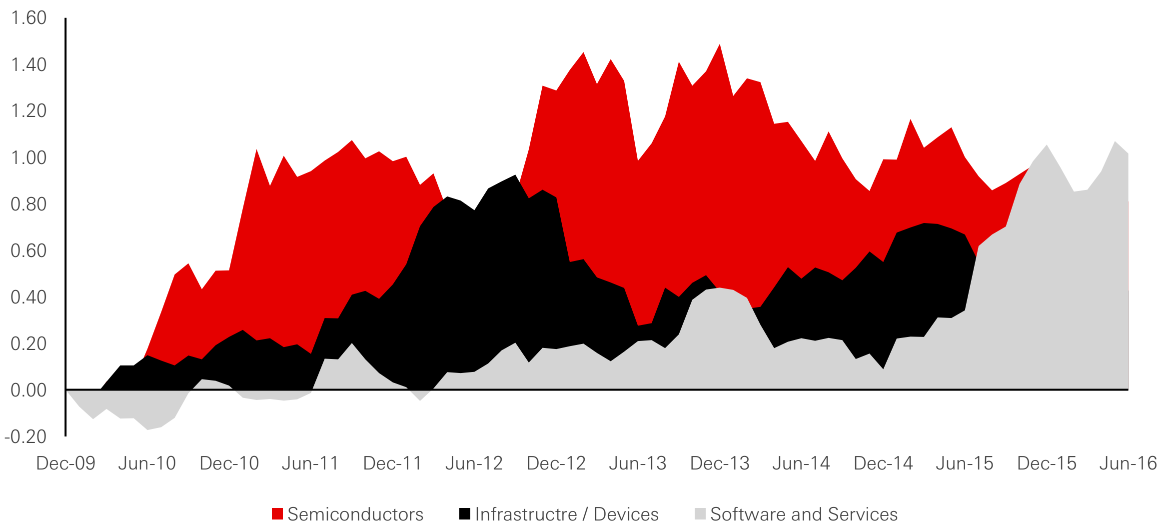
Mark Twain is credited with saying that "History doesn't repeat itself, but if often rhymes". As we look at the current technology platform change, we find ourselves coming back to this saying and wondering whether history will indeed repeat itself or just rhyme? To offer some context around this current AI driven cycle, we will take a look back at the mobile internet cycle.

In the early days of the transition to the new mobile internet platform we saw an initial surge in the semiconductor sector, as infrastructure providers started to demand cutting-edge processors from the likes of ARM and Qualcomm – those which could handle new app-based operating systems and protocols found in the 3G and 4G standards. The platform here was the smartphone mobile handset itself, which provided ubiquitous compute to everyone, everywhere.

As smartphone penetration grew, the infrastructure providers (i.e. handsets) like Apple and Samsung started to emerge, disrupting the market that existed at the time. Along with the growth in smartphones we started to see the development of an app economy – the software and service element, and in particular social media and ecommerce, that we all use today. The latter two segments have created some of the largest companies in the world, namely Amazon and Google.

> The mobile internet platform shift saw stock leadership transition from semis and infrastructure providers to software and services.

Figure 3: Mobile Internet Cycle Stock Performance (relative to S&P 500)




**Past performance is not an indicator of future returns.**
Source: HSBC Asset Management, Morgan Stanley Research, Refinitiv. Data at 31 December 2016.

So why did stock return leadership change between these three areas of semiconductors, infrastructure and software? For the first two areas, competition started to dilute margins and the penetration of handsets started to limit growth – there are only so many handsets a user can own. Software though was different, in that whole new monetisation opportunities were created on the back of this new platform, disrupting other industries – think ecommerce disrupting physical stores, streaming of media disrupting linear TV, etc.

The question though is whether history will repeat itself and whether ultimately, software will again take the lion's share of investment returns as it did previously?

