Software

Year Ahead 2024: AI, Consolidation, Cloud

Price Objective Change

05 January 2024

Equity
Americas
Server & Enterprise Software

Positive setup for software but too soon to be a blind bull

The BofA Global Research US Economics team forecasts a soft landing and rate cuts beginning in Mar'24, which may provide a positive catalyst for the high-growth software sector, but software is not inexpensive after jumping 58% in 2023 and it's likely too soon to be a blind bull while we remain in the early-Recovery phase of the business cycle. However, we remain positive on the sector due to secular tailwinds from the newest AI wave, improving IT spending and the continued shift to the Cloud. We expect mid-teen revenue growth, improving margins, multiple reversion and positive revisions to offset cyclical headwinds in 1H24 before driving a stronger 2H24.

6 Key trends for 2024 and 3 secular themes

Six key '24 trends: 1) AI products and use cases that provide quantifiable operational efficiencies and new revenue streams; 2) AI spending may cannibalize "nice-to-have" projects as IT spending remains constrained; 3) Increasing focus on CRM applications; 4) DevSecOps productivity acceleration due to proliferation of low/no-code applications; 5) Vertical software consolidation; and 6) Continued adoption of tokenized assets.

Three secular themes: 1) AI features become an integral component for all software solutions; 2) Vendor consolidation as enterprise wallets remain constrained and functional benefits of platform solutions become apparent; and 3) Sustained Cloud migration with revenue growth acceleration potential as optimization headwinds ease.

Highlighting top Buys & stocks to watch

We expect diverging subsector performance with the potential for undervalued names within favorable subsectors, such as CRM and Infrastructure, to produce positive returns. See Coverage Summary for PO and rating changes.

Buys: 1) **CRM** – Enduring mid-teen revenue growth and margin expansion from sales productivity efforts; 2) **HUBS** – Easing macro pressure likely to result in meaningful revenue reacceleration for the SMB CRM leader; 3) **MSFT** – AI expected to drive incremental growth in core Azure and Office franchises, ongoing margin/FCF growth from scale; 4) **NOW** – Best-in-class growth likely to move higher with AI and ongoing consolidation of the large IT & custom apps markets; 5) **GTLB** – DevSecOps consolidator, AI monetization, 25%+ revenue growth, expanding margins potential; and 6) **U** – Estimate upside, improving industry trends, compelling valuation.

Stocks to Watch: 1) **ORCL** – Reliance on cloud migrations and data center investment poses risk to growth and margin targets; and 2) **TWLO** – Bull thesis of accelerating revenue challenging, secular headwinds, expensive.

Alkesh Shah
Research Analyst
BofAS
+1 646 855 1556
alkesh.shah@bofa.com

Brad Sills
Research Analyst
BofAS
+1 415 676 3531
brad.sills@bofa.com

Koji Ikeda, CFA
Research Analyst
BofAS
+1 415 913 2106
koji.ikeda@bofa.com

Michael J. Funk
Research Analyst
BofAS
+1 646 855 5664
michael.j.funk@bofa.com

Adam Bergere
Research Analyst
BofAS
+1 415 279 8591
adam.bergere@bofa.com

Andrew Moss
Research Analyst
BofAS
+1 646 743 2178
andrew.moss@bofa.com

Natalie Howe
Research Analyst
BofAS
+1 415 436 1103
natalie.howe@bofa.com

Matt Bullock
Research Analyst
BofAS
+1 646 556 2903
matthew.bullock2@bofa.com

Carly Liu
Research Analyst
BofAS
+1 415 298 7319
carly.liu@bofa.com

George McGreehan
Research Analyst
BofAS
+1 415 913 4315
george.mcgreehan@bofa.com

Refer to important disclosures on page 118 to 121. Analyst Certification on page 116. Price Objective Basis/Risk on page 102.
12641603

Timestamp: 05 January 2024 05:24AM EST

Contents

Key '24 Themes: AI, Consolidation & Cloud

Goldilocks scenario drives soft landing potential

Shifting expectations

Peak macro uncertainty in '22, driven by higher-than-expected inflation, rising rates and increased recession risk, led to expectations of a hard landing in '23. However, much has changed over the last 12 months. Our colleagues note the potential for a goldilocks scenario and anticipate a soft landing following decelerating inflation and a dovish Fed pivot that could deliver four 25bp rate cuts beginning in Mar'24. Of the 219 investors who responded to BofA Research's Fund Manager Survey in Dec'23, only 9% expect the Fed to hike rates further.

Rising focus on software – growth inflection stories and new ideas

During the first half of '23, new deals were slower to close, consumer and small and midsize business (SMB) spending was mixed and enterprise spending was constrained. As a result, some software companies experienced slowing growth, while others shifted focus from growth to efficiency and productivity. However, software valuations increased following '22 weakness as investors looked through near-term macro headwinds (Exhibit 1). Our client conversations in '23 indicated rising focus on the software sector as investors searched for growth inflection stories and new ideas beyond the Magnificent 7 (Mag 7), a trend we expect to continue.[1]

Exhibit 1: Too soon to be a blind software bull in '24 following strong '23 performance
Software (S5SOFT) performance relative to the S&P (SPX) and Nasdaq (CCMP)

	Performance		
Year	S&P Software	S&P	Nasdaq
2023	58%	24%	43%
2022	-30%	-19%	-33%
2021	41%	27%	21%
2020	44%	16%	44%
2019	46%	29%	35%
2018	16%	-6%	-4%
2017	39%	19%	28%
2016	9%	10%	8%

Source: BofA Global Research, Bloomberg
As of 1/1/24. S&P Software measures the performance of the S&P 500 Software Industry GICS3 Index (S5SOFT).
BofA GLOBAL RESEARCH

Where are we today (and what can we expect in '24)?

2024 outlook – upside risk for undervalued names but balanced on sector overall

We are balanced on the software sector overall for '24, particularly in 1H24, given cyclical headwinds and strong '23 performance, but expect diverging performance across software subsectors with the potential for undervalued names within subsectors we view favorably to produce positive returns (Exhibit 2).

See Our Industry Positioning for 2024 for Top Pick deep dives and see Coverage Summary for a list of covered companies categorized by subsector.

Although we are balanced on the software sector overall in '24, we expect decelerating headwinds to produce mixed performance in 1H24 before tailwinds accelerate in 2H24 that shift performance positively. We also see the potential for AI beneficiaries and Software-as-a-Service (SaaS) companies with growing market shares to outperform and offset lower, although potentially accelerating, spending on "nice-to-have" software. Our view is that cyclical headwinds could pressure software returns broadly over the next year, particularly in 1H24. However, secular tailwinds, specifically multiple reversion toward long-term (5- and 10-year) medians, as well as AI optimism, driven by product

[1] *Magnificent 7 (Mag 7) refers to Apple (AAPL), Amazon (AMZN), Alphabet (GOOG), NVIDIA (NVDA), Meta (META), Microsoft (MSFT) and Tesla (TSLA). At the end of '23, Mag 7 names represented 29% of the S&P's market cap and Mag 7 performance was responsible for 64% of the S&P's gains.*

launches and articulated monetization strategies, could drive idiosyncratic upside risk for select stocks.

Exhibit 2: We are bullish on the CRM and Infrastructure subsectors
Server & Enterprise Software Coverage Matrix

	Coverage Universe						
	Communications	CRM	Design	ERP & Back Office	HCM	Infrastructure	Vertical
	Mixed	*Bullish*	*Cautious*	*Mixed*	*Mixed*	*Bullish*	*Mixed*
Top Buys	NICE RNG	CRM HUBS	U	BILL	WDAY	GTLB MDB MSFT NOW	CCCS
Top Underperforms	TWLO	–	–	AVDX BL	–	EVBG	ENFN

Source: BofA Global Research

BofA GLOBAL RESEARCH

Macro: Business Cycle & Rates

Early-Recovery Phase – too soon to be a blind bull

US Software – secular tailwinds, cyclical headwinds

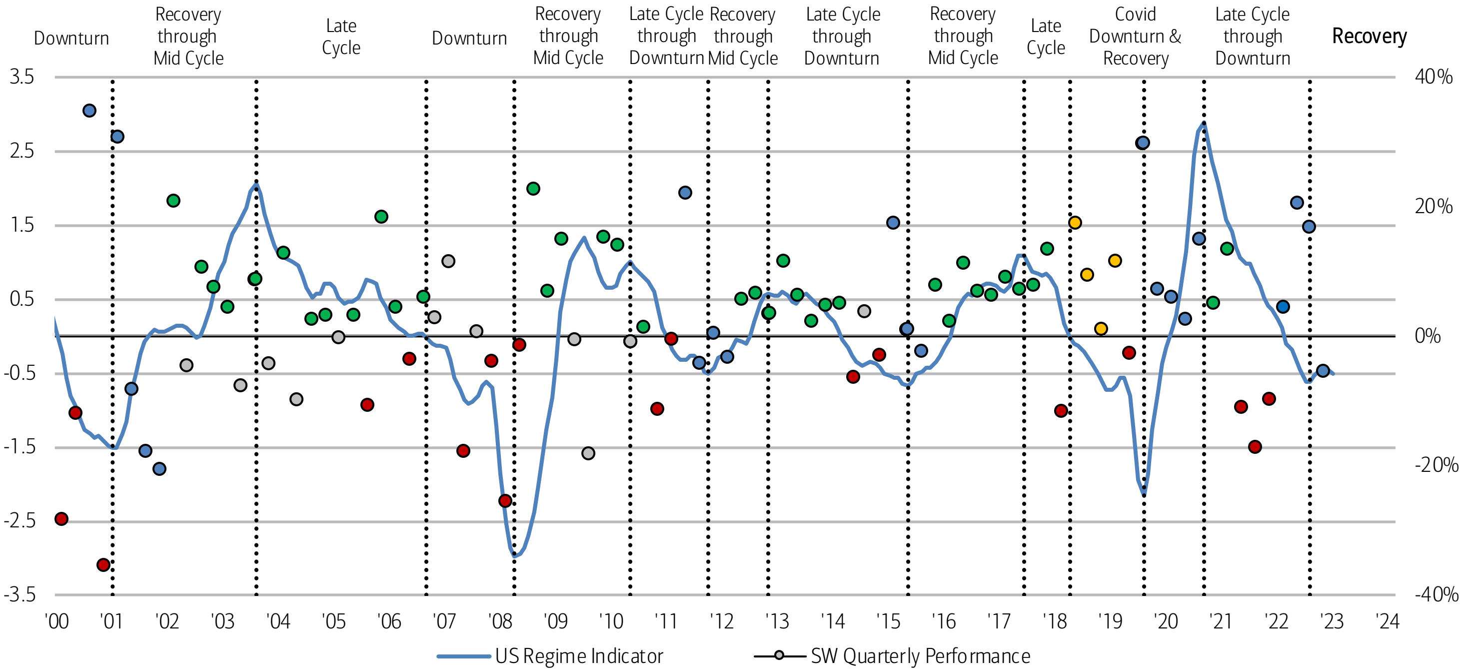
We expect secular tailwinds to drive software company performance over the long term, but see the potential for shorter-term cyclical headwinds to pressure software company performance in 1H24. The US economy entered the Recovery phase of the business cycle in Jun'23, but our view is that it's likely too early in the economic recovery to be a blind bull. Although we expect undervalued software names within select subsectors to deliver positive performance in the year ahead, it's likely several quarters too soon to expect the software sector to broadly deliver positive returns.

Downturn head fakes and early-Recovery weakness

Software has historically produced positive returns during the late-Recovery, Mid-Cycle and early-Late Cycle phases (green dots – see Exhibit 3) of the US business cycle following an inflection in economic activity, but early-Recovery returns, which is where we are now, have been less impressive. Software performance has repeatedly produced 1-2 quarters of strong returns (20%+) during the late-Downturn phase (head fakes) followed by 1-3 quarters of negative returns during the early-Recovery phase (blue dots).

Note that we exclude the post-Global Financial Crisis (GFC) Recovery phase from our analysis. We also exclude the Covid Downturn (yellow dots) and Recovery phases from our analysis, given atypical software demand driven by relatively unconstrained enterprise hardware and software budgets as the labor force shifted to work-from-home.

Exhibit 3: Software has historically produced positive returns in the late-Recovery and Mid-Cycle phases of the US business cycle
Software (S5SOFT) quarterly performance (RHS) relative to our proprietary US Regime Indicator (LHS)

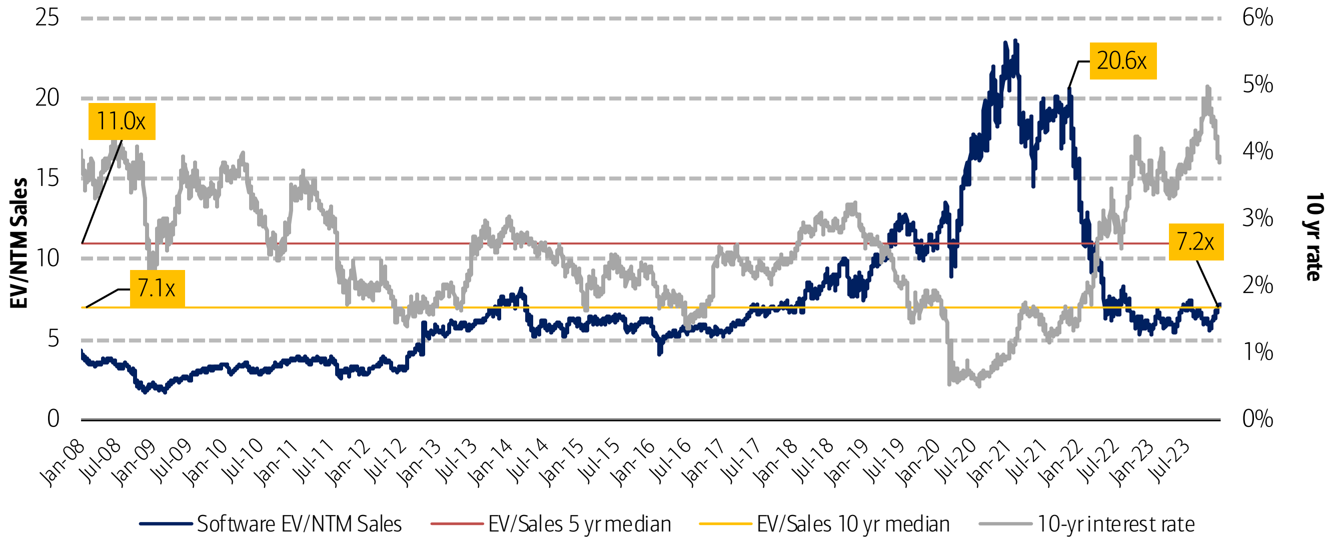


Source: BofA Global Research, BofA US Equity & Quant Strategy, Refinitiv, ICE Data Indices, Institute for Supply Management, Bureau of Labor Statistics, Federal Research, Bloomberg
LHS = Left-hand side. RHS = Right-hand side.
Note that green/red dots indicate positive/negative performance. Blue dots illustrate historic Software performance during transitions from Downturn to Recovery phases and yellow dots illustrate Software performance during the Covid-induced Downturn phase. The LHS y-axis indicates economic expansion/contraction when above/below 0.
Disclaimer: The US Regime Indicator is based on eight inputs (see appendix). The Indicator is intended to be an indicative metric only and may not be used for reference purposes or as a measure of performance for any financial instrument or contract., or otherwise be relied upon by third parties for any other purpose, without the written consent of BofA Global Research. The Indicator was not created to act as a benchmark.
BofA GLOBAL RESEARCH

Where are we now and where might we be headed?

