Seeking Singularity

Q2 2022

The Singularity group

Highlights

- **In H1 2022, the Singularity Index registered a gross return of -32.2%** vs the MSCI AC World Index's return of -20.2%. The strategy's exposure to growth and quality continued to weigh on performance in a strongly macro-driven risk-off environment. **Since inception on December 21 2017, the strategy delivered a gross return of +43.3% (+8.3% p.a.)** vs the benchmark's return of +26.7% (5.4% p.a.), an outperformance of 2.9% p.a.
- **Singularity Small & Mid**, which comprises the top 100 innovation companies within the USD 1bn to USD 25bn market cap range, **posted a net return of -31.3% for H1 2022 and -25.1% since launch on May 10, 2021** (vs -18.5% for the MSCI AC Mid Cap Index). In the backtest based on live data, the strategy is up +38.3% since inception, representing an outperformance of +23% vs the global mid cap benchmark.
- While risks in the markets remain following the worst 6 months for equities in decades, it pays to start focusing on the longer term outlook and recovery for both economies and markets. **The good news is that after such large drawdowns, the market often tends to recover significantly over a 1- to 3-year period.** More importantly, while short- to medium-term gyrations are hard to predict, **we expect innovation stocks to continue to provide superior returns in the long run. Valuation looks significantly more attractive with the Singularity Index trading at a P/E of 22, which is 25% below the average P/E since inception.**
- **Singularity Portfolios remain fundamentally healthy and strong with solid profitability, growth, and solvency metrics.** We believe that our focus on companies with durable competitive advantages, pricing power, strong balance sheets, and attractive valuations will help our portfolio weather an inflationary environment while still offering significant upside potential.

Singularity Insights - The Advent of Peak AI?

- **Artificial Intelligence (AI) is the largest Singularity Sector representing 22% of total revenues in the Singularity Universe and 23% of total revenues in the Singularity Index.** In this report, we take an in-depth look at the sector's key focus areas and future outlook.
- We assess that recommender systems and their applications in video download and streaming services have become commoditized, resulting in Netflix and Spotify exiting the portfolio in the last rebalancing.
- Based on expert consultations, we see an accelerating shift from innovation in Discriminative AI (conditional models used for classification or regression) to Generative AI.

TSG Updates

- We continue to strengthen our Singularity Think Tank and welcomed five new experts in the second quarter, covering specializations in Sustainability in Energy and Mobility, Novel Food, Plant Science, Neuroscience, and Biosensing.
- Our semi-annual Think Tank round table explored topics around innovation investing in the face of global sustainability challenges, and the potential of Machine Learning (ML) and Deep Learning (DL) in brain imaging.
- Also, with our Novel Food experts, we took a deep dive into some of the key innovations and technological bottlenecks in the Cultivated Meat and Fish sector.

Singularity in the Spotlight

- We asked 1.100 C-level executives about the state of innovation, 400 answered. Please find our inaugural **TSG Global Innovation Survey** here.
- An article by renowned German Handelsblatt covered the survey, the convergence of technologies, and the Singularity Index.
- "Switzerland is Renovating the Internet and has a Lead in Data Ethics" - a recap of our exclusive survey launch event in Lucerne.
- "What's the Bottleneck in the Novel Food Revolution?" - a Singularity Think Tank inspired piece on the key innovations in the upcoming cultivated protein space.
- "Innovation as a Catalyst for Circularity: How CO2 and Waste Become Sought-After Resources" - an overview on the drivers and enablers of a circular economy.
- Our **latest Greg Cast covers the recent rebalancing**: "Tesla, Netflix, and Spotify dropping out of the Singularity Index".
- Why do we think that Tesla, Netflix, and Spotify are not innovative enough for the Singularity Index at this point in time? Watch the replay of our next **Singularity Insights Quarterly Live Webinar** for answers and Singularity Think Tank inspired insights by our Director of Research Shiko Ben-Menahem and a performance update from CIO Gregory Hung. **Click Here**

An investor who entered the market at -20%, in similar market downturns generated an average return of +16% over the next 12 months and +29% and +33% over a 24- and 36-months period respectively.

Performance Commentary

SINGULARITY FUND

The first half year made history, in a painful way. Global markets had their most bruising 6 months in decades. Accelerating inflation – mainly driven by higher energy and food prices and rising interest rates – fuelled a broad based rout. The S&P 500 recorded the worst performance since 1968, just shy off the 1932 sell-off. Bonds did even worse: With the swift rise in real rates, the total return of US 10-year treasuries had their worst H1 since 1788.

The good news is that after such large drawdowns, the market often tends to recover significantly. For instance, in years in which the S&P 500 was down by more than -15% in the first half of the year, such as occurred in 1932, 1939, 1940, 1962, and 1970, the S&P 500 has rallied an average of 24% in the ensuing six months. More generally speaking, in past cases where the market had drawdowns in excess of -20%, forward returns were positive in most instances. An investor who entered the market at -20% in such cases generated an average return of +16% over the next 12 months and +29% and +33% over a 24- and 36-months period respectively.