## Semiconductors – increasing complexity and reduced competition

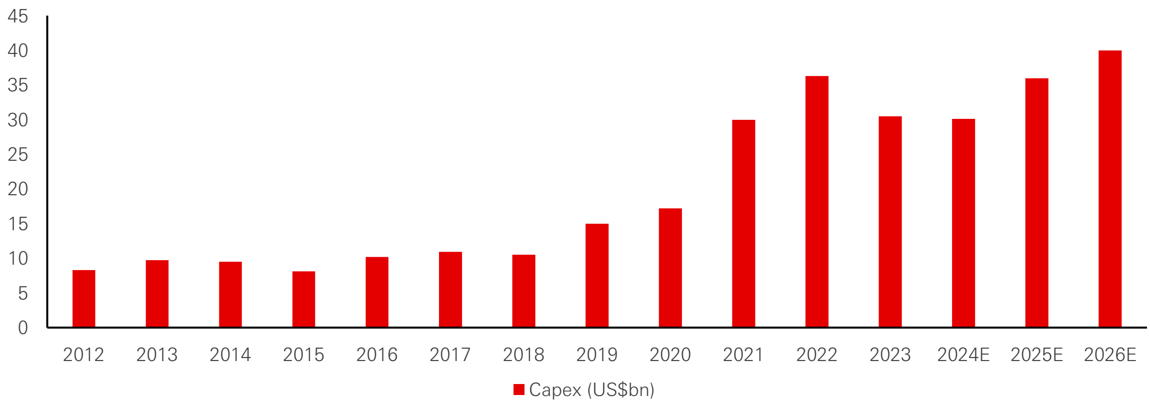
Certainly, when we look at performance of the semiconductor sector over the last 18 months it would be hard not to argue that we are seeing many similarities to the mobile internet cycle. However, industry dynamics have changed over the subsequent years and lead us to question whether competition will fade sector returns. The ever-rising cost of manufacturing semiconductors at scale and increasing complexity – fitting over 100 billion transistors on a piece of silicon the size of several postage stamps – has driven up barriers to entry, leading to consolidation. The upside of this is that the industry is more disciplined around investment and the resultant margin profile more attractive. The DRAM market, a component of the memory semiconductor industry, is a great illustrator of this point.

> Higher barriers to entry for semiconductor segments today means sector returns may not fade as easily as they did previously.

In 2005 the market was rife with competition, with over 15 players competing on price. Over the years this has whittled its way down to just three. As of last year, Samsung Electronics, SK Hynix, and Micron Technology have a combined market share in DRAM of ~97%. It could be logically deduced that this has created significant barriers to entry and low competition should exist within the DRAM market.

We can see this consolidation effect in other areas of the semiconductor market, driven in part by the constant drive to shrink – or the drive to continue pushing Moore's Law. This 'law' is really a prediction rather than a physical law, that Gordon Moore (co-founder of Fairchild Semiconductor and Intel) made back in 1965. His observation was that the number of transistors on a microchip would double about every two years with a minimal cost increase. This minimal increase might be true at the microchip level but the capex cost to leading manufacturers, such as TSMC, has significantly increased – these days a single piece of machinery can cost in the hundreds of millions of dollars. This inevitably creates a huge barrier for any new company to enter the leading-edge area of the semiconductor market, which is the area that is driving the development of Generative AI.

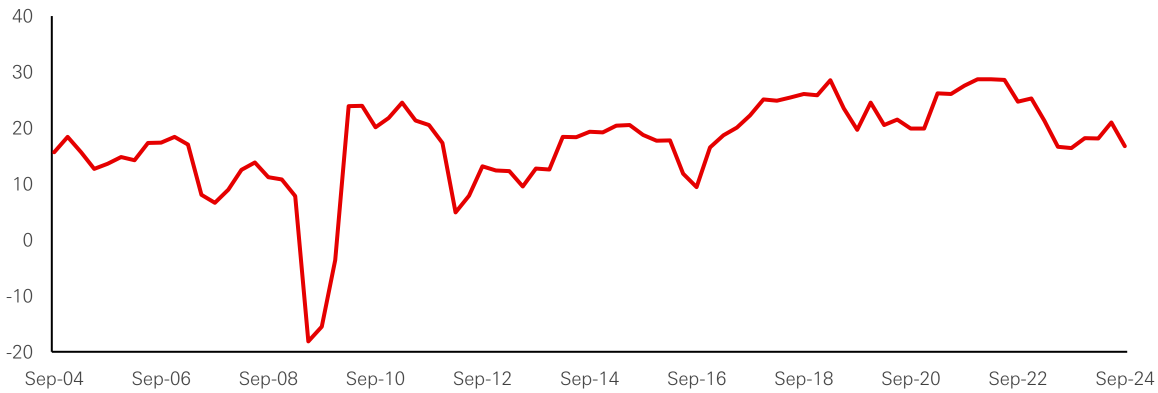
Figure 4: TSMC's capex (USDbn)




Source: HSBC Asset Management, Bloomberg, September 2024.