Following two quarters of 20%+ returns (head fakes) during the late-Downturn period, the US business cycle entered Recovery in Jun'23. Consistent with software performance during prior early-Recovery phases, 3Q23 returns were negative. Our view is that cyclical headwinds could pressure software returns broadly over the next several quarters, especially if economic activity decelerates. However, secular tailwinds, specifically multiple reversion toward the 5- and 10-year medians and AI optimism, could drive idiosyncratic upside risk for select stocks (Exhibit 4). See our most recent weekly comps report for additional metrics and analysis.

Exhibit 4: EV/NTM Sales multiple remains below the 5- and 10-yr medians despite expectations of normalizing rates
EV/NTM Sales versus 10-year interest rate



Source: BofA Global Research estimates, Bloomberg
*Constituents: BofA Software coverage. As of 12/25/23.

BofA GLOBAL RESEARCH

Key Investment Risks

Macro

IT spending slowed in 1H23 as expectations of a slowing economy increased and sentiment shifted negatively, but sentiment is rebounding as expectations reset. However, any economic indicator that suggests a goldilocks scenario and resulting soft landing are unlikely to occur could push the economy backwards toward a Downturn, rather than forward toward mid-Recovery.

Rates

Start-ups, SMBs and enterprises provided tailwinds to software company growth during the pandemic as the labor force shifted to work-from-home, driving atypical software demand due to relatively unconstrained enterprise hardware and software budgets. However, higher rates and less funding availability likely pressured companies, specifically start-ups, driving a renewed focus on cost cutting. Falling rates should drive tailwinds for software companies, but any shift in expectations that the Fed may need to resume the hiking cycle would likely produce headwinds as companies shift back to an even larger focus on efficiencies.

AI

AI may add risk to some companies as certain “nice-to-have” projects are delayed due to the costs of developing, testing and deploying AI solutions, specifically specialized solutions that require extensive model fine-tuning. Some AI projects may also require high initial investment before benefits are realized over the longer term. We also note AI regulatory risks and legal risks that could drive AI development costs higher and pressure AI product margins, which we expect to become increasingly in focus as companies in our coverage universe clarify monetization strategies.

AI: Disruption ≠ Revenue (yet)

Does disruption drive revenue?

Economic and corporate AI implications – a potential disconnect

Companies integrated AI into processes and products over the last few decades, but our view is that AI's newest wave represents a paradigm shift in corporate efficiency and productivity in line with past disruptive technologies like the personal computer and internet. The newest foundation models and AI applications may transform the economy as corporates implement tools into their processes that drive permanent operational efficiency and productivity gains, but significant economic implications do not necessarily indicate top- and bottom-line growth for the Pick & Shovel companies producing the AI products that enable transformation to occur.

AI-driven disruption – faster than many may expect

Past disruptive technologies have historically reached mainstream adoption after 15-30 years, but AI-driven efficiencies and incremental revenue may appear across sectors globally as soon as the next 3-5 years, a faster pace than many may expect. The newest foundation models are immature and applications are only just beginning to emerge, but corporate AI implementation could boost S&P operating margins by 250bps, equivalent to ~$65bn in cost savings, over the next five years.

A significant number of companies within our coverage universe are rapidly developing AI products, many of which have already entered production. We expect corporate adoption to progress rapidly as initial implementation strategies focused on operational efficiency and revenue enhancement ultimately drive business transformation.

> "Software is eating the world, but AI is going to eat software."
>
> – Jensen Huang, Nvidia founder and CEO, May'17

Focus: AI product adoption to AI product monetization

It's difficult to overstate how transformative the AI applications that have only just emerged could be, as well as the thousands that have yet to be created. The list of companies leveraging AI applications to drive efficiencies and increased productivity is expansive and touches firms across every sector globally. We expect software companies to increase AI investments significantly in the year ahead (Exhibit 5), although it remains unclear whether the newest wave of AI products will produce the next leg of software revenue growth, enable companies to defend their market shares or a mix of both (Exhibit 6).

Among our software coverage, almost all are developing AI products; however, very few have articulated monetization strategies. Some of our covered companies are likely to produce AI products to defend their market shares, but we expect many more to articulate AI product monetization strategies in '24 as focus on adoption shifts to monetization. We already have, or will have in the near term, the option of AI-embedded products from Adobe, Alphabet, Amazon, Booking, Expedia, HubSpot, Meta, Microsoft, Palantir, Pinterest, Salesforce, ServiceNow, Uber and Workday, but it's easy to forget that the newest AI applications emerged largely within the last 12 months and remain early in development.

Exhibit 5: Tech industry groups lead in AI investment

Past investment in AI as a percentage of revenue

Industry Group	AI Investment as % of Rev
Semis	6.2%
Tech Hardware & Equip	4.5%
Software	3.7%
Banks	2.5%
Food & Bev	2.5%
Pharma, Biotech & Life Sci	2.5%
Financial Svcs	2.5%
REITs	2.5%
Media & Ent	2.5%
Autos	2.4%
Insurance	2.4%
Health Care Equip & Svcs	2.4%
Commercial Svcs	2.4%
Cons. Discr. Dist & Retail	2.3%
Capital Goods	2.1%
Household Products	2.0%
Energy	2.0%
Materials	1.7%
Telecom	1.4%
Cons. Services	1.4%
Cons. Staples Dist & Retail	0.6%
Transportation	0.5%
Cons. Durables	0.5%
Real Estate	0.3%
Utilities	0.0%

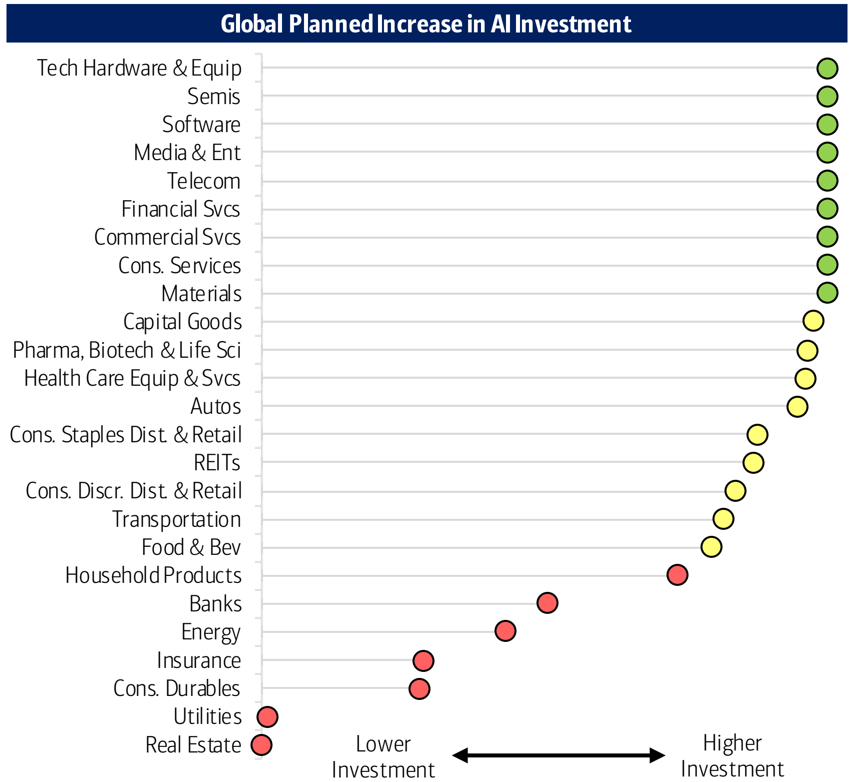
Source: BofA Global Research

Green/red shading indicates the top/bottom 25% of industry groups by past investment as a percent of revenue. Results are based on survey responses.

BofA GLOBAL RESEARCH

Exhibit 6: Tech industry groups also lead in future AI investment

Industry group intentions for future AI investment are skewed toward "higher"



Source: BofA Global Research

Green/red shading indicates the top/bottom 25% of industry groups by planned increase in AI investment. Results based on survey responses.

BofA GLOBAL RESEARCH

Will AI drive software revenue growth acceleration in '24? Unlikely

ChatGPT reached 100mn users in record time and AI applications have produced as many images in just one year as all of humanity's photographers have produced in 150 years. However, the companies producing the AI tools that enabled these feats have yet to see a proportional boost in revenue. We do not expect AI products to drive significant incremental revenue among our covered companies in the year ahead (Exhibit 7) and see the potential for AI-driven revenue to fall below expectations over the next five years (Exhibit 8).

It's only the beginning

Our view is that select companies with monetizable AI products in production may begin to generate incremental revenue in the year ahead, potentially cannibalizing corporate spending on "nice-to-have" software. Although corporate spending for some software segments may decelerate in the short term as focus shifts to AI initiatives, we expect many of the companies developing AI products and features to produce revenue over the longer term that offsets revenue lost due to AI dilution. The newest AI wave is most likely to be net revenue additive for companies that develop substantive AI products and features that leverage large data sets and are sold through formidable sales channels.

See AI: A Notable Spending Priority for corporate spending expectations from our Dec'23 IT Spending Survey.

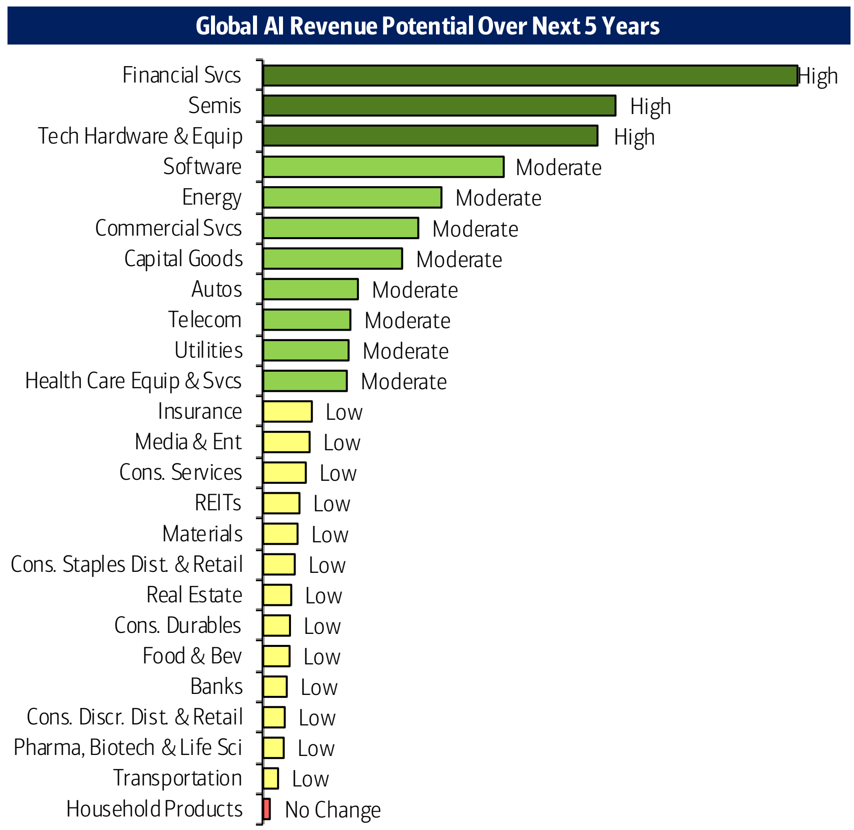
Exhibit 7: Only Semis (6%), Cap Goods (6%) and Software (4%) derive a significant % of rev from AI
Corporate revenue derived from AI products as a % of revenue

Industry Group	% Revenue from AI
Semis	Moderate
Capital Goods	Moderate
Software	Low-to-Moderate
Health Care Equip & Svcs	Low
Tech Hardware & Equip	Low
Household Products	Low
Materials	Low
REITs	Low
Banks	Low
Commercial Svcs	Low
Cons. Durables	Low
Cons. Services	Low
Energy	Low
Food & Bev	Low
Cons. Staples Dist & Retail	Low
Media & Ent	Low
Pharma, Biotech & Life Sci	Low
Real Estate	Low
Telecom	Low
Transportation	Low
Utilities	Low
Autos	Low
Financial Svcs	Low
Cons. Discr. Dist & Retail	Low
Insurance	Low

Source: BofA Global Research
Moderate = 6-20% of revenue from AI, Low = 0-5% of revenue from AI. Results are based on survey responses.

BofA GLOBAL RESEARCH

Exhibit 8: AI-driven revenue may increase significantly for some industry groups
High / Moderate / Low Increase = +21-50% / +6-20% / +1-5%



Source: BofA Global Research. Results are based on survey responses.

BofA GLOBAL RESEARCH

Expectations are sometimes all that's needed (see: Magnificent 7)

We view AI's newest wave as largely responsible for powering the Mag 7 rally in '23, but Mag 7 performance, excluding Nvidia, was largely driven by AI expectations, rather than quantifiable financial implications.[2] For example, AI expectations partially drove performance for Alphabet and Amazon, which made significant AI investments, but have yet to generate significant revenue from those investments. We expect concentrated Mag 7 performance to broaden in the year ahead, producing a stock-pickers market in which undervalued software stocks could outperform, but also see the potential for AI product launches to drive a positive shift in sentiment, resulting in positive software performance earlier in the Recovery phase than has occurred historically.