Figure 1

Bear Markets & Recoveries in the S&P 500 Index

									Performance after dropping more than -20% from peak					
Peak	Recovery	Length (years)	Max DD	Time to Recovery	P/E at Peak	P/E at Trough	Ratio	10Y UST Yield at Peak	3M	6M	12M	18M	24M	36M
8/2/1956	9/24/1958	3,1	-21,6%	0,9	13,8	12,2	88%	n/a	5,2%	9,3%	31,0%	47,1%	44,7%	38,6%
12/12/1961	9/3/1963	2,5	-28,0%	1,2	22,4	15,4	69%	n/a	7,3%	11,2%	26,1%	30,2%	44,8%	59,3%
2/9/1966	5/4/1967	1,8	-22,2%	0,6	18,0	12,9	72%	4,7%	7,9%	17,6%	24,6%	19,6%	36,4%	25,5%
11/29/1968	3/6/1972	4,7	-36,1%	1,8	18,0	13,2	73%	5,8%	-4,9%	-8,9%	10,7%	13,3%	19,9%	35,9%
1/11/1973	7/17/1980	10,9	-48,2%	5,8	19,5	7,5	39%	6,4%	0,7%	-9,2%	-28,1%	-6,3%	-6,3%	6,5%
11/28/1980	11/3/1982	2,8	-27,1%	0,2	9,1	7,1	77%	12,7%	3,0%	1,3%	32,1%	46,6%	39,9%	63,5%
8/25/1987	7/26/1989	2,8	-33,5%	1,6	22,5	14,7	66%	8,7%	11,0%	15,8%	26,4%	42,5%	62,4%	48,8%
9/1/2000	10/23/2006	8,9	-47,4%	4,0	28,4	17,3	61%	5,7%	6,6%	-6,8%	0,1%	-22,8%	-24,2%	-0,0%
10/9/2007	4/2/2012	6,5	-55,3%	3,1	17,5	11,1	63%	4,6%	-26,4%	-28,2%	-24,2%	-4,0%	-6,5%	14,7%
2/19/2020	8/10/2020	0,7	-33,8%	0,4	22,3	14,4	65%	1,6%	21,6%	35,9%	61,8%	84,2%	74,9%	?
1/3/2022	ongoing	?	-20,5%	?	24,7	?	77%	1,6%	?	?	?	?	?	?
	Average	4,5	-35,3%	2,0	19,1	12,6	68%	6,3%	3,2%	3,8%	16,1%	25,0%	28,6%	32,5%

Source: TSG, Bloomberg

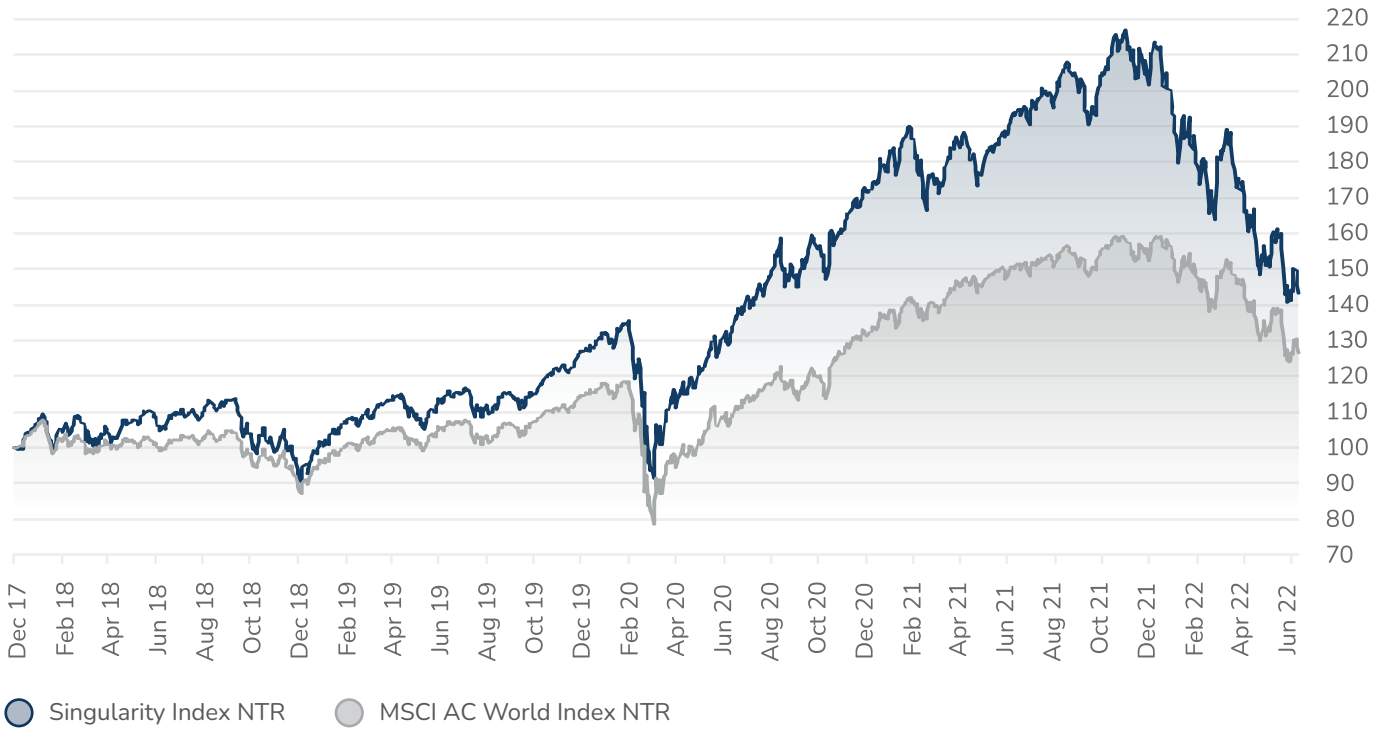
Spliced data: SPX price index until Dec 1987, SPX TR index from Jan 1988.

The old adage "time in the market is more important than timing the market" rings more true than ever. While on a short- to medium-term timeframe equities ebb and flow according to different factors, over the long run innovation has proven to win out.

In H1 2022, the Singularity Index registered a gross return of -32.2% vs the MSCI AC World Index's return of -20.2%. Both security selection and sector allocation contributed negatively in the first six months. The strategy's exposure to growth and quality continued to weigh on performance in a continued strongly macro-driven risk-off environment. **Since inception on December 21 2017, the strategy delivered a gross return of +43.3% (+8.3% p.a.) vs the benchmark's return of +26.7% (+5.4% p.a.).** This represents an outperformance of +16.7% over the entire period or 2.9% p.a.

Figure 2

Singularity Index Performance Since Inception



Source: TSG, Bloomberg

Singularity Sectors: All sectors were negative during the first half of the year. The Singularity Sectors holding up better in H1 were **IOT** (-22.7%), **Big Data** (-28.1%), and **Robotics** (-28.6%)**. Blockchain** (-70.1%), **Compute Power** (-36.9%), and **AI** (-36.1%) were the bottom performers year to date.