However, this does not remove the normal peaks and troughs of economic cycles, though we do see the effect of improving profitability throughout the cycle as compared to previous ones.

Figure 5: Semiconductor industry operating margins (%)




Source: HSBC Asset Management, Bloomberg, September 2024

Using the US Semiconductor Sector Index (SOX) as a proxy, the trough of operating margin over the past 20 years is getting higher and higher. Does this mean that the semiconductor sector will accrue more of the benefits during this platform shift? It is certainly possible that during this current investment period, driven by Generative AI, the margin profile of the sector stays elevated for an extended period and in the event of a down cycle, the margin profile could be higher than before.

**Software – to buy or build?**

When we look at software it is fair to say that nobody envisaged the changes that the mobile app economy would bring to the world. The role of social media and its impact on our lives or the impact of the Software-as-a-Service (SaaS) model on enterprises are good examples – all built on the back of the semiconductor and compute infrastructure. The same parallels are being drawn today regarding the build out of AI infrastructure. But is this correct? Are there differences this time?

We do know that it is complex for an Enterprise to build a scalable and sustainable architecture for Generative AI, requiring careful planning, investment and time. There are many considerations that need to be undertaken, and this perhaps sheds some light on why the performance of the software sector has been relatively lacklustre. The first step by many Enterprises is to consider what problem they are using Generative AI to solve – for example, is it an efficiency led issue or a revenue generating issue they want to solve? Can this problem be solved externally through 3rd party software providers, or can the problem be solved internally – do they buy or do they build?

Regardless of this decision, the enterprise needs to have their data 'in the right place' – a strong digital core is essential, but for many, data will be siloed and stored in different locations – both regional and on/off premise.

> With over $900 million in new Gen AI bookings this quarter, we now have $2 billion in Gen AI sales year-to-date, and we have also achieved $500 million in revenue year-to-date."
>
> *Accenture, Q3 FY 2024 Earnings Call.*

> We've used multiple large language models to accurately create or improve over 850 million pieces of data in the catalogue.
> Without the use of generative AI, this work would have required nearly 100x the current headcount to complete in the same amount of time."
>
> *Walmart Q2 FY 2025, Earnings Call*

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Generative AI requires large amounts of data to train models effectively, so it is critical to have the right data infrastructure. For many this will involve utilising cloud-based solutions that provide scalable and easy access to AI models. This approach has led to impressive revenue growth figures from the main cloud providers, alongside even larger capex growth figures as they scale for further demand growth ahead.

These early Enterprise use cases are often unique, and while there are thousands of pilot studies around Generative AI being conducted, there is no standard deployment or standard architecture. Therefore, standardised software is difficult to deploy. It could be argued that much of the success of the software sector in the Cloud platform era was due to the standardised nature of the platform it was built on. This enabled its rapid expansion.

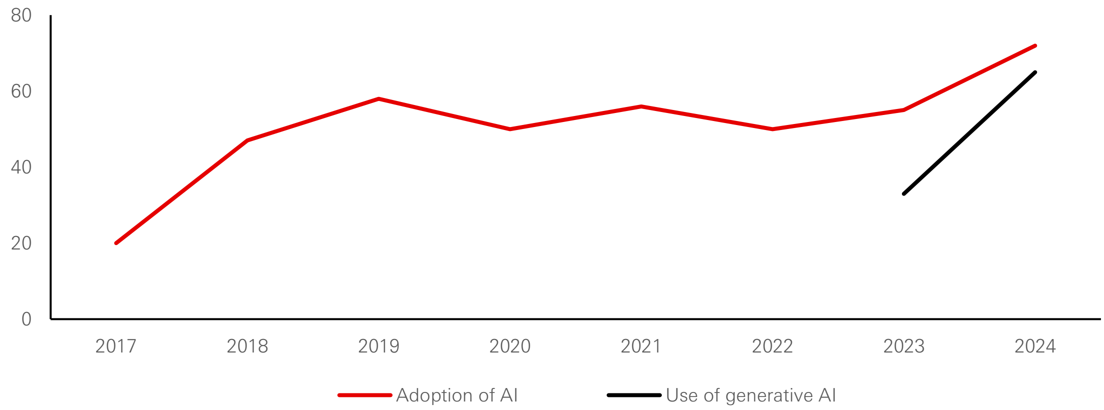
As of now, the mentality on software by many is one of 'build it and they will come', but much of the Generative AI software and solutions for Enterprises today are just an incremental add-on to existing software, that might eventually be free. This is a far cry from the creation of a whole new ecosystem that was developed when software was moved to the cloud from on-premise. Accordingly, there is a concern by many that the proportionate $ value attached to software will be a lot lower in the AI investment cycle. Of course, we will not know this until we look back at the end of this platform cycle.