> "AI will probably most likely lead to the end of the world, but in the meantime, there'll be great companies."
>
> – Sam Altman, OpenAI co-founder and CEO, Jun'15

Show me the money – AI software market expected to reach $944bn by '27

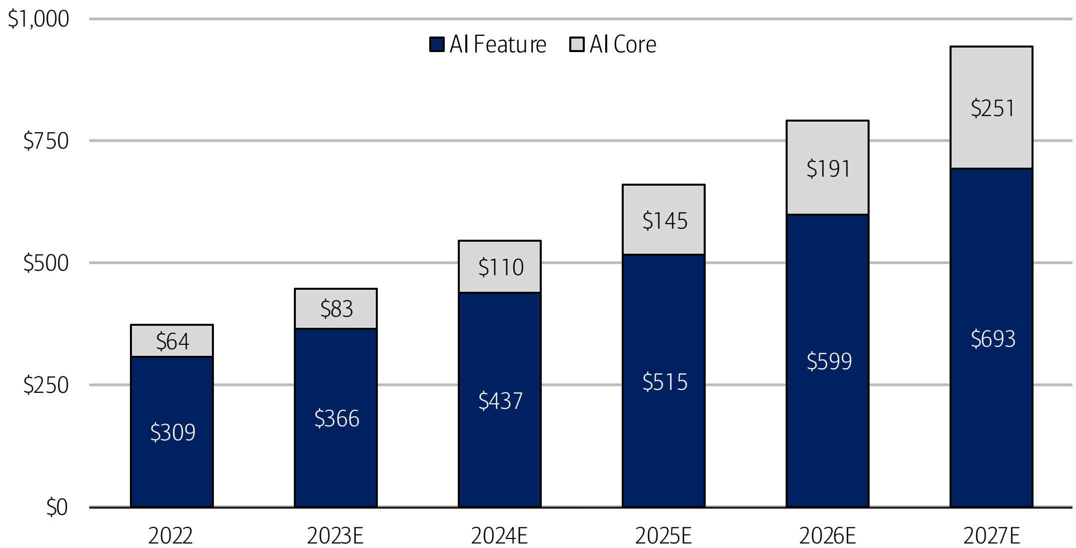
The global AI software revenue opportunity is projected to reach $944bn by 2027, +153% vs 2022, according to IDC (Exhibit 9). AI Core software revenue is expected to reach $251bn by 2027 at a CAGR of 31.4% and AI Feature software revenue is expected to reach $693bn by 2027 at a CAGR of 17.6%, indicating that AI Feature software

[2] *Nvidia has generated incremental revenue from sales of next-generation GPUs optimized for AI use cases.*

revenue is likely to accelerate at a slower pace than AI Core software revenue, but ultimately result in a significantly larger market in absolute terms.[3] We note that AI products developed by our covered companies largely fall in the AI Feature category. For example, Microsoft Copilot embeds AI features into already existing products that would continue to function even if AI features were removed.

Our view is that monetization of AI products will likely occur gradually and the economic implications from AI may be larger than corporate revenue implications in the near term. However, we expect many of our covered companies with AI products in development or production to generate meaningful incremental revenue over the intermediate term, particularly for companies with large proprietary data sets and robust sales channels.

Exhibit 9: The AI software market is expected to grow to $944bn by 2027, +153% vs 2022
Global AI software revenues ($bn) from 2022-2027E



Source: BofA Global Research, IDC
AI Feature software includes software product offerings that were already developed and in production before AI features were embedded. AI Feature software would continue to function even if AI capabilities were removed. AI Core software includes software product offerings that were developed with AI features as the core component of functionality. AI Core software would not continue to function if AI capabilities were removed.
BofA GLOBAL RESEARCH

Our Proprietary AI Framework

Refreshing our recently launched AI framework

We refresh our proprietary AI framework to incorporate new learnings, updated data and scores for stocks not covered when we launched our framework in May'23.[4] We recommend that investors leverage our proprietary AI framework as a tool to generate investment ideas and to identify both consensus and non-consensus AI beneficiaries within our coverage universe.

Our framework is not intended to be comprehensive in nature or to represent definitive views on companies likely to be AI beneficiaries. Our framework is not intended either to reflect views on timing, including when AI-driven tailwinds or headwinds are likely to be reflected in stock prices.

[3] *AI Feature software includes software product offerings that were already developed and in production before AI features were embedded. AI Feature software would continue to function even if AI capabilities were removed. AI Core software includes software product offerings that were developed with AI features as the core component of functionality. AI Core software would not continue to function if AI capabilities were removed.*

[4] *Scores for stocks not covered when we launched our proprietary AI framework in May'23 include MongoDB (MDB), PagerDuty (PD), Paycom (PAYC), Paylocity (PCTY) and Snowflake (SNOW).*

AI framework methodology

Categorizing our covered companies – 13 "yes" or "no" questions posed

Our framework methodology poses 13 "yes" or "no" questions for companies within our coverage universe and categorizes our covered companies into three tiers based on answers to these 13 questions. The 13 questions are intended to gauge the potential for our covered companies to capture AI-driven tailwinds or to experience AI-driven headwinds over the next 12 months. Companies can receive a maximum of 9 points, indicating the highest potential for AI-driven tailwinds, and a minimum of -4 points, indicating the highest potential for AI-driven headwinds.

Categorizing our covered companies – 3 tiers

We categorize companies that receive 5+ points in Tier 1, companies that receive +2 to +4 points in Tier 2 and companies that receive -4 to +1 points in Tier 3. Companies receive 1 point for each "positive" question posed where the answer is "yes," based on our analysis, and 0 points for each "positive" question posed where the answer is "no." Similarly, companies receive -1 point for each "negative" question posed where the answer is "yes," based on our analysis, and 0 points for each "negative question posed where the answer is "no."

9 "positive" questions and 4 "negative" questions posed

We list the 13 questions used for our AI framework below in Exhibit 10.

Exhibit 10: A list of the 13 questions used to produce scores from our proprietary AI framework
The 13 questions include 9 "positive" questions and 4 "negative" questions

Positive Questions
Q1: Does the company possess a market-leading historical dataset in one or more of the industries in which it operates?
Q2: Does the company have a market-leading install base in one or more of the industries in which it operates?
Q3: Does the company have international reach?
Q4: Does the company have a multi-faceted AI monetization opportunity?
Q5: Does the company have an expected $1bn+ AI R&D budget over the next 12 months?
Q6: Does the company offer market-leading AI solutions for specific verticals?
Q7: Does the company have current AI offerings or an announced AI roadmap that enhances its ability to expand pipelines at top-of-funnel with freemium versions?
Q8: Does the company have AI offerings that include use cases or end-users with more stringent compliance requirements?
Q9: Does the company have a robust sales channel?
Negative Questions
Q1: Does the company include a user base for which a significant percentage are consumers?
Q2: Is the company more likely to have disintermediated data relative to peers due to a history of M&A?
Q3: Does the company have AI offerings that facilitate transactions (as opposed to workflows)?
Q4: Do AI-powered products have the potential to produce headwinds for the company's TAM?

Source: BofA Global Research
For Question 4 under Negative Questions, TAM includes seat count compressive and/or pricing power deteriorations

BofA GLOBAL RESEARCH

Applying our AI framework – key takeaways

Infrastructure, Vertical, Design – highest tiered by count and percentage

Our analysis indicates that AI beneficiaries likely exist across the software subsectors for which we categorize our coverage universe. However, some subsectors are more likely to include beneficiaries than others. For example, when applying our AI framework to our coverage universe, the Infrastructure and Vertical subsectors have the largest number of covered companies in Tier 1, but the Design subsector has the largest percentage of covered companies in Tier 1.

Infrastructure & CRM incl. the 5 covered companies that screen most favorably

Covered companies that screen most favorably include Microsoft (Infrastructure), Oracle (Infrastructure), MongoDB (Infrastructure), HubSpot (CRM) and Salesforce CRM), all of which are within the Infrastructure and CRM subsectors (Exhibit 11 & Exhibit 12). However, the 23 companies that we cover and include in Tier 1, representing 38% of our coverage universe, are also distributed across the Vertical, Design and HCM subsectors. The Collaboration, Communication and ERP & Back Office subsectors do not include any covered companies in Tier 1.

Exhibit 11: Infrastructure and Vertical subsectors include the highest number of companies in Tier 1
Tiering results from our proprietary AI framework

	Tier Count				Tier Percentage		
Subsector	**Tier 1**	**Tier 2**	**Tier 3**	**Total**	**Tier 1**	**Tier 2**	**Tier 3**
Collaboration	0	0	1	1	0%	0%	100%
Communication	0	3	3	6	0%	50%	50%
CRM	3	2	4	9	33%	22%	44%
Design	3	1	0	4	75%	25%	0%
ERP & Back Office	0	5	2	7	0%	71%	29%
HCM	1	1	1	3	33%	33%	33%
Infrastructure	11	7	1	19	58%	37%	5%
Security	0	0	1	1	0%	0%	100%
Vertical	5	2	3	10	50%	20%	30%
Total	**23**	**21**	**16**	**60**	**38%**	**35%**	**27%**

Source: BofA Global Research

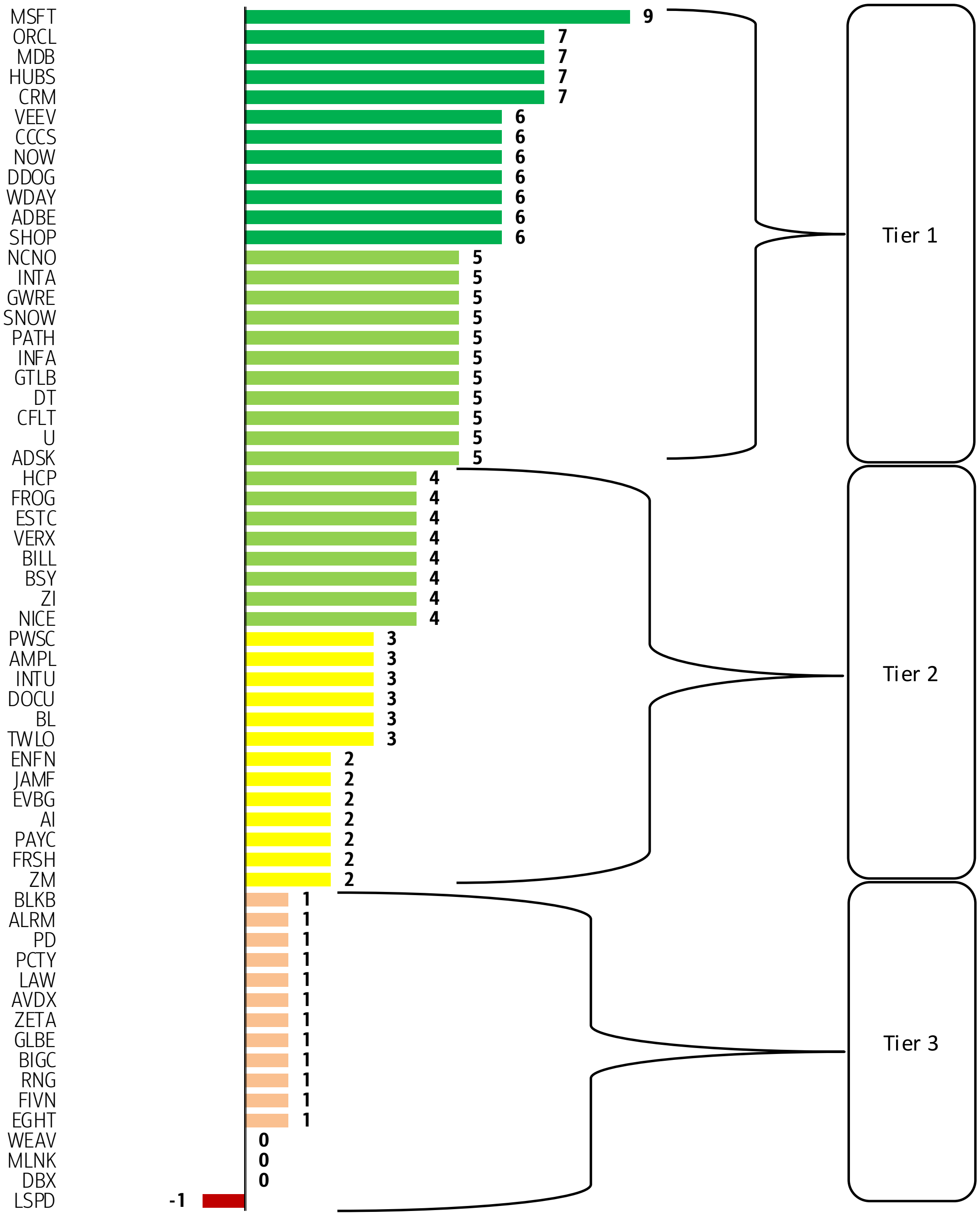
BofA GLOBAL RESEARCH

Coverage universe scores by subsector

See Exhibit 74-Exhibit 80 in the Proprietary AI Framework Continued section of the appendix for covered company scores by subsector. Note that we do not include standalone exhibits for Collaboration and Security due to the limited number of companies that we cover within both subsectors.

Exhibit 12: MSFT and LSPD screen most/least favorably within our coverage universe

Leveraging our AI framework to produce scores and tiers for our coverage universe



Source: BofA Global Research

This screen is not a recommended list either individually or as a group of stocks. Investors should consider the fundamentals of the companies and their own individual circumstances/objectives before making any investment decisions. This screen is intended to be an indicative metric only and may not be used for reference purposes or as a measure of performance for any financial instrument or contract, or otherwise relied upon by third parties for any other purpose, without the prior written consent of BofA Global Research. The screen was not created to act as a benchmark.

BofA GLOBAL RESEARCH

Spending: SMB & Enterprise

Corporate spend expectations – constrained but improving

We analyze management commentary from within our coverage universe and the results of our IT Spending Survey, conducted in Dec'23, to produce budget expectations for the year ahead. Our view is that IT budgets will likely remain constrained in 1H24 before reaccelerating in 2H24. Management commentary post-3Q23 earnings indicates a shift from the overwhelmingly bearish macro sentiment that we've heard since early 2022 to a more balanced macro sentiment. However, software vendors that service large enterprises noted that 3Q23 upside was largely driven by early renewals and deals to add new offerings, instead of new customer signings, and software vendors that service SMBs noted that macro pressures remain.[5]

Our IT Spending Survey indicates that overall spending is expected to grow 8.7% in 2024, a decline from the 9.0% expected increase in 2024 from our Jun'23 survey, but an increase from the 7.9% expected increase in 2024 from our 2023 survey. Our view is that spending expectations from our survey indicate that budgets may improve in the year ahead but will likely continue to remain constrained. We expect continued macro uncertainty and resulting SMB spending deceleration to produce near-term growth headwinds for some of our coverage. However, a shift in focus from rate hikes to cuts, a bullish shift in equity sentiment and new AI revenue streams – 21% of '24 budgets likely allocated to AI projects – could drive upside risk to intermediate-term expectations.

Mgmt macro commentary – read-throughs for spending

Sentiment – from bearish to balanced (but not quite bullish)

Post-3Q23 earnings, management commentary from within our coverage universe suggested a more balanced macro sentiment, a shift from the overwhelmingly bearish macro sentiment that we've heard since early 2022 (Exhibit 13).