The **IOT** exposure is grouped around core enabling communications infrastructure and equipment providers that are crucial for building out high throughput networks (e.g., **Verizon** [VZ US, SC: 23], **China Tower** [788 HK, SC: 99], **Arista Networks** [ANET US, SC: 100]), also cell tower REITS (e.g. **American Tower** [AMT US, SC: 100], **Crown Castle** [CCI US, 100]), as well as network security providers such as **Palo Alto Networks** (PANW US, SC: 100) or **Fortinet** (FTNT US, SC: 100). In **Big Data**, global payment network providers like **Visa** (V US, SC: 100) and **Mastercard** (MA US, SC: 100) held up relatively well in the prevailing market environment while other players with a strong fintech association – including **Paypal** (PYPL US, SC: 92) and **Adyen** (ADYEN NA, SC: 97) – sold off significantly more. **Amazon** (AMZN US, SC: 20), captured in this sector for its leading role in cloud storage and compute through Amazon Web Services, sold off alongside markets.

Top contributors to portfolio returns were IBM (IBM US, +0.05%, Singularity Score [SC]: 74), Johnson & Johnson (JNJ US, +0.03%, SC: 24), and China Tower (788 HK, +0.03%, SC: 99).

Compute Power suffered as core players in the semiconductor industry experienced significant pullbacks: **Nvidia** (NVDA US, SC: 100) was down -48% and **TSMC** (2330 TW, SC: 97) lost -27%. Software players proved more stable in this sector with **Synopsis** (SNPS US, SC: 100) and **Cadence** (CDNS US, SC: 100), whose solutions are instrumental to design and development of complex chips and electronic systems, were down by "only" -18% and -19%.

Attribution: Top contributors to portfolio returns were **IBM** (IBM US, +0.05%, Singularity Score [SC]: 74), **Johnson & Johnson** (JNJ US, +0.03%, SC: 24), and **China Tower** (788 HK, +0.03%, SC: 99). Bottom contributors were **Nvidia** (NVDA US, -2.2%, SC: 100), **Tesla** (TSLA US, +1.5%, SC: 0), and **Meta Platforms** (FB US, -1.4%, SC: 100).

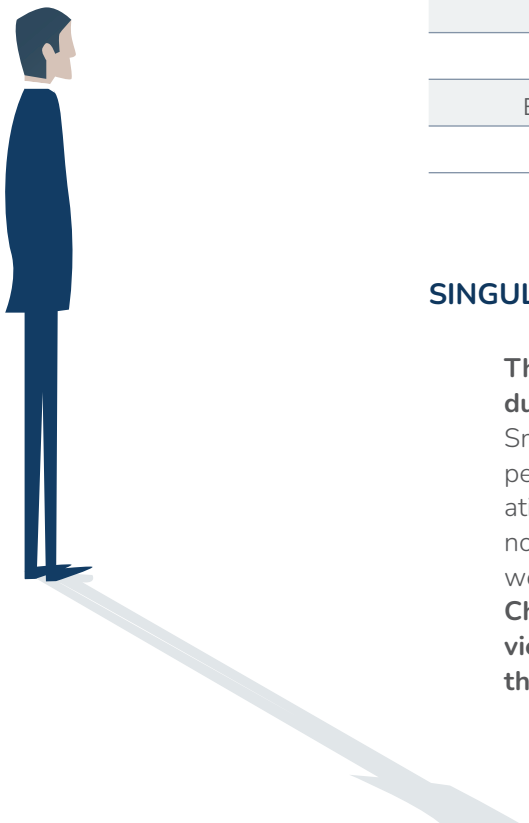
Singularity Stocks: Best 3 performing stocks in the portfolio for H1 in terms of absolute performance were **Gitlab** (GTLB US, +40.8%, SC: 100), a recently IPO'd company that entered the portfolio in the most recent rebalancing ahead of a strong set of earnings and rallied strongly, **China Tower** (788 HK, +20.8%, SC: 99) which significantly outperformed after a beat on earnings in April, and **BYD** (1211 HK, +20.0, SC: 8) who posted record sales numbers on the back of increasing demand for EVs as one of the leading battery suppliers.

Figure 3

Singularity Index: Top H1 Performers by Singularity Sector

Sector	Company	Perf (%)
Artificial Intelligence	Gitlab	40,8
Internet of Things	China Tower	20,8
New Energy	BYD	17,0
Virtual Reality	Bilibili	14,6
Compute Power	Pure Storage	9,7
Advanced Materials	Amcor	8,8
Big Data	IBM	8,2
Robotics	Largan Precision	7,4
Bioinformatics	Qiagen	4,3
Blockchain	Block	-62,0