### Benefactors set to broaden beyond current infrastructure buildout leaders

There appears to be little question that we are going through a technological platform shift with the rise of Generative AI. It has sparked a flood of investment, primarily into the semiconductor sector for the reconfiguration and build out of new data centres to handle the training and querying of these new models.

So, what are the implications of this and how does this frame our investment thinking? The current semiconductor phase is being driven by the training aspect of these foundational AI models, where computational power is primacy – training trillions of tokens is a very intensive computational process. This is computation at the leading edge and only a very few have the silicon necessary to do this, explaining why equity performance in the sector has been so narrow. As Generative AI matures and a greater number of use cases go into production – with rapidly growing adoption by organisations (figure 5) supporting this expectation – the inference side of the equation becomes more important.

Figure 5: Organisations that have adopted AI in at least 1 business function (% of respondents)




Source: Mckinsey & Company, May 2024

AI inference (conclusions or predictions based on given data sets) will certainly be at the heart of AI applications going forward. Importantly, the performance requirements for inference are lower and cost efficiency becomes a key driver. When we couple this with model improvements, the cost of compute is getting lower, and thus expectations are for a rise in competition via private companies or AI service providers developing their own custom silicon. This will lead to a broadening out of the equity return landscape.

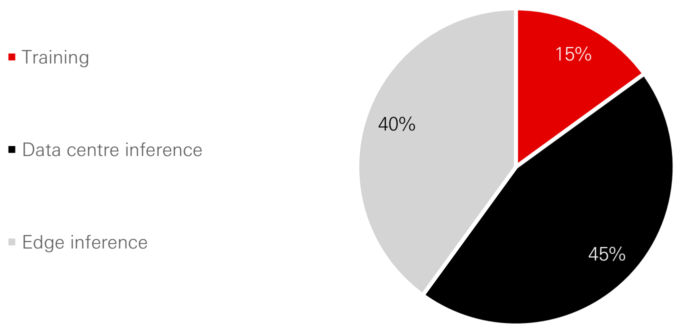
For software it is still very early days, and announcements like those of Walmart quoted on the prior page are rare. Over the coming months and quarters, we expect many more examples of productivity gains to arise as Enterprises embrace the power of Generative AI. As we have highlighted earlier, an Enterprise needs to have a strong digital core to really benefit from Generative AI – to go through a process of digital transformation. As such, we expect companies within the IT service sector will clearly benefit from this platform change as they assist enterprises in navigating through a digital transformation process. This extends beyond software behemoths such as Microsoft, to smaller players that can deliver specialised software solutions to meet the functional needs of enterprises across industries.

Like many parts of the software sector, the IT Service sector has lagged the broader equity market this year, with economic concerns overriding the nascent growth we are seeing from Generative AI associated revenue. With visibility now on the horizon for the direction of US interest rates and spending indications for software and IT services looking to be improving for 2025, we view the recent lows as being the trough.

We are still yet to see how this platform shift embraces the consumer, though we can see some emerging benefits of having some form of Generative AI installed on our edge devices.

We expect similarities to past platform shifts, seeing opportunity for software and IT services to take up stock market leadership by delivering Gen AI capabilities more broadly to companies and consumers.

Figure 6: Estimate of where the AI chips market could settle




Source: Techspot, HSBC Research, August 2024.

While we are still early in the investment cycle to see whether existing software providers will accrue the benefits or if a whole new set of companies will emerge, a key question is whether Generative AI in the long run will do the unthinkable and disrupt the software sector itself! This is an area we are keenly tracking.

Debate will continue around the potential scale of societal change and benefits to productivity at this early stage of AI development. Projections for $1 trillion in capex spending on AI infrastructure in the coming years means that adoption and returns must be substantial to justify the spend and support profitability - and resulting equity gains. What is clear is that software and IT services will ultimately have to play a leading role in delivering AI capabilities broadly to organisations and consumers, if we are indeed in the midst of a new platform shift and adoption is to reach levels sufficient to support today’s infrastructure investments.



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