Enterprise & Cloud – green shoots forming for improved software spend

On the positive side, we are encouraged by commentary indicating better-than-expected bookings/backlog growth from enterprise application giants, such as Salesforce (CRM), ServiceNow (NOW) and Workday (WDAY). Much of the upside originated from early renewals and as customers signed coterminous deals to add new offerings, some of which were AI-related. We view this emerging trend as a leading indicator that software spending is likely to reaccelerate, further supported by the BofA Global Economics team's expectation that the Fed will begin cutting rates in 1Q24 (Exhibit 14).

We also note positive commentary on stabilization of workload optimization and consumption from cloud consumption vendors, such as Microsoft Azure (MSFT), Amazon AWS (AMZN, covered by Justin Post), Snowflake (SNOW), MongoDB (MDB) and Datadog (DDOG). The stabilization trend has been unchanged since Microsoft noted easier comparisons beginning in Q2CY23 across the public cloud landscape, but results have not suggested that new workload migration has picked up meaningfully. However, we view signs of improving enterprise application spend as a potential leading indicator for improving consumption across the software landscape.

Macro headwinds have not fully shifted to tailwinds…

On the negative side, management from software vendors that service SMBs, such as HubSpot (HUBS) and BILL (BILL), indicated that macro pressures remain as elevated interest rates and tighter credit conditions continue to pressure SMB spending, which impacted variable priced offerings. For example, HubSpot customers downsized spend on unused seats for Sales Hub subscriptions, marketing contacts for Marketing Hub and the number of domains for CMS Hub.[6] Both BILL and Intuit (INTU) saw increased

[5] *Small and midsize businesses (SMBs), generally defined as businesses with fewer than 1,000 full-time employees, represent approximately half of all US employment and approximately half of all US technology spending, according to McKinsey.*

[6] *CMS = Content Management System*

pressure on SMB total payment volumes (TPVs), but macro headwinds have not yet impacted gross retention for software vendors that service SMBs as is typically the case during a downturn.

...and continue to pressure pandemic beneficiaries

Spending rationalization and budget scrutiny continue to impact pandemic beneficiaries, such as ZoomInfo (ZI), DocuSign (DOCU) and Zoom (ZM). Macro headwinds appeared to be more sustained within the Vertical subsector, which includes names such as Autodesk (ADSK) and nCino (NCNO), relative to others, given outsized exposure to more cyclical end-industries like construction and banking.

Exhibit 13: Management commentary on macro has become more balanced

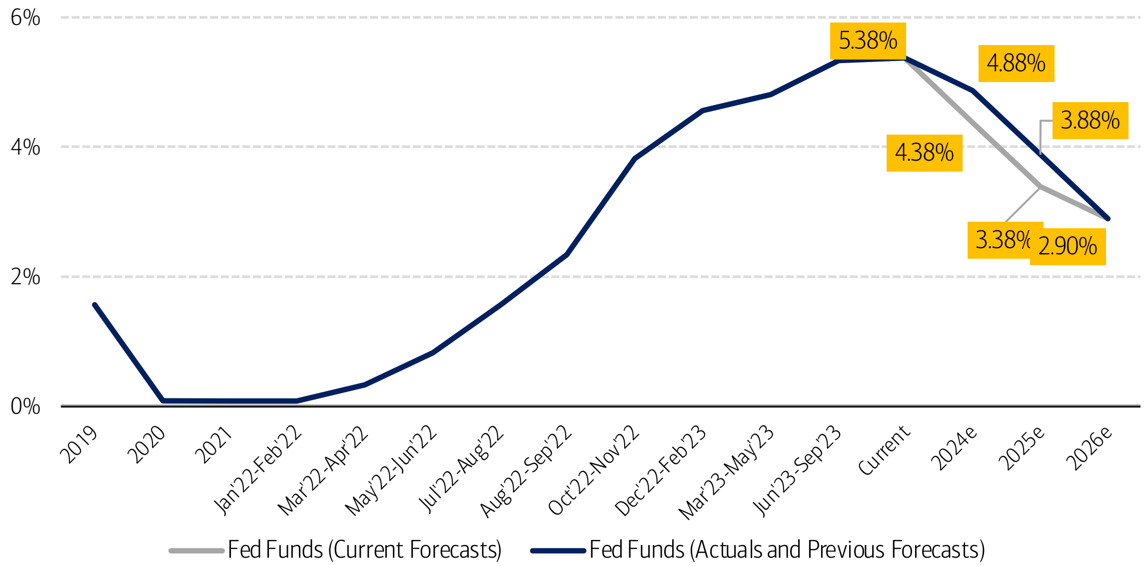
Management commentary from 3Q23 earnings, macro pressures easing versus macro headwinds remaining

Macro Tailwinds		Macro Headwinds	
Company	**Commentary**	**Company**	**Commentary**
Amazon (Covered by Justin Post)	"We're already seeing it now with the attenuation of optimization over the last several months, but I think you'll continue to see the attenuation continue. And we're already seeing more and more companies that are turning their attention to newer initiatives." *–Amazon CEO, F3Q23 earnings call*	Autodesk	"The macroeconomic drag on new subscriber growth, a smaller EBA renewal cohort with less upfront revenue mix, and the absence of EBA true up payments are headwinds to revenue growth in fiscal '25." *–Autodesk CFO, F3Q24 earnings call*
Datadog	"We continue to see impact from optimization in our business. But we believe that the intensity and breadth of optimization we've experienced in recent quarters is moderating." *–Datadog CEO, F3Q23 earnings call*	BILL	"The external economic environment has ...resulted in declining B2B spending trends. Beginning in late fiscal Q1 and continuing into Q2, we have seen further tightening by our customers and suppliers. With higher interest rates, tighter credit conditions and cost increases for businesses, SMBs are focused on finding ways to lower expenses. This is most pronounced with larger SMBs and mid-market companies." *–BILL CFO, F1Q24 earnings call*
JFrog	"We did talk about the [cloud] usage trends and we continue to see continued growth of usage. So we do believe that this wave of optimization is behind us. We continue to see the adoption of our platform by larger customers on marketplaces." *–JFrog CEO, F3Q23 earnings call*	DocuSign	"Expansion headwinds continue to impact year-over-year billings growth, these dynamics are also visible in our dollar net retention, which was 100% in Q3. Expansion rates continue to be tempered by spending optimization and IT budget scrutiny. We expect dollar net retention to trend downward in Q4." *–DocuSign CFO, F3Q24 earnings call*
Salesforce	" We're cautious about saying... it's all green shoots...But at the same level, we are honest with you that we have a lot of green shoots in products, in geographies, and you can see in this growth rate in large deals. So we're excited." *–Salesforce CEO, F3Q24 earnings call*	HubSpot	"We continue to see pressure on net upgrade motions including seats, contact tears, additions and portal, and expect this to persist in the short term." *–HubSpot CFO, F3Q23 earnings call*
ServiceNow	"Q3 results were just phenomenal across the board, and the beat on...cRPO was two things, specifically strong net new ACV growth, and that was primarily driven...by very strong Federal business, which was just fantastic and great business for us." *–ServiceNow CFO, F3Q23 earnings call*	nCino	"Churn and downsell for the rest of the business were in line with expectations in the third quarter, but in light of the elevated IMB churn, we are adjusting our churn rate expectation for the full year to about 9% of prior year subscription revenues up from 6%." *–nCino CFO, F3Q24 earnings call*
Snowflake	"Consumption trends have improved. We are seeing stability in customer expansion patterns. Our guidance is based on observed patterns and assumes continued stability of consumption." *–Snowflake CFO, F3Q24 earnings call*	Zoom	"We certainly have seen impact in our customers having retraction in their own businesses and in their own employee count...not seen a lot of logo churn. It has been more down-selling in terms of right-sizing their Meeting license numbers." *–Zoom CFO, F3Q24 earnings call*
Workday	"We saw a nice uptick in SKUs being sold back into our customer base, that drive...these early renewals like Talent Optimization, Accounting Center, Prism and Extend are just four examples of where customers are demanding more from us... driving those early renewals more than we [intended]." *–Workday co-CEO, F3Q24 earnings call*	ZoomInfo	The environment does continue to be challenging, and we are expecting net retention for the year to be below 90%. As a result, in Q4, which is our highest period for renewals, that net retention below 100% creates a headwind that's amplified by the higher concentration of renewals." *–ZoomInfo CFO, F3Q23 earnings call*

Source: BofA Global Research, company earnings transcripts

BofA GLOBAL RESEARCH

Exhibit 14: Our Global Economics team expects the Fed to begin cutting rates in 1Q24
Fed Fund rates, current forecasts versus previous forecasts



Source: Federal Reserve, BofA Global Research

BofA GLOBAL RESEARCH

IT Spending Survey

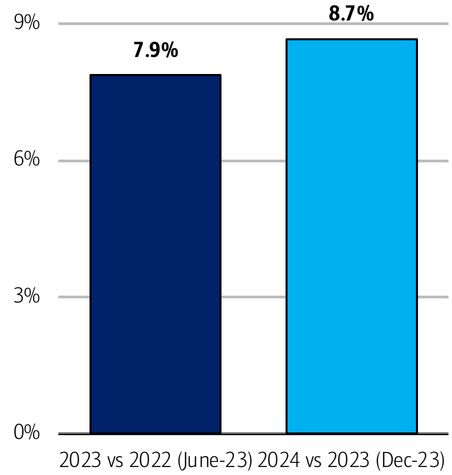
We conducted an update to our IT Spending Survey from Jun'23 with responses from 500+ IT professionals across verticals and company sizes. The survey responses came equally from IT professionals across SMBs (<1,000 employees), mid-sized firms (1,001-5,000 employees), and large enterprises (5,000+ employees).

Survey – slight decline in '24 spending expectations

Our Dec'23 survey indicates that overall spending is expected to grow 8.7% in 2024, a decline from the 9.0% expected increase from our Jun'23 survey, but an increase from the 7.9% expected increase in 2023 (Exhibit 15).

We compare our most recent Dec'23 IT Spending Survey to our previously conducted IT Spending Survey in Jun'23. We note that the 8.7% y/y expectation is 30bps below the 9.0% level for 2024 seen in our Jun'23 survey, suggesting that companies may be tightening their budgets more than previously anticipated (Exhibit 16). However, the 8.7% for 2024 is still above the 7.9% for 2023 (last surveyed in Jun'23) (Exhibit 17). We view the higher spending outlook for 2024 as a positive for our software coverage universe and expect clear industry leaders to benefit as budgets remain more constrained than anticipated.

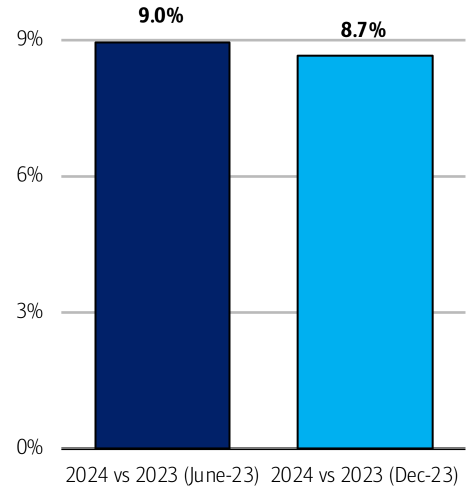
Exhibit 15: What is your expected software spending budget increase? (2023 vs 2024)
2024 spending expectations are higher than 2023



Source: BofA Global Research

BofA GLOBAL RESEARCH

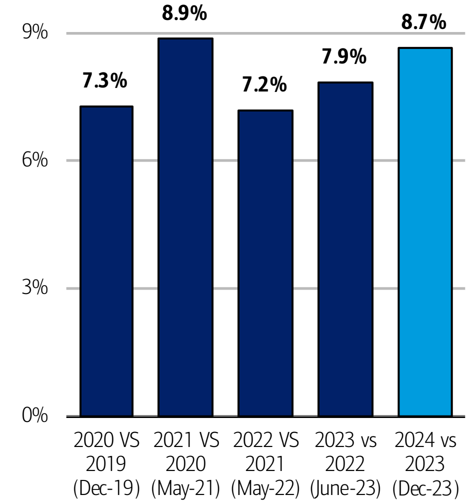
Exhibit 16: What is your expected software spending budget increase? (2024, Dec'23 vs Jun'23)
Expectations for 2024 were lower in our Dec'23 survey than in our Jun'23 survey.



Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 17: What is your expected software spending budget increase? (Based on most recent survey asked for each year)
Spending expectations have increased in every survey iteration after a decline in May'22.



Source: BofA Global Research

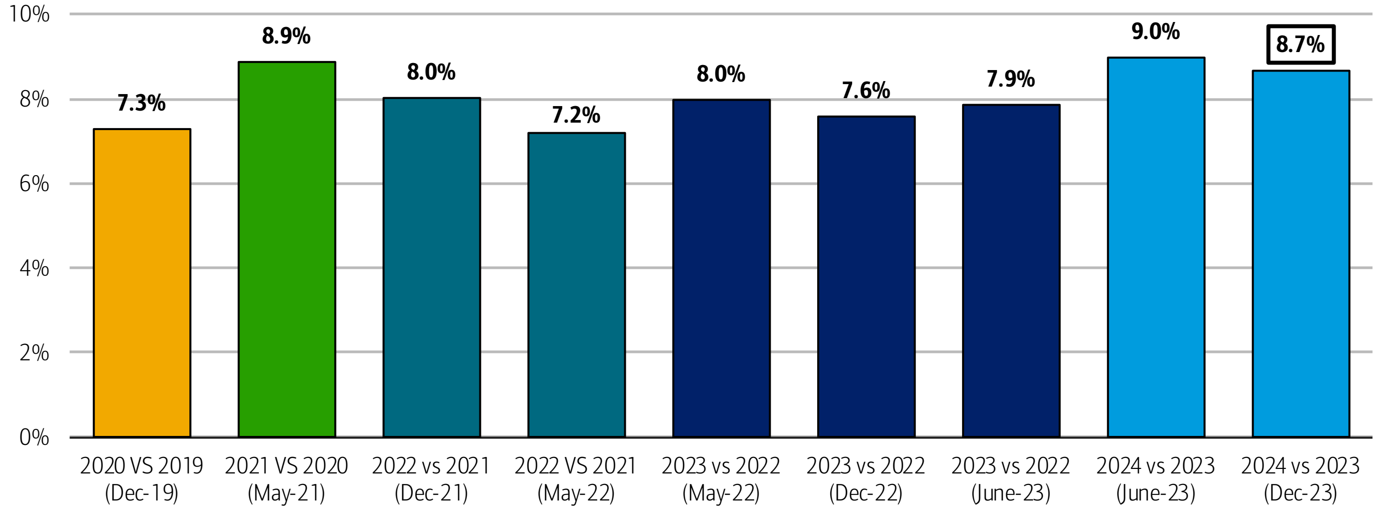
BofA GLOBAL RESEARCH

Year over year, respondents during our Dec'22 survey anticipated their IT spending to increase 7.6% y/y in the upcoming year. This compares to our Dec'23 survey, where respondents anticipated spending to increase 8.7% y/y.