Source: TSG, Bloomberg



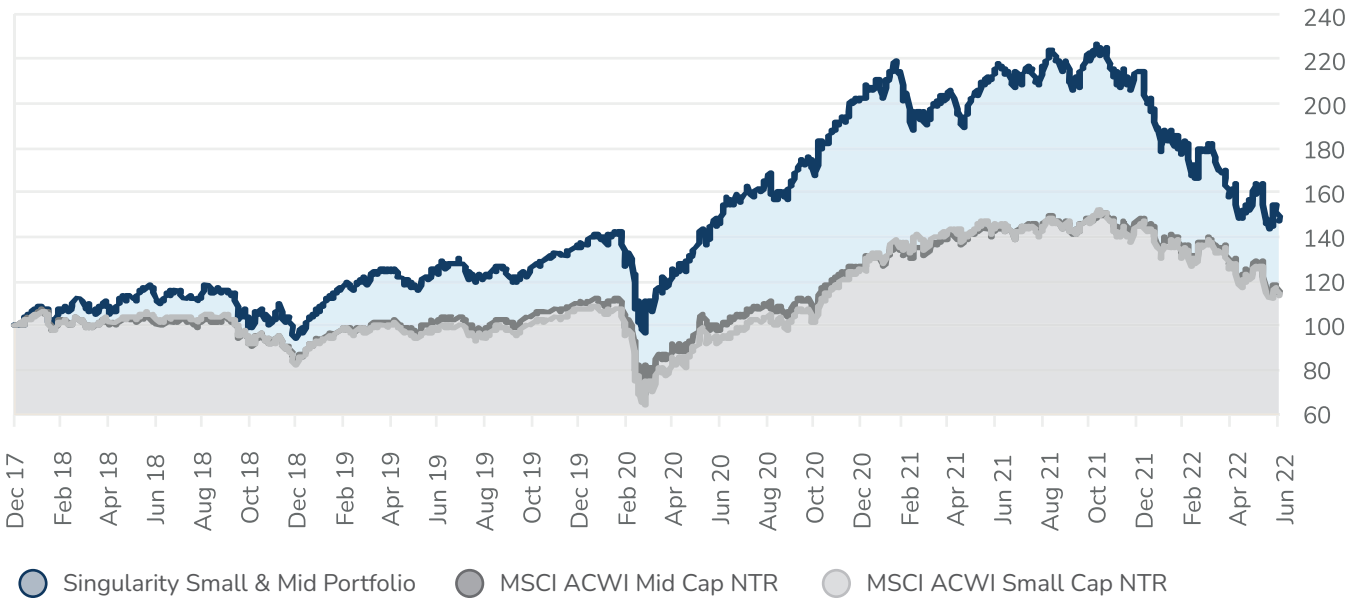
SINGULARITY SMALL & MID

The Singularity Small & Mid strategy posted a net return of -31.3% during the first half, compared to -22.3% and -22.0% for the MSCI AC Small Cap Index and MSCI AC Mid Cap Index respectively. The underperformance stems purely from the first quarter where the strategy's relatively larger exposure to growth (and underweight to value), the technology sector, and to China (with an average portfolio weight of ca. 18%) weighed on portfolio returns. As discussed in the last quarterly report, **Chinese stocks had become very attractive from a valuation point of view and were able to post a return of +7.1% in the second quarter, the only market finishing in positive territory.**

Since launch of the certificate on May 10 2021, the strategy is down by -25.1% on a gross basis, underperforming the above indices by -3.2% and -5.6%. **Since strategy inception (Dec 21, 2021) cumulative net performance is +38.3%**, representing an outperformance of +25.1% and +23.0% respectively.

Figure 4

Live Performance and Backtest: Singularity Small & Mid vs. MSCI AC Small & Mid Cap Indices per end of June 2022 (indexed)



Source: TSG, Bloomberg

Best 3 performing stocks per sector in the portfolio for H1 in terms of absolute performance were **Pure Storage** (PSTG US, +0.04%, SC: 100), which continued to beat on earnings and sales, **Amcor** (AMCR US, +0.10%, SC: 69) a provider of flexible and sustainable packaging solutions that benefited from stronger year-end profit guidance, and **Okta** (OKTA, US, +0.06%, SC: 100), a cloud-based identity and access management platform, which was added to the portfolio in the last rebalancing on May 20th and reported better than expected first quarter results.

Figure 5

Singularity Small & Mid: Top H1 Performers by Singularity Sector

Sector	Company	Perf (%)
Compute Power	Pure Storage	9,7
Advanced Materials	Amcor	8,8
Internet of Things	Okta	7,3
Big Data	MongoDB	4,6
Artificial Intelligence	UiPath	4,5
Bioinformatics	Qiagen	4,3
New Energy	Terna-Rete	4,1
Virtual Reality	Roblox	4
Robotics	Olympus	-4,4

Source: TSG, Bloomberg

Portfolio Analytics

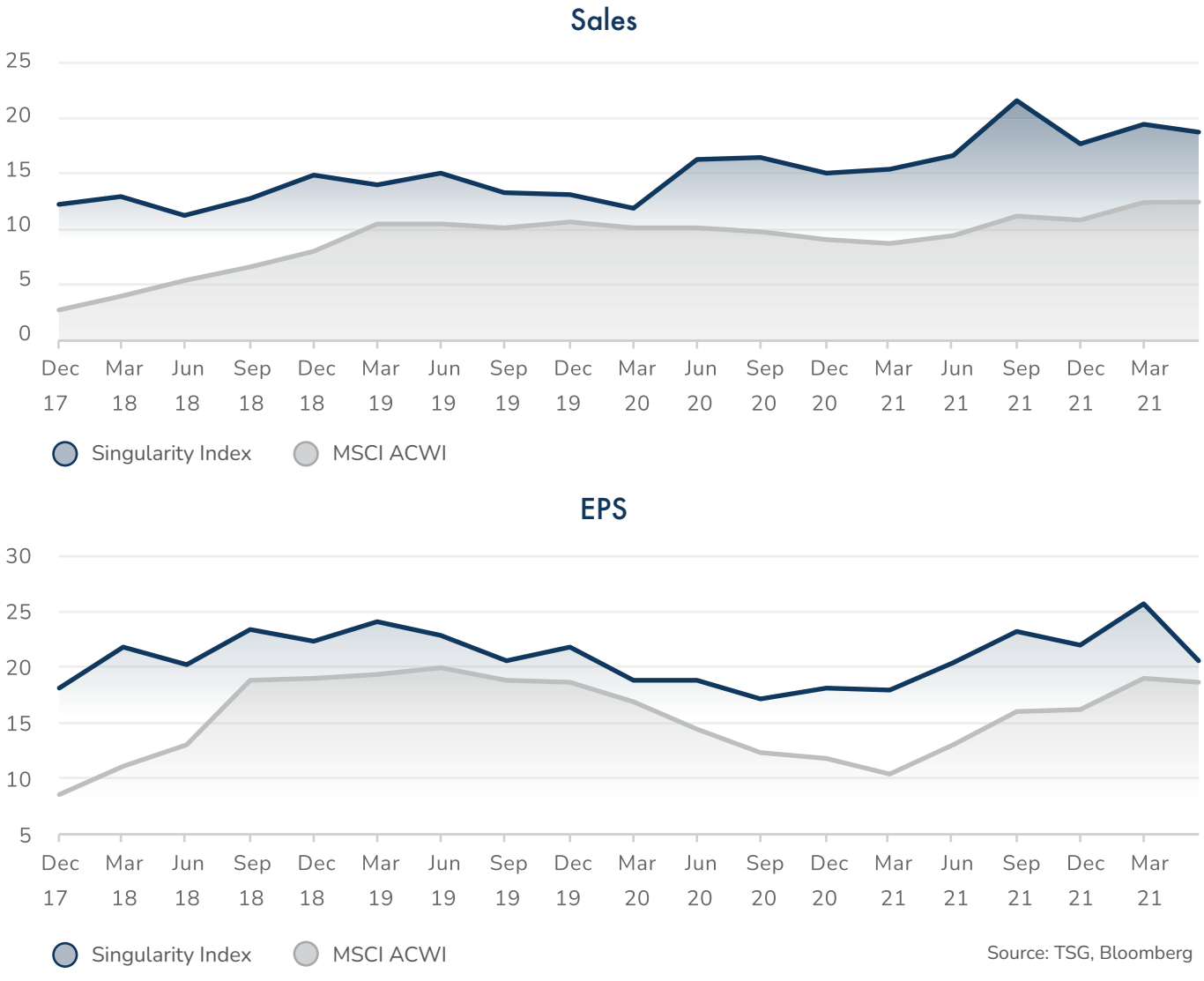
In the wake of the market sell-off, valuations in terms of Last Twelve Months P/E ratios have come down drastically for the Singularity Index from close to 35 at the beginning of the year to 22 at the end of Q2, currently trading at -25% below the average P/E since inception. Meanwhile, the **relative P/E ratio of the Singularity Index vs the MSCI ACWI has fallen below its historical average** and has become a lot more attractive in comparison.

Recent performance should not obscure the fact that the portfolio remains fundamentally healthy and strong. Earnings and sales growth (year-over-year) in Q1 2021 were 33% and 22% respectively (vs 11% and 18% for MSCI ACWI), surprising both on earnings (+7.2%) and sales (5.2%). Second quarter earnings season for the portfolio so far looks solid: sales and earnings are surprising positively and are up by +14% and +8% year-over-year.

Since inception of the strategy sales and earnings growth have been strong and consistently superior vs the global equity benchmark as measured by 3-year compound annual growth rates.

Figure 6

3-Year Sales and EPS Compound Annual Growth Rate



Source: TSG, Bloomberg

Innovation is the most important driver of pricing power as it is the only way to create durable, sustainable, and predictable growth in the long term. Innovation generates above-average organic growth, which allows them to produce significant free cash flow, reinvest in their businesses at higher rates, and ultimately drive superior shareholder returns.

At current levels, our investors are holding a highly profitable portfolio with attractive growth potential and a healthy balance sheet at significantly more attractive valuations.

Whether or not you believe in sustained inflation, **our portfolio offers a resilient set of characteristics which would also hold up in a more entrenched inflationary environment:** Simplistically speaking, the main levers of business value are revenue growth, operating margins, and the cost of capital. Increased inflation favors companies with pricing power who are able to pass on higher costs into their offering and limit the compression of margins during downturns. In our view, **innovation is the most important driver of pricing power as it is the only way to create durable, sustainable, and predictable growth in the long term.** This is why we focus on companies that are able to remain in our key areas of innovation. These companies generate above-average organic growth, which allows them to generate significant free cash flow, reinvest in their businesses at higher rates, and ultimately drive superior shareholder returns.

Our portfolio's operating margin of 26% and profit margin of 22%, a spread of ca. 4 percentage points over the MSCI ACWI in both cases, give testament to this. Higher inflation also increases the cost of capital predominantly through the transmission channels of higher risk-free rates and credit spreads. The higher the debt load of a company the more severe the effect. Given the low levels of debt in our portfolio the effect of higher rates and related default risk is likely to be comparatively muted. **In summary, we believe that our focus on companies with durable competitive advantages, strong balance sheets, and attractive valuations would help our portfolio weather an inflationary environment while still offering significant upside potential.**

Figure 7

Portfolio Characteristics

As of June 30, 2022	The Singularity Fund	MSCI All Country World	+/-
PROFITABILITY			
Profit Margin	22.0%	17.9%	+4.2%
Operating Margin	26.2%	22.5%	+3.8%
Return on Equity	23.1%	15.7%	+2.9%
Return on Assets	11.9%	8.8%	+3.3%
BALANCE SHEET / SOLVENCY			
Total Debt to Equity	99.4%	122.6%	-23.2%
Total Debt to Total Assets	24.2%	26.2%	-2.0%
Total Debt to EBITDA	1.9x	2.7x	-0.8x
LIQUIDITY			
Quick Ratio	2.0x	1.4x	+0.5x
Current Ratio	2.2x	1.6x	+0.6x
GROWTH RATES (3Y CARG)			
Revenue	15.9%	10.1%	+5.8%
EBITDA	18.6%	14.2%	+0.6x
EPS	24.1%	16.6%	+7.5%

Source: TSG, FactSet

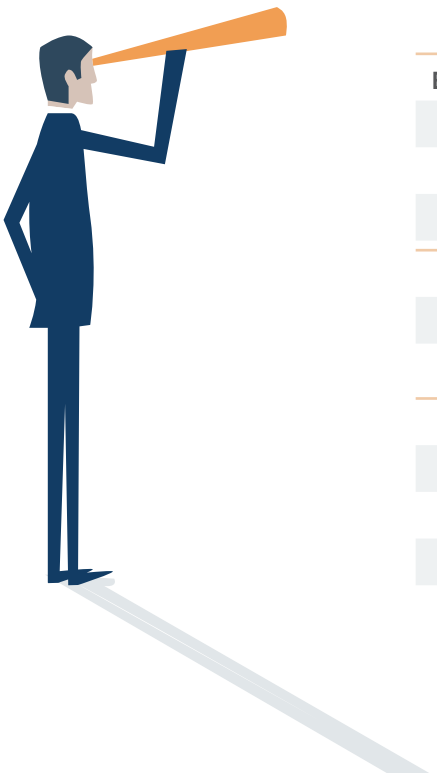
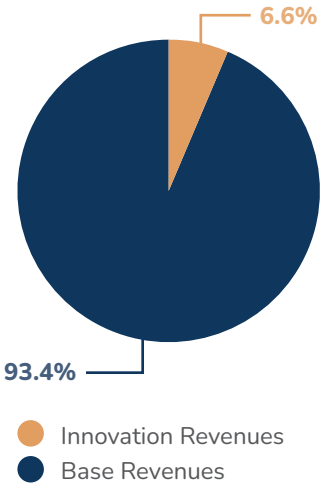