Dec'23 Survey –spend uptick but less than expected

Our Dec'23 survey results suggest that overall spending is expected to grow 8.7% in 2023, largely holding from our Jun'23 survey results of 9.0% (Exhibit 18). We view this as consistent with management commentary at recent conferences and earnings calls, where the tone from most management teams suggests that near-term macro pressure is expected to ease somewhat. Many management teams have commented that demand and/or usage began to weaken in 2Q/CY2022, which aligns with our historical survey results. With expectations of "anniversary-ing" these bad quarters in the next few months, our view is that spending intentions could increase.

Exhibit 18: What is your expected software spending budget increase for 2024?
Spending growth held relatively steady for 2024.



Source: BofA Global Research

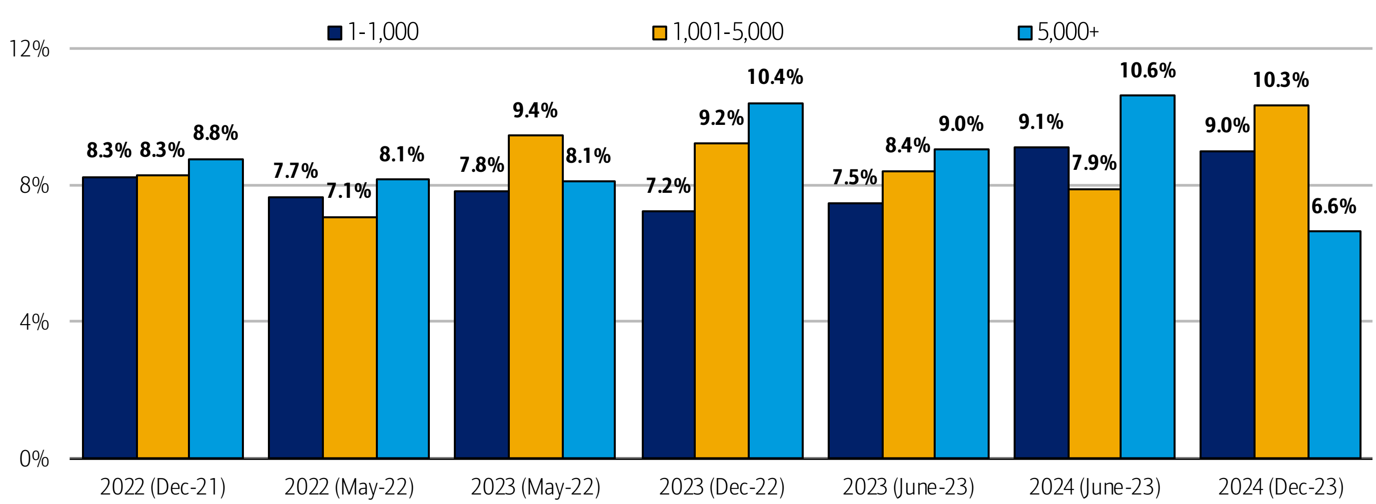
BofA GLOBAL RESEARCH

Large enterprises – largest decline in spend expectations

Enterprises intend to increase spending by 6.6% in 2024, which is 340bps lower than the 9.0% expected in 2023 (Exhibit 19). When we compare 2024 expectations across our Dec'23 survey and our Jun'23 survey, expectations declined by 400bps from 10.6%, which we view as notable given enterprises historically tend to have the highest spending intention. These results align with the Bank of America Institute's December small business checkpoint report, which highlighted that SMBs and mid-sized firms likely had the strongest spending tendencies.

SMBs expect to increase software spending by 9.0%, up 150bs from 2023 expectations of 7.5%. The 9.0% is a slight 10bps decline from Jun'23 expectations for 2024. Mid-sized firms had the largest increase for 2024 and expect to increase spending by 10.3% in 2024, up from 8.4% in 2023. The 2024 outlook for mid-sized firms also increased 240bps from Jun'23's 7.9%.

Exhibit 19: What is your expected software spending budget increase for 2024? (By company size)
Large enterprises had the largest decline in spending expectations for 2024, declining by 4pts.



Source: BofA Global Research

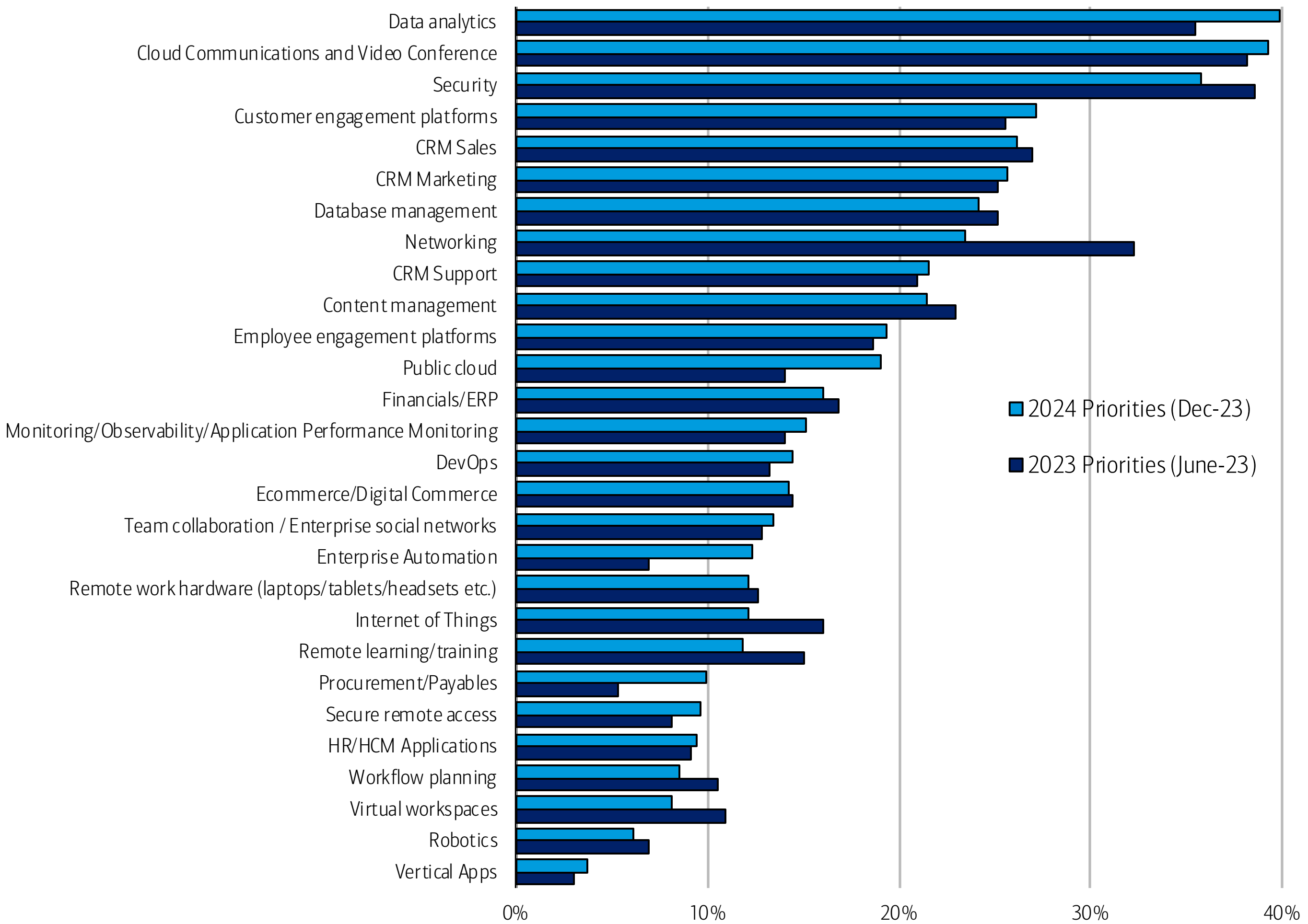
BofA GLOBAL RESEARCH

Data Analytics secures the top spot

We asked respondents to select their top five spending priorities. Data Analytics was the most frequently selected software spending priority, with 40% of respondents selecting it compared to 36% in our Jun'23 survey, when it was the third most selected priority (Exhibit 20). Cloud Communications and Video Conferencing came in second, with 39% of respondents selecting it compared to 38% in our Jun'23 survey, when it was also second most selected. Security was the third most frequently selected priority at 36%, down three points from Jun'23.

Data Analytics secures the top spot with 40% of respondents indicating it as a top priority, up 4pts from our Jun'23 survey.

Exhibit 20: What are your company's priorities for your budget? (Select top 5)
Data Analytics takes the top spot, with Cloud Communications and Video Conferencing following closely behind.



Source: BofA Global Research

BofA GLOBAL RESEARCH

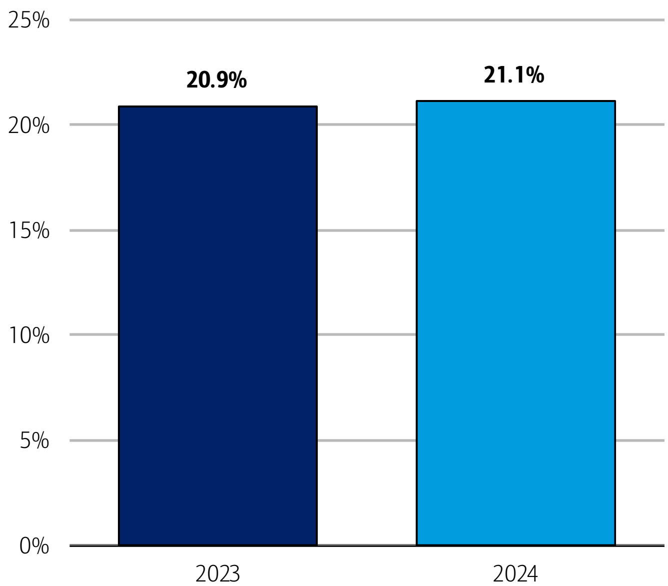
AI: A Notable Spending Priority

We asked respondents about AI spending intentions for 2024 in the four major software categories: front office applications, back office applications, infrastructure software, and desktops applications. We also asked which software vendors they will look to for solutions in each category and show comparisons to our prior survey where applicable.

The average response was 21% of software budgets to be allocated to AI in 2024, holding steady from 21% in 2023 in our Jun'23 survey.

The average response for expected percent of software budgets allocated to AI was 21% for both 2023 and 2024 (Exhibit 21). For 2024, 7% of respondents indicated that they would not spend any of their budget on AI, which we find significant, but not surprising, given AI development and corporate adoption remains nascent. We note that 24.7% indicated intentions to spend between 1-10% of IT budgets on AI; 26.4% indicated intentions to spend between 11-20%; 17.9% indicated intentions to spend between 21-30%; 9.4% indicated intentions to spend between 31-40%; 6.8% indicated intentions to spend between 41-50%; 4.1% indicated intentions to spend between 50-60%; 2.4% indicated intentions to spend between 61-70%; and 1.3% indicated intentions to spend 70%+ (Exhibit 23).

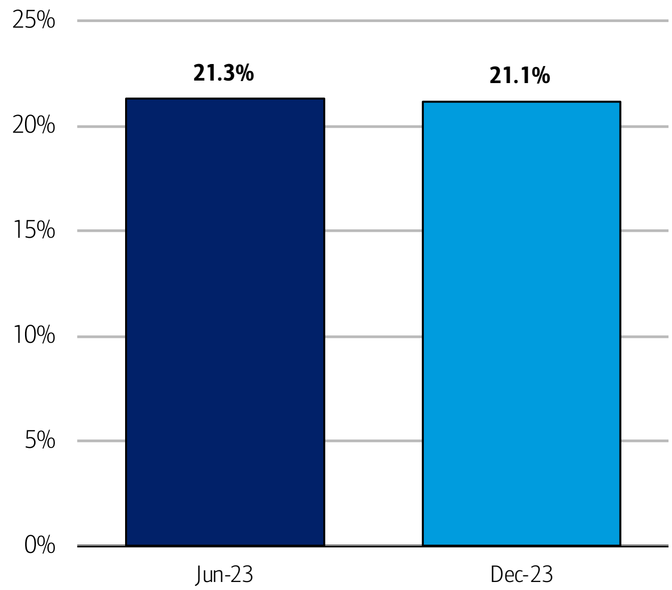
Exhibit 21: Weighted average percentage of software budgets that will be allocated to AI, 2023 vs 2024 (Jun'23 survey vs Dec'23)
Expectations for AI allocation are holding steady.



Source: BofA Global Research

BofA GLOBAL RESEARCH

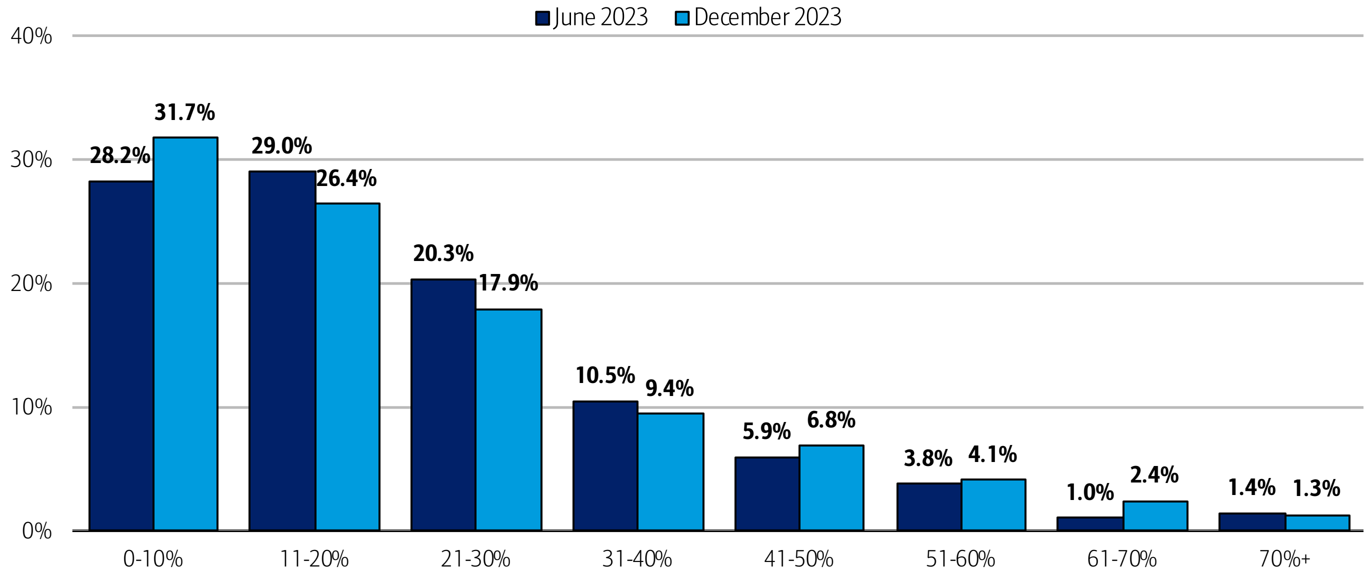
Exhibit 22: Weighted average percentage of software budgets that will be allocated to AI, 2024 (Jun'23 survey vs Dec'23)
Expectations are relatively flat at ~21%.



Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 23: What portion of your software budgets will be allocated to AI? (2023 vs 2024, Jun'23 survey vs Dec'23)
Respondents most frequently expect to spend between 11-20% of software budgets on AI.



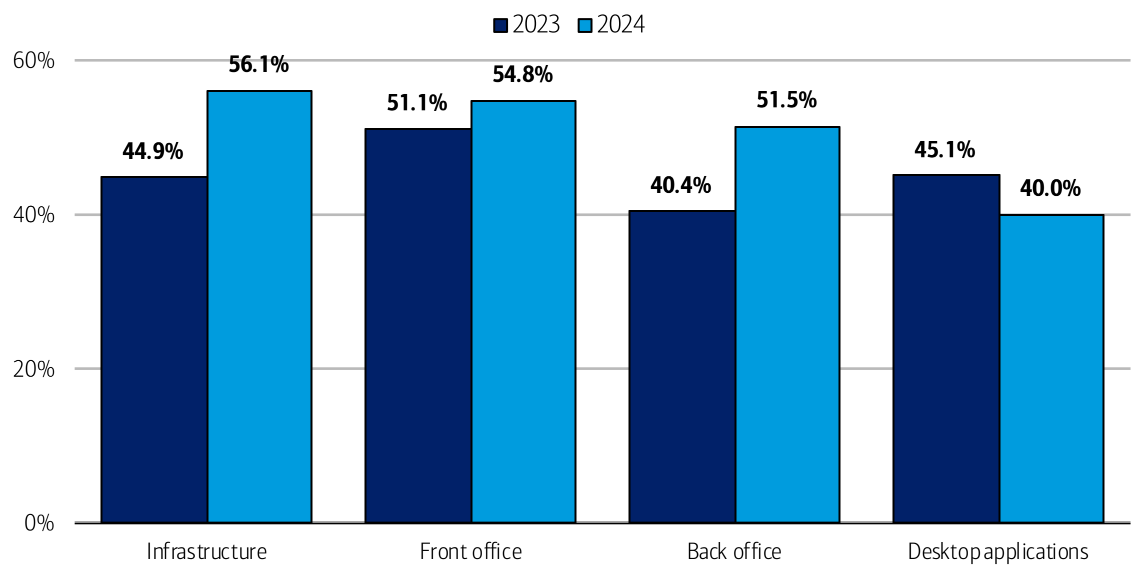
Source: BofA Global Research

BofA GLOBAL RESEARCH

Infrastructure surges to the top for AI investments

We asked respondents "Which software categories are you considering investing in AI capabilities?" with the four categories of front office, back office, infrastructure, and desktop applications (Exhibit 24). We note that 56% of respondents selected infrastructure as a spending category for AI, up 11pts from our Jun'23 survey when it was the third most selected; 55% of respondents indicated front office as a spending category for AI, up 3pts; 52% selected back office, up 12pts; and 40% selected desktop applications, down 5pts.

Exhibit 24: Which software categories are you considering investing in AI Capabilities?
Respondents are most likely to invest in AI capabilities for infrastructure software



Source: BofA Global Research

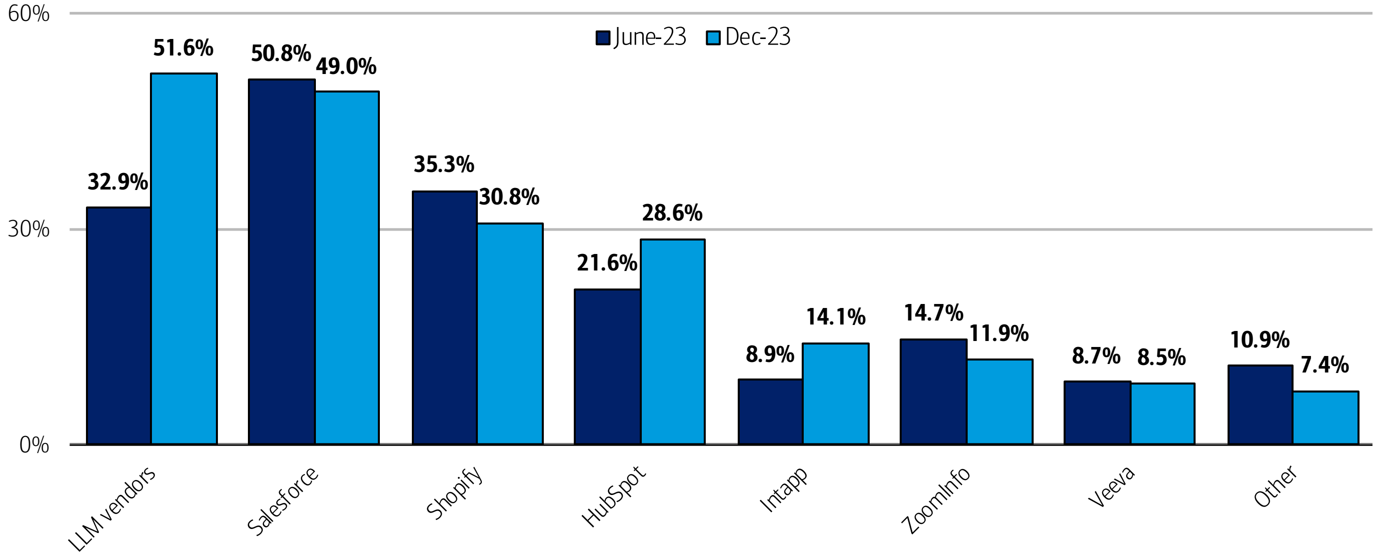
BofA GLOBAL RESEARCH

In our survey, we asked respondents to choose which vendor they look to for AI capabilities within each software category and included our coverage universe. For each category, we included large language model vendors (LLM) as a category to gain a sense of the disruptive potential for each category. For front office and back office, respondents most frequently selected LLMs as where they would most likely invest in AI.

Front Office – Salesforce AI most selected after LLMs

Other than LLMs (52%), Salesforce registered highest for front office firms in which respondents plan to invest in AI offerings, with 49% of respondents selecting it, down slightly (2pts) from our Jun'23 survey (Exhibit 25). The next closest vendor was Shopify (SHOP) with 31% selecting it. HubSpot (HUBS) was next with 28% and Intapp (INTA) followed at 14%.

Exhibit 25: Which front office vendors will you look to for AI capabilities? (Jun'23 survey vs Dec'23)
LLMs had the largest increase in selection, up 18.7pts since our Jun'23 survey.



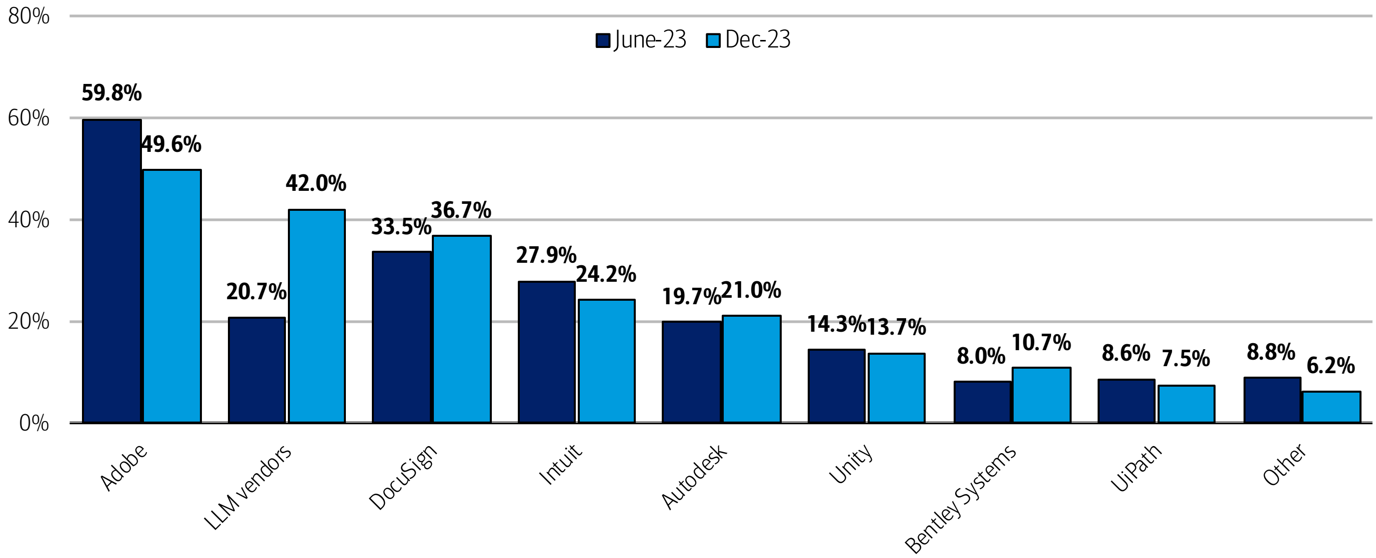
Source: BofA Global Research

BofA GLOBAL RESEARCH

Desktop – Adobe stays at the top for AI investments

Within the desktop applications category, Adobe (ADBE) was the most selected as the vendor to invest in for AI capabilities, with 50% of respondents indicating so but down 10pts from the 60% in our Jun'23 survey. LLMs came second at 42%, and DocuSign (DOCU) third at 37% (Exhibit 26).

Exhibit 26: Which desktop application vendors will you look to for AI capabilities?
Adobe maintained the top spot from our Jun'23 survey, but dropped 10.1pts; LLM vendors were selected at nearly double the rate as in Jun'23.



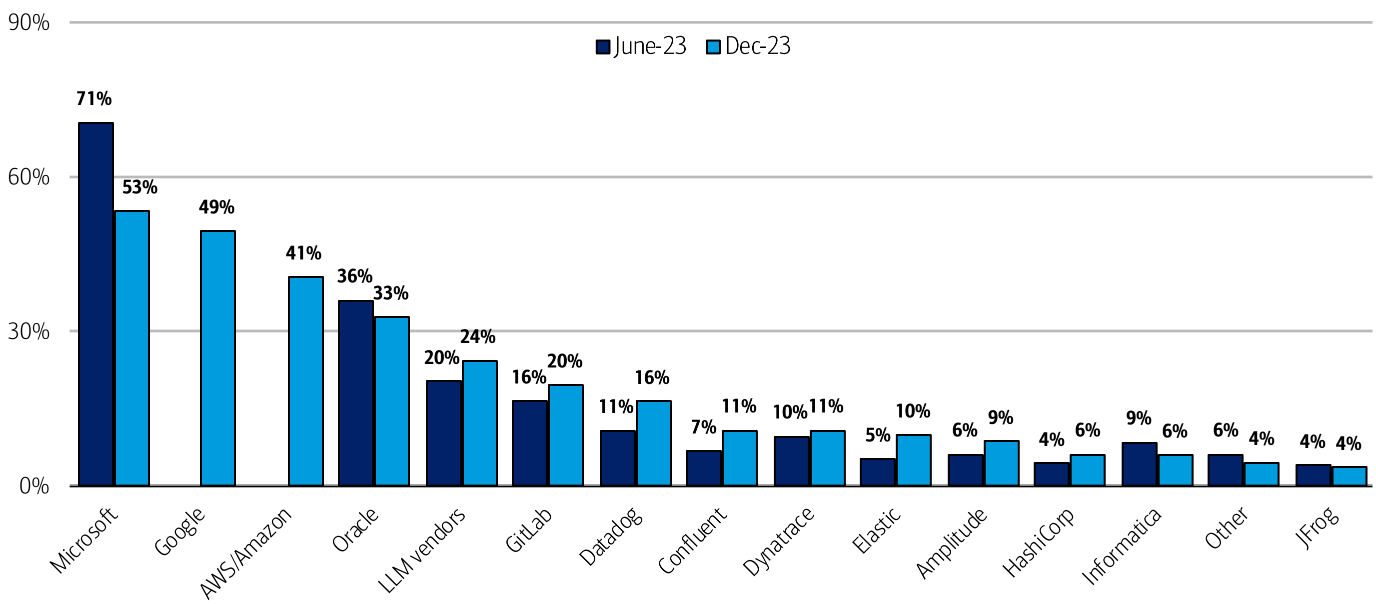
Source: BofA Global Research

BofA GLOBAL RESEARCH

Infrastructure – Microsoft again earns top spot for AI infrastructure

According to respondents, Microsoft (MSFT) is looked to the most for AI investments in the infrastructure category with 54% selecting it. However, Microsoft selections were down 17pts from the 71% in our Jun'23 survey (Exhibit 27). Google (GOOG) ranked second at 49%, and AWS/Amazon (AMZN) third at 41%, followed by Oracle (ORCL) at 33%, LLMs at 24%, GitLab (GTLB) at 20%, Datadog (DDOG) at 16% and Dynatrace (DT) at11%. We note that we did not include Google/GCP or Amazon/AWS as options in our Jun'23 survey, given we focused primarily on platforms within our coverage universe. However, given the rapid evolution of AI and offerings from the hyperscalers, we included Google and Amazon in our Dec'23 survey.

Exhibit 27: Which infrastructure vendors will you look to for AI capabilities? (Jun'23 survey vs Dec'23)
Microsoft had a notable 17.2pt drop between our Jun'23 and our Dec'23 survey. Google and Amazon ranked very well as potential solutions for AI.