Figure 8

Innovation Revenues



Source: TSG, FactSet

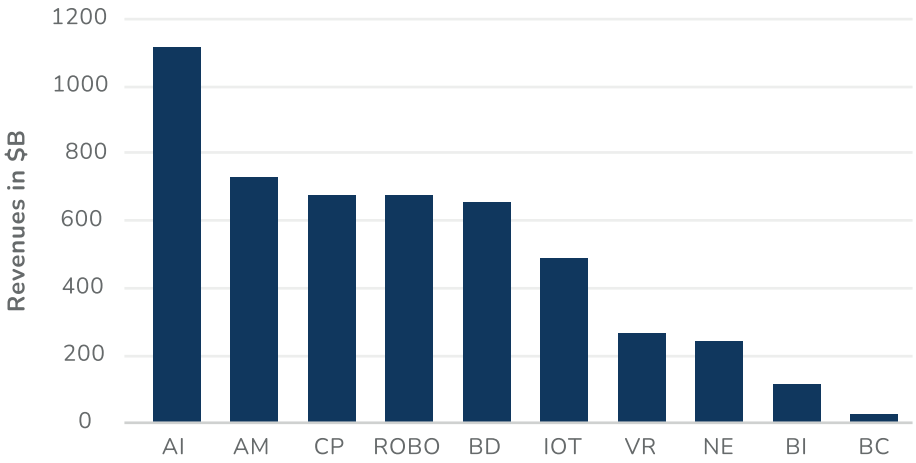
Singularity Insights - A Snapshot of Global Innovation Revenues

USD 75.3T. That is the 2021 year-end number for total revenues of all global listed companies according to FactSet. At TSG, we've made it our mission to **dissect companies' revenues into innovative and non-innovative streams based on an expert-led approach**. As a result of this process, out of the USD 75.3T total revenues, we deem that **about USD 5T (or 6.6%) are linked to innovation as it pertains to our 10 Singularity Sectors.**

On a global basis, Artificial Intelligence (AI) was by far the largest Singularity Sector, with total Singularity revenues of USD 1.1T, followed by Advanced Materials (USD 726B), Compute Power (USD 676B), Robotics (USD 674B) and Big Data (USD 654B).

Figure 9

Revenues by Singularity Sector

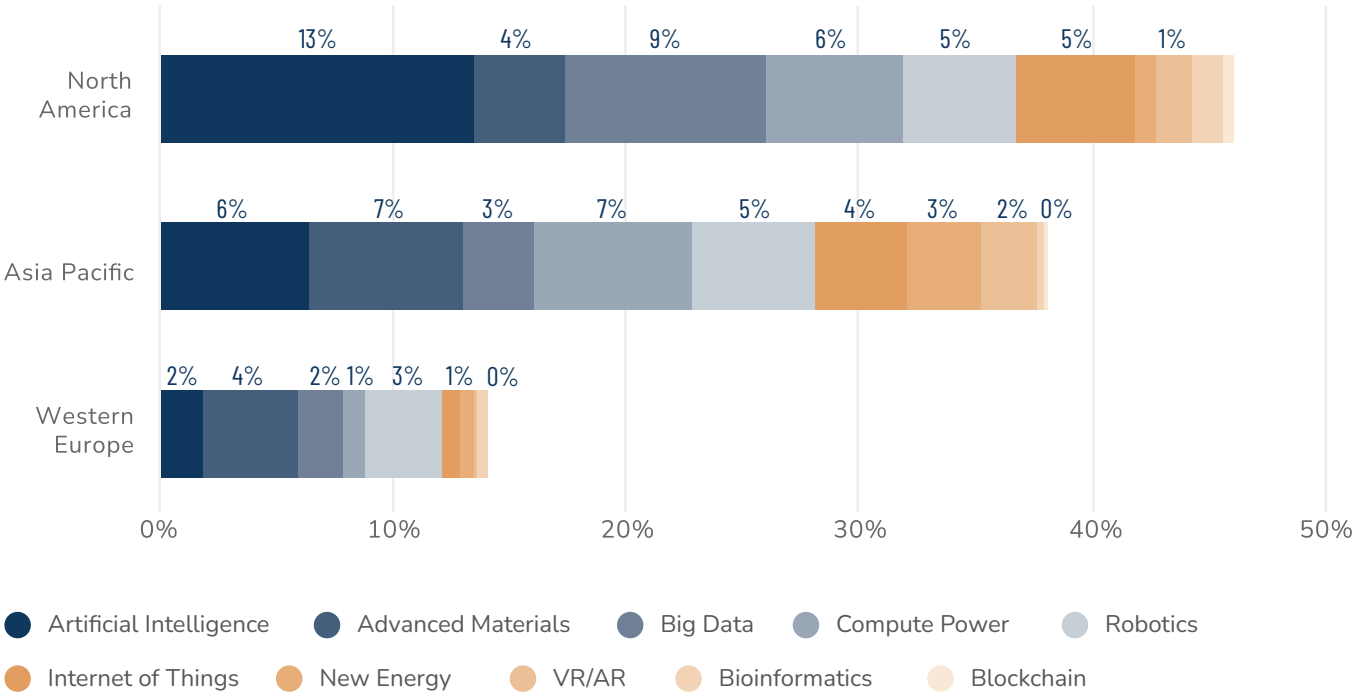


Source: TSG, FactSet

Diving into the regional sector exposure, we find stark differences: North America is skewed towards AI, Big Data and Compute Power, whereas Western Europe is dominated by Advanced Materials, Robotics, and Big Data. Asia Pacific shares some core exposures with North America (AI and Big Data), while Advanced Materials takes third place. In all regions, Blockchain, Bioinformatics, New Energy, and Virtual Reality represent the smallest sectors with combined revenues of less than 15% of total global revenues.