Source: BofA Global Research

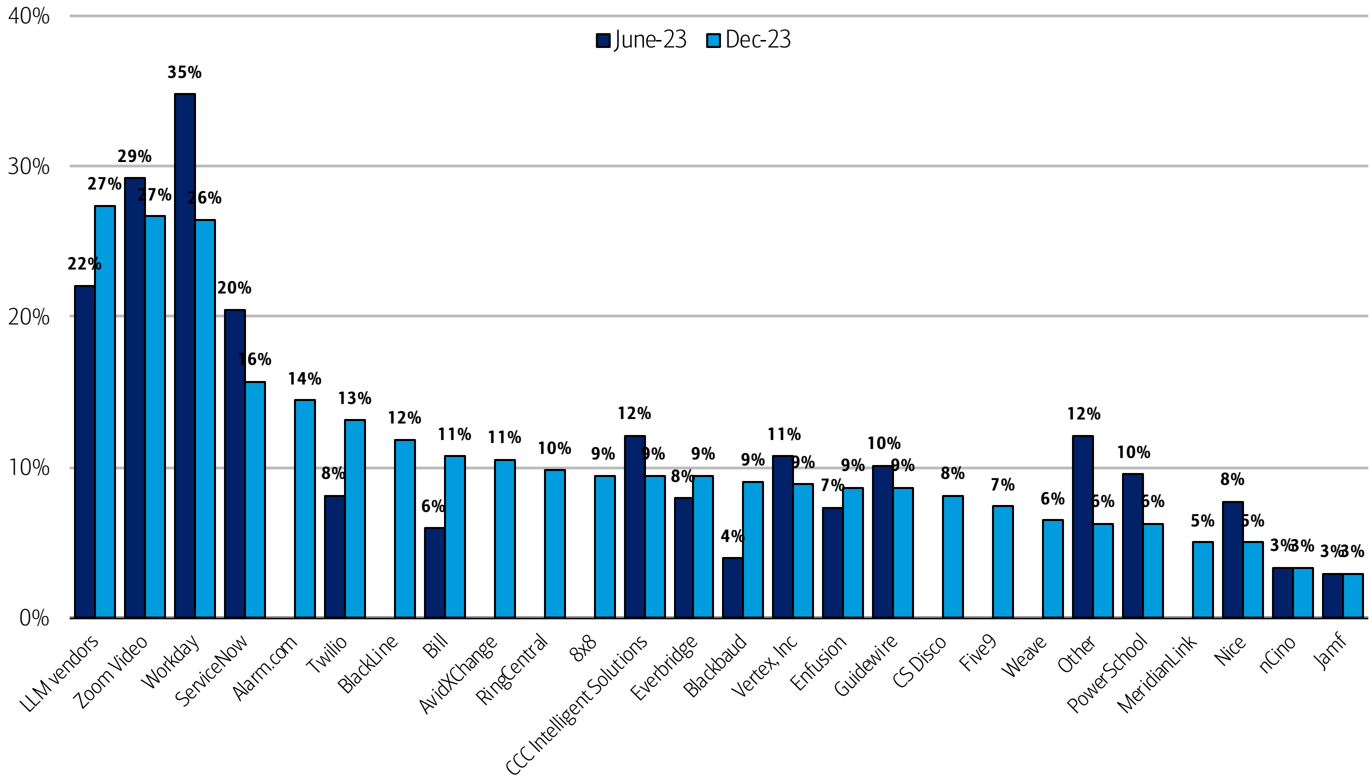
Exhibit 27: Which infrastructure vendors will you look to for AI capabilities? (Jun'23 survey vs Dec'23)
Microsoft had a notable 17.2pt drop between our Jun'23 and our Dec'23 survey. Google and Amazon ranked very well as potential solutions for AI.

BofA GLOBAL RESEARCH

Back Office – LLMs, Workday, Zoom are top focuses

Other than LLMs (27%), Zoom (ZM) was the most selected vendor of AI capabilities at 27%. Workday (WDAY) came next at 27% (Exhibit 28). Back office had the largest declines in selection compared to our last survey; in our Jun'23 survey, the top vendor (Workday) was selected 35% (as opposed to LLMs in our Dec'23 at 27%).

Exhibit 28: Which back office vendors will you look to for AI capabilities? (Jun'23 survey vs Dec'23)
Workday had the largest drop in being selected for its AI opportunities, down 8.3pts from our Jun'23 survey. We note that we did not include some options in our Jun'23 survey.



Source: BofA Global Research

BofA GLOBAL RESEARCH

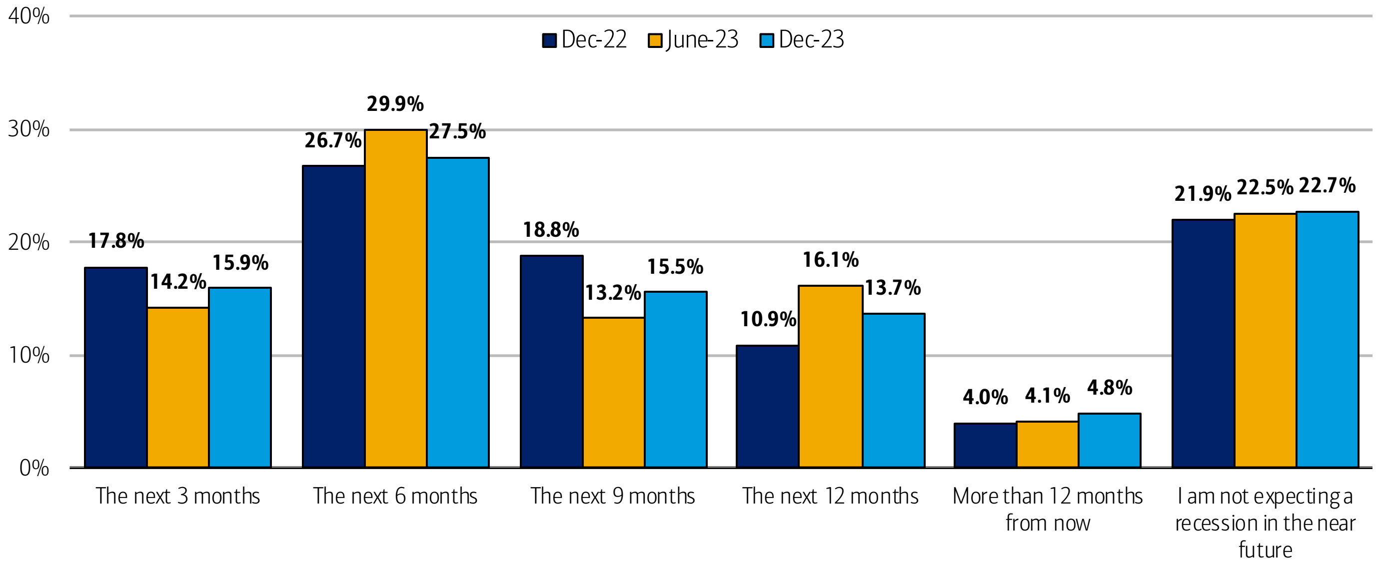
Recession Expectations Remain Steady

16% of respondents expect a recession in the next 3 months, up slightly from 14% in our last survey.

We asked respondents about when they expect a recession to occur. We note that 16% of respondents expect there to be a recession within the next three months, up from 14% in Jun'23 (Exhibit 29). Expectations for a recession in the next six months was the most common answer with 28% of respondents selecting it, down 3pts from 30% in Jun'23. Expectations for a recession in the next nine months increased 3pts from Jun'23 with 16% selecting it vs the 13% prior. Expectations for a recession in the next 12 months increased decreased 2 points to 14% from 16%. Flat from Jun'23, 23% of respondents are not expecting a recession in the near term, which is roughly comparable to the 22% of respondents in Dec'22.

Exhibit 29: When are you expecting a recession?

Nearly a quarter of respondents do not expect a recession in the near future.



Source: BofA Global Research

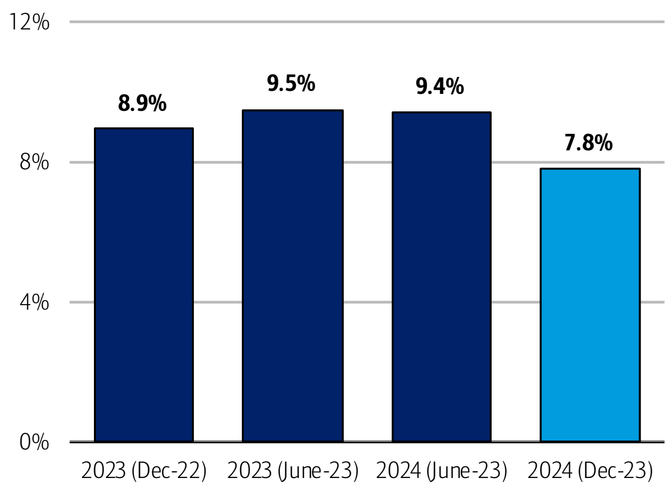
BofA GLOBAL RESEARCH

Hiring budgets decelerate in enterprise

Our Dec'23 survey results suggest hiring budgets to grow 7.8% in 2024, 160bps down from our Jun'23 survey expectations for 2024.

We asked respondents about hiring budget expectations for 2024. Expectations were lower at 7.8% compared to expectations of 9.4% in our Jun'23 survey and expectations of 9.5%for 2023 (Exhibit 30). Across company sizes, all cohorts had lower hiring budget expectations from our Jun'23 survey. SMB expectations saw the largest decline of 2.7pts to 6.3%. Mid-sized firm expectations declined to 8.5% versus 10.4% in Jun'23, but we note that this level is steady for 2023 expectations in our Dec'22 and Jun'23 survey. Large enterprises expectations declined to 8.5% from 9.7% prior (Exhibit 31).

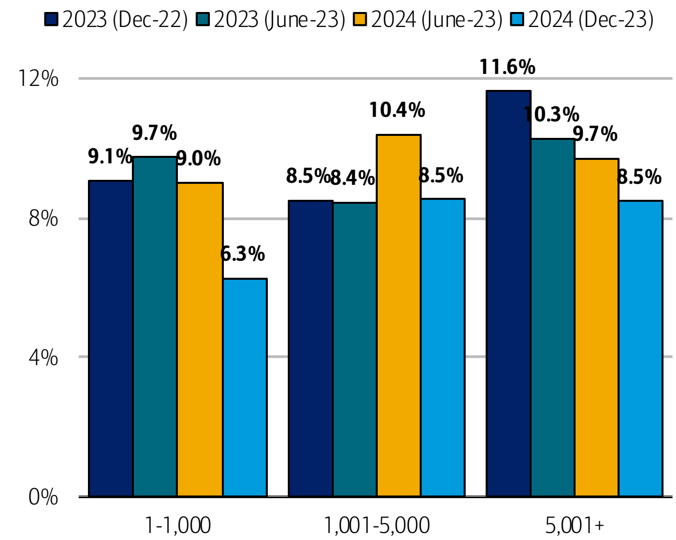
Exhibit 30: What is your expected hiring budget increase?
Hiring budget expectations dropped a notable 160bps in our Dec'23 survey vs our Jun'23 survey for 2024, and are lower than historical trends.



Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 31: What is your expected hiring budget increase? (Across Company Size)
SMBs had the largest decline in their expected hiring budget increase and lowered their growth expectations by 270bps.



Source: BofA Global Research

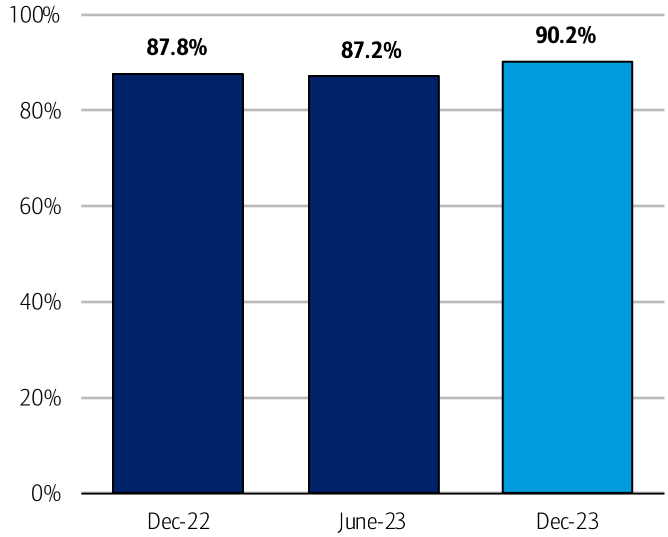
BofA GLOBAL RESEARCH

Impact of rates up slightly from Jun'23

Our Dec'23 survey results suggest that more firms are noticing the impact of rising rates, with 90% of respondents noticing the impact vs 87% in Jun'23.

We asked respondents if they noticed the impact of rising rates with 90% indicating they notice the impact (Exhibit 32). Respondents from large enterprises (89%) had the largest increase in noticing the impact of rates compared to our Jun'23 survey (77%), but noticed the impact less than mid-sized firms (94%). Large enterprises noticed the impact at a comparable rate to SMBs (89%) (Exhibit 33).

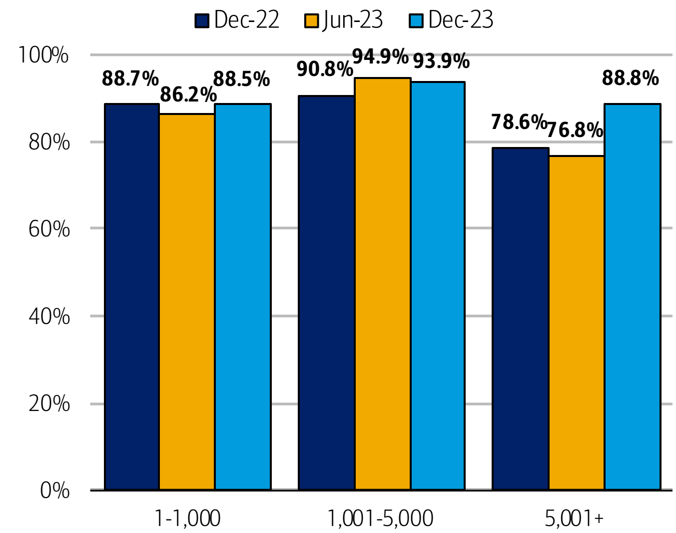
Exhibit 32: Is your firm noticing the impact of rising interest rates
Firms noticing the impact of rising rates increased 30bps from our Jun'23 survey.



Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 33: Is your firm noticing the impact of rising interest rates? (Across company size)
Large enterprises saw the largest increase in the percent who saw the impact – up 12pts from our Jun'23 survey



Source: BofA Global Research

BofA GLOBAL RESEARCH

See IT Spending Survey Continued in the appendix for more.

Vendor Consolidation Likely to Persist

Constrained IT budgets drive further consolidation in '24

Mgmt commentary, surveys and NLP indicate budgets to remain constrained

Macro uncertainty likely drove companies to tighten IT spending, which we view as the primary catalyst behind accelerating vendor consolidation in 2023. However, management commentary and IT Spending Survey results, both covered above, indicate that vendor consolidation will likely remain a priority in 2024 as IT budgets for large enterprises (5k+ employees) remain constrained. We also note that our Natural Language Processing (NLP) analysis of earnings transcripts supports our view that vendor consolidation is likely to persist (Exhibit 34).