Figure 10

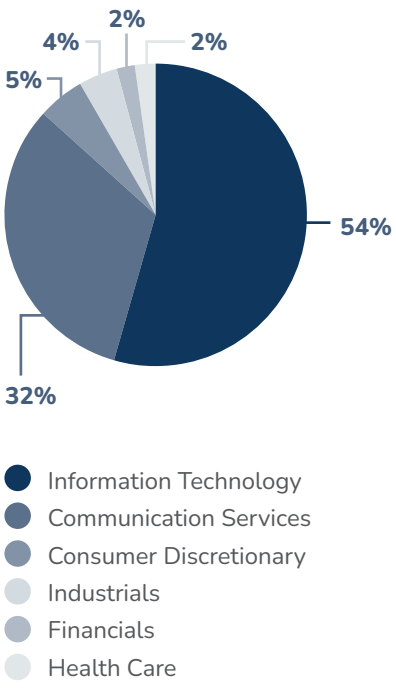
Sector Exposure by Region



Source: TSG, FactSet

Figure 11

GICS Sector Exposure of AI



Source: TSG, FactSet

An In-Depth Look at the Global AI Universe: The Advent of Peak AI?

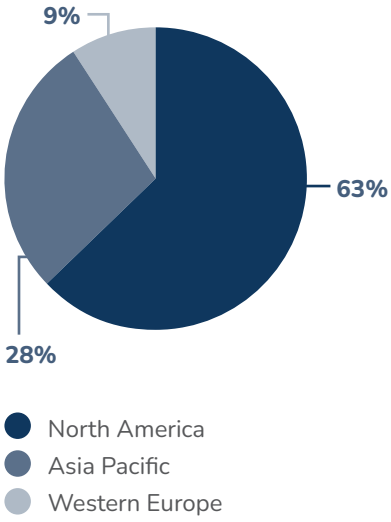
With AI being the largest contributor to date, we first take a closer look at the sector's characteristics and historical innovation trends that put it at the forefront of innovation. We then examine the next leg of the evolution of AI with the aim to evaluate currently leading business models for their capability to maintain or expand their relevance.

Looking at the **spread of AI revenues in terms of traditional industry sectors (GICS),** we see the majority of AI revenues in Information Technology (IT) (54%), Communication Services (32%), and Consumer Discretionary (5%), followed by the Industrials (4%), Financials (2%), and Health Care (2%) sectors.

Representing AI applications in the **IT** sector**, Microsoft** (MSFT US, SC: 70) obtained a leading position with its Azure cloud platform, which offers a variety of AI products and services including vision, speech, language, and decision-making AI solutions. In the **Communication Services** sector, **Alphabet** (GOOGL US, SC: 65) pioneered the application of AI in search and ads, and continues to evolve the technology to enhance user experience and revenues. AI is also engrained in **Meta Platform's** (FB US, SC: 100) business model, which over the past decade has been at the forefront of applying AI to personalize ads for individual users, using ML- and DL-based analytics on the company's social network and search data, and in its user interface design. Finally, in less than a decade, **Amazon** has come to dominate the **Consumer Discretionary** sector in North America,

Figure 12

Regional Exposure of AI



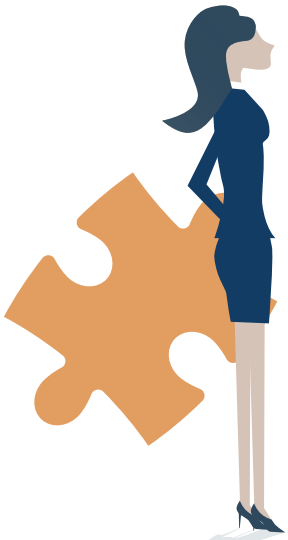
Source: TSG, FactSet

Australia, and large parts of Europe by relying on its AI platform to optimize customers' purchasing experience. Amazon soon commercialized its AI capabilities, offering them as solutions to customers of its AWS cloud computing platform. In all these examples, winning business models of some of the World's largest companies have been powered by the vast amounts of data they collect and own and by their innovations in AI that enabled them to accelerate their value generation.

Looking at regional allocation of value generated with AI, the dominance of US-based **Alphabet**, **Amazon, Microsoft** , and **Meta Platforms** is clearly reflected in **North America** accounting for 63% of global AI revenues. **Asia Pacific** takes second place with 28% of AI revenues, with the biggest players in our universe being consulting firms including **Tata Consultancy Services** (TCS NS, SC: 100), **Fujitsu** (6702 JT, SC: 70), and **NTT Data Corporation** (9613 JP, SC: 72).

Finally, **Western Europe** takes a much smaller share in the AI universe with 9% of total revenues. Europe's trailing position dates back to its lagging tech adoption in the internet and software technology wave in the early 2000s, during which US-based tech firms established a leading position in the ICT and software space. As digital technologies have spread and permeated non-tech sectors, Europe's relatively weak position carried over into the AI revolution. In addition, the EU's more comprehensive data legislation has made consumer data protection a key priority, whereas in comparison, the U.S. has had a lenient and piecemeal approach to data regulation, giving companies more leeway to collect and monetize consumer data.

A Shifting AI Innovation Landscape: From Discriminative AI to Generative AI



Looking back: Over the course of a decade, developments in AI have caused breakneck transformations across segments, reaching far beyond the tech industry. As AI has come to touch practically every possible business process, our expert consultations point toward a broader commoditization of ML and DL algorithms. A case in point concerns AI applications for personalizing the way users consume content and make purchasing decisions. Powered by large data pools on customer behaviors and preferences, **recommender algorithms** have not only given rise to new media and entertainment giants, but quickly made their way into practically any self-respecting retail and media platform. Donnacha Daly PhD, Singularity Think Tank expert and Head of the Artificial Intelligence and Machine Learning programme at the Lucerne University of Applied Sciences and Arts (HSLU), notes that **"If a user doesn't find good content on a subscription platform (e.g., Netflix) effectively, they leave the platform, and customer churn is a major cost."**

By enabling personalized content selection, recommender systems have thus played a critical role in companies' quest to engage and retain customers. Yet while companies such as **Netflix**, **Alphabet**, **Amazon**, and **Baidu** (9888 HK, SC: 71) have continued to make major strides in improving the core technology and accuracy of their recommender models over the past decade, standard recommender solutions have become widely available off the shelf, such that we consider the technology to be largely commoditized. **Recommender systems are not the drivers of exponential growth anymore, but a necessity to maintain a brands' status with**

Promising applications of Generative AI that are currently being developed include customized advertising, digital image and audio correction and editing, rapid prototyping for manufacturing, and data augmentation for robotics process automation.

consumers. Accordingly, the past rebalancing saw an exit from our exposure to the media download and streaming domain, where recommender systems had been a key revenue driver and core technological focus in our portfolios. As a result of this development, subscription video streaming service **Netflix** (NFLX US, SC: 0) and audio streaming platform **Spotify** (SPOT US, SC: 0) exited the Index in the last rebalancing with Singularity Scores at zero.

Looking forward: Underlying the commoditization of recommender algorithms we see a **broader shift from innovation in Discriminative AI to innovation in Generative AI**. Discriminative ML/DL algorithms aim to draw decision boundaries in data spaces and predict data labels (e.g., how likely is a person to default on a loan; should a job candidate be hired or not; how likely is a user to watch a certain movie) using classification or regression techniques. Although incremental improvements in Discriminative AI are likely to continue, technological improvements require large investments. Daly notes that ***"Not many companies can justify a spend of three to ten million dollars to train a large AI model – nor do they have to. Most use-cases allow for the reuse of open-source models trained by larger players such as Alphabet and OpenAI, which can be fine-tuned in-house with proprietary data (so-called transfer learning). For most companies, the value is in owning unique data and deploying it with the help of commoditized AI solutions."***

With Discriminative AI solutions becoming increasingly commoditized, our key focus is shifting toward innovations in **Generative AI.** Generative AI models have the ability to learn and understand the natural features and underlying patterns of data (e.g., categories and dimensions of text, audio files, or images) and use that to **create new similar content**. Examples range from DALL·E 2, a new AI system that can create realistic images and art from a description in natural language, and GPT-3, the third generation of AI research lab OpenAI's language prediction model, which uses a DL-based autoregressive language model to generate human-like text. The latter finds increasing adoption in a variety of tasks, including natural language understanding, machine translation, and the generation of news articles.

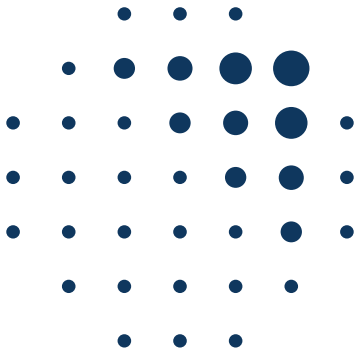
While potential applications are limitless, promising business applications that are currently being developed include **customized advertising, digital image and audio correction and editing, rapid prototyping for manufacturing, and data augmentation for robotics process automation**. Generative AI also stands to deliver better results on the unmet promises of chatbots as alternatives to human engagement in customer support. Current chatbots are retrieval-based, meaning that they select the best possible response in an interaction based on user input and a database of predefined responses. Using techniques such as keywords matching, ML, or DL to select optimal responses, chatbots are currently unable to generate new output, leading to problematic performance outcomes and disappointing user experiences. Alexander Stumpfegger, Singularity Think Tank expert and Head of Consulting at CID, observes that ***"Bots have underdelivered. You can't have a meaningful conversation with a bot because it's not true AI but a scripted Q&A. Natural Language Processing and Generation (NLP/NLG) can help bots sound more human but it won't change the content of their message so you can't really use them to resolve business problems."*** In the near future, however, such issues may belong to the past when chatbots using Generative AI – while currently still in developmental stages – will be better at generating new dialogue based on large amounts of conversational training data.

AI consulting sees continued growth: The progressing commoditization of Discriminative AI solutions notwithstanding, based on our expert interactions, we assess continued value generation beyond the technological development, and deployment of AI. In particular, **professional service providers supporting the implementation of AI products and services will continue to see growth by making established AI technologies come to life for their enterprise customers**. Companies across industry sectors continue to find themselves pressed into digital transformation to meet competitive pressures and customer demand. Worldwide spending on digital transformation is projected to rise from USD 1.8T in 2022 to USD 2.8T by 2025.[1] The COVID-19 pandemic was a clear accelerator for AI adoption in this trend. In the transition from non-digital to digital business processes and services, AI-powered hardware and software solutions tend to take center stage in investors' attention to cloud migration, tools for digital communication and collaboration, and intelligent business process automation. This development is likely to continue with the estimated expansion of the AI market, which according to some estimates is set to see a fourfold increase by 2030.[2] While hardware and software account for the lion's share of the AI market, IT services and consulting related AI revenues – which currently make up roughly a quarter of the AI pie – will continue to benefit considerably from increased spending on the integration of AI applications such as Computer Vision and Natural Language Processing into standard business processes.

Companies such as **Accenture** (ACN US, SC: 82), **NTT Data Corporation** (9613 JP, SC: 72), and **Cognizant Technology Solutions** (CTSH US, SC: 71) are core accelerators for adoption of AI solutions. These players have the talent, ability, and experience to help businesses outside of the technology sector understand the benefits of AI and integrate ML/DL solutions into business models to solve complex issues. For example, **NTT**'s consulting services help companies leverage AI and Intelligent Automation to accelerate business automation in IT processes from data centers to end users in both cloud and other applications. **Accenture**'s Accenture Labs is a technology research and development organization that deploys talent to work on the most complex challenges, aiming to improve the way businesses operate by helping them become more efficient and effective. Its client-facing Applied Intelligence service enables the company's data and applied intelligence capabilities, to help enterprises scale AI adoption. Finally, **Cognizant Technology Solutions**, another major global consulting firm, commercialized "LEAF" (Learning Evolutionary AI Framework) – an ML framework that uses evolutionary algorithms, DL, and distributed computation technology to discover optimal strategies for business decision-making, to tackle complex problems, and to identify new growth areas.

Together with our Think Tank experts, we continue to monitor these technological developments in our Singularity Sectors and their implications for our portfolios.

1. Source: IDC; Statista
2. Source: Grand View Research



+41 43 558 71 79
www.singularity-group.com
@thesingularitygroup
@JoinSingularity
@thesingularitygroup

The Singularity group