IT budgets may expand but likely less than expected

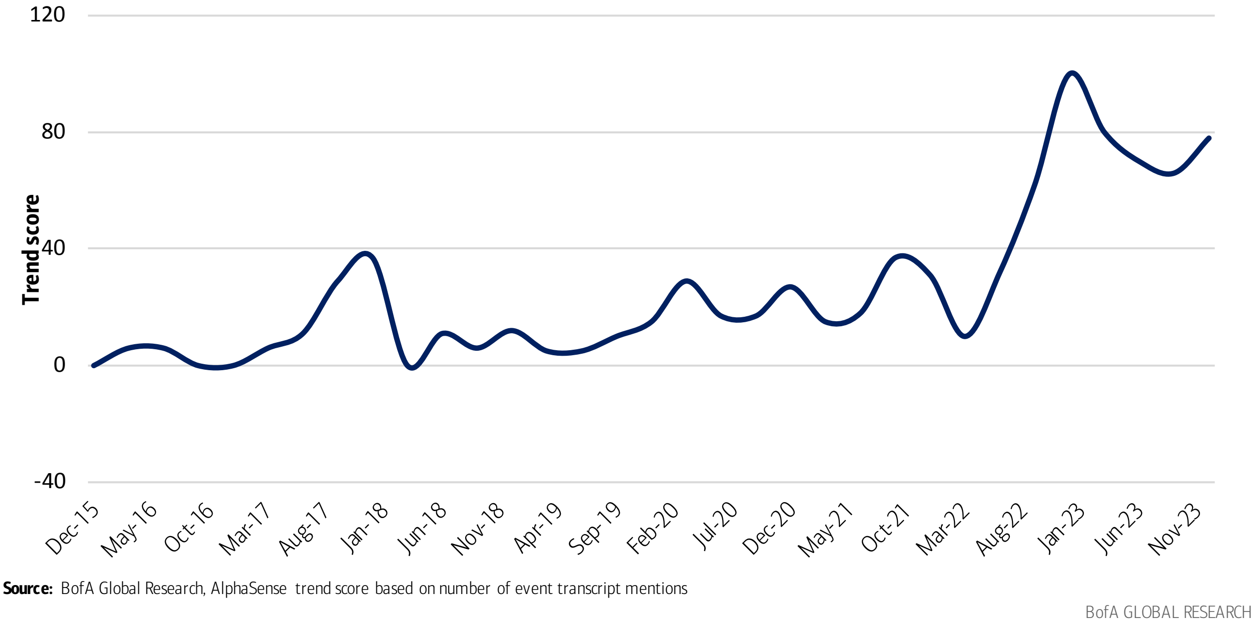
Our view is that budgets are likely to expand in 2024, but likely less than expected previously. According to our most recent IT Spending Survey, conducted in Dec'23, large enterprises expect to increase IT budgets by 6.6% in 2024. However, results from our Jun'23 survey indicated an expected an increase of 10.6%, suggesting that budgets may be slower to expand than expected previously.

Vendor consolidation may continue even in an expanding IT budget environment

Our conversations with company management suggest that companies have observed functional benefits from vendor consolidation, including 1) better user experiences and workflows, 2) more seamless transfer of data and 3) reduced complexity. We expect these functional benefits to drive sustainable momentum for vendor consolidation initiatives even as IT budgets become less constrained.

Exhibit 34: Vendor consolidation was an important '23 theme and will likely persist in '24

Vendor consolidation trend score based on software company transcript mentions



Source: BofA Global Research, AlphaSense trend score based on number of event transcript mentions

Vendor sprawl leaves plenty of room for consolidation

78 software applications on average just for Security departments

Vendor sprawl, a function of decentralized purchasing processes and loose budget constraints, drives significant inefficiencies for companies that often find them themselves with redundant applications across departments (Exhibit 35). Multiple applications that address the same need create unnecessary costs, complexity and security risks. Large companies (2k+ employees) leverage 211 software applications on average, +8% in 2022 y/y, according to a 2023 Okta survey. Onboarding applications at the department level adds up over time. Security and Engineering departments at large companies leverage an average of 78 and 77 applications, respectively, according to a 2021 Productiv survey.

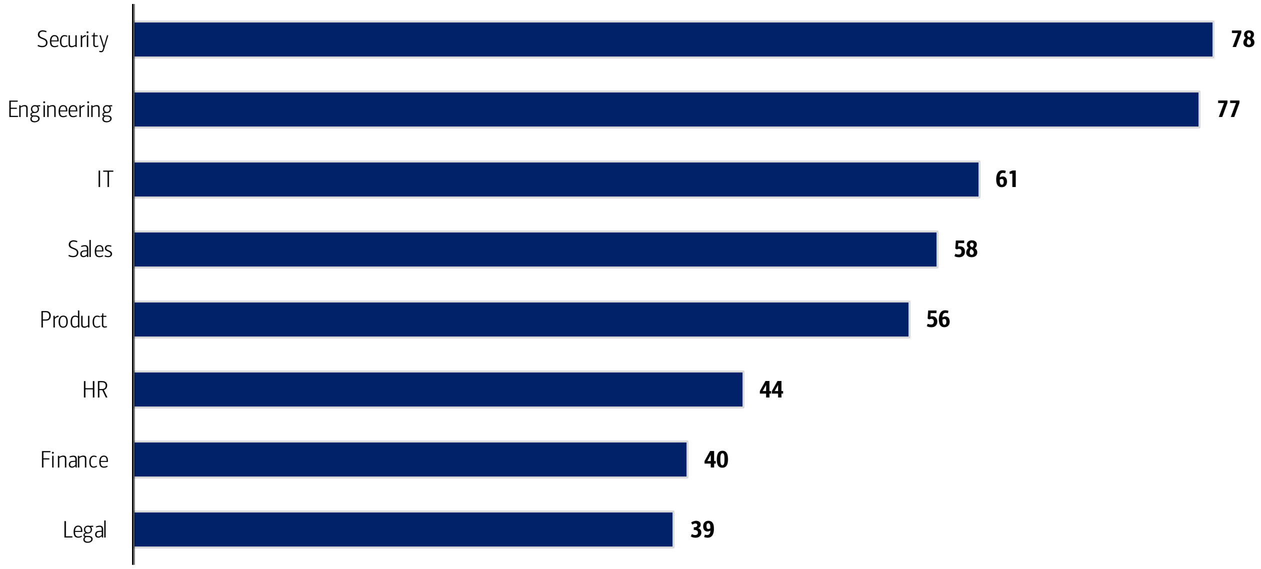
The year of (vendor) efficiency, powered by AI

Despite the small spending rebound we saw in 2H23, which we expect to continue in 2024, companies are likely to optimize spend by decreasing redundant vendor solutions, cutting unused or non-critical seats and reviewing the speed at which workloads hosted at Hyperscalers are added. We expect many "nice-to-have" projects to be delayed in favor of potential AI-powered projects. Companies will likely leverage AI capabilities to some extent over the next 3-5 years with larger companies most likely to use AI-powered products and features to streamline internal processes and enhance client-facing solutions in order to drive cost reductions.

Consolidation drives opportunity for wallet share capture

Software vendors that offer applications with broad functionality and the potential to bundle offerings with attractive total cost of ownership (TCO) may capture incremental wallet share as contracts expire, in our view. We expect vendor consolidation to be most prevalent in the Communications and Infrastructure categories in 2024 (Exhibit 36).

Exhibit 35: Large companies leverage dozens of applications across numerous vendors
Average number of applications used by department



Source: BofA Global Research, Productiv

BofA GLOBAL RESEARCH

Exhibit 36: Communications, Infrastructure and Security – highest potential for vendor consolidation
Software categories and our views on the potential for vendor consolidation

Software Subsector	Potential for Vendor Consolidation
Communications	High
Infrastructure	High
Security	High
Collaboration	Medium
CRM	Medium
HCM	Medium
Design	Low
ERP & Back Office	Low
Vertical	Low

Source: BofA Global Research

BofA GLOBAL RESEARCH

See Vendor Consolidation Continued in the appendix for more.

Public Cloud

Early innings for public cloud growth and adoption

Public cloud TAM of $359bn in '24 with significant growth potential

Public cloud services are a cornerstone of modern IT infrastructure strategies and have emerged as the largest spend category, which we size at $358.7bn (+24% y/y) for 2024, in the software industry. Our proprietary TAM analysis suggests only 25% of total compute is currently done via public cloud, indicating a long runway for continued public cloud growth and adoption.

Workload optimization to moderate as macro headwinds decelerate

Over the past one and a half years, the public cloud infrastructure subsector has faced macro headwinds that have primarily manifested in the form of workload optimization, leading to meaningful revenue growth deceleration among large public cloud infrastructure providers, such as Microsoft, Amazon, Google, Snowflake, Datadog, MongoDB, Confluent and HashiCorp.[7] In 2024, we expect workload optimization to moderate.

The rapid adoption of AI has caused some GPU capacity constraints across major public cloud vendors, impacting quarterly results in some cases (Oracle, for example). We continue to expect GPU capacity to be constrained, but less so, now that the major hyperscalers are offering their own GPU alternatives (Amazon Trainium2, Microsoft Maia, Google's Tensor Processing Units). We do not foresee any slowdown to the adoption of multi- and hybrid-cloud infrastructure footprints among large enterprises given relative benefits such as cost, compliance and technical capabilities.

MSFT & MDB best positioned

Within our coverage universe, we view Microsoft and MongoDB as best positioned to benefit from 1) workload growth driven by AI use cases, 2) lower reliance on Nvidia GPU capacity and 3) multi- and hybrid-cloud adoption and enablement.

Expectations heading into 2024

Workload optimizations moderate & savings reinvested into new workloads

Public cloud workload optimization has been the new normal since 2022.[8] As customers lap big-step function changes in optimization, we expect the propensity to add additional workloads will likely begin to return with the additional optimization savings. Microsoft may start seeing this dynamic heading into 2024 after meeting with business unit CFOs in Redmond. Additionally, BofA Internet analyst Justin Post, who covers Amazon and Google, suggests AWS is already seeing stabilization in consumption headwinds with q/q results also suggesting dissipating optimization headwinds. Google continues to see optimization weigh on top-line trends.

Reported results and current estimates are meaningfully lower than prior (1/31/21) estimates before the macro-induced workload optimization dynamic had begun to play out (Exhibit 37). We highlight in red the first quarters for each company where the reported cloud growth rate was below 12/31/2021 consensus estimates.

Exhibit 37: Pre 2022 estimates versus current estimates & results

A meaningful delta exists b/t previously forecasted cloud growth rates vs reported results and forward looking estimates as of 1/2/2024

12/31/21 Estimates	1Q22	2Q22	3Q22	4Q22	1Q23	2Q23	3Q23	4Q23E	1Q24E	2Q24E	3Q24E	4Q24E
AWS	31.6%	28.9%	$\boxed{27.7\%}$	23.4%	19.0%	19.8%	23.5%	25.3%	23.6%	27.1%	30.7%	n/a
Microsoft Azure	43.9%	$\boxed{40.6\%}$	38.5%	38.0%	34.2%	35.1%	38.0%	40.2%	39.4%	38.8%	37.1%	n/a
GCP	39.4%	$\boxed{36.2\%}$	36.4%	32.2%	30.6%	36.0%	32.9%	34.0%	35.4%	40.1%	41.5%	n/a

[7] *Workload optimization refers to the deliberate allocation of computing resources to boost efficiency and cut costs. It involves dynamically adjusting resources usings tools like auto-scaling and load balancing. This ensures applications run smoothly but are also adapting to changing demands without overspending on unnecessary compute/resources.*

[8] *Microsoft first called out the workload optimization trend in April 2022.*

Exhibit 37: Pre 2022 estimates versus current estimates & results

A meaningful delta exists b/t previously forecasted cloud growth rates vs reported results and forward looking estimates as of 1/2/2024

12/31/21 Estimates	1Q22	2Q22	3Q22	4Q22	1Q23	2Q23	3Q23	4Q23E	1Q24E	2Q24E	3Q24E	4Q24E
Results & Current Estimates	**1Q22**	**2Q22**	**3Q22**	**4Q22**	**1Q23**	**2Q23**	**3Q23**	**4Q23E**	**1Q24E**	**2Q24E**	**3Q24E**	**4Q24E**
AWS	36.6%	33.3%	27.5%	20.2%	15.8%	12.2%	12.3%	13.0%	15.2%	16.3%	16.9%	17.2%
Microsoft Azure	45.6%	39.6%	35.2%	31.3%	27.2%	26.5%	29.0%	27.4%	26.2%	26.3%	25.9%	26.0%
GCP	43.8%	35.6%	37.7%	32.0%	28.1%	28.0%	22.4%	22.4%	23.3%	23.1%	23.3%	23.1%

Source: Visible Alpha, company report

BofA GLOBAL RESEARCH

> "AWS's year-over-year growth rate continued to stabilize in Q3 and while we still saw elevated cost optimization relative to a year ago, this continued to attenuate as more companies transition to deploying net new workloads."
>
> – Andy Jassy, Amazon CEO, 3Q23 earnings call

> "…workloads start, then workloads get optimized, and then new workloads start, and that cycle continues. We'll lap some of those optimization cycles that were fairly extreme perhaps in the second half of our fiscal."
>
> – Amy Hood, Microsoft Executive Vice President and CFO, F2Q24 earnings call

> "On Cloud, maybe what I would say is, overall, we had definitely started seeing customers looking to optimize spend. We leaned into it to help customers given some of the challenges they were facing and so that was a factor… And so we see signs of stabilization, and I'm optimistic about what's ahead."
>
> – Sundar Pichai, Alphabet CEO, 3Q23 earnings call

GPU capacity impacting quarterly results

We expect the IaaS category to become commoditized. That said, 2023 presented a bump in the road to the commoditization trend as the hardware offerings of a cloud provider became more relevant due to the shortage of GPU capacity, specifically Nvidia GPUs. Having Nvidia GPUs running and available for customers was a key differentiator for cloud providers. Oracle, for example, had an outsized amount of Nvidia GPU capacity and saw strong new growth and existing customer growth as a result (+57% y/y revenue growth in 2023 versus +32% y/y revenue growth in 2022 for OCI). On the flip side, we also saw that once Oracle started to become capacity constrained (likely in GPUs) in F2Q24, it was not able to fulfill all of the demand it received, leading to lost revenue/bookings.

Illustrative quotes by Microsoft and Oracle:

> "Frankly, the only limiting factor is our ability to get the data centers handed over and filled up fast enough. This quarter alone, we're talking about hundreds of millions of dollars that we would have been able to recognize if our capacity was available. So, the reality is as we roll out, and we've got just so many moving parts, as you can hear from us, we have a lot of capacity coming online. And as you can see in my CapEx guidance, we expect OCI to just grow astronomically,

frankly. It is the ideal infrastructure for so much use. And of course, also as more GPUs become available, and we can put those in, we have just a really unlimited amount of demand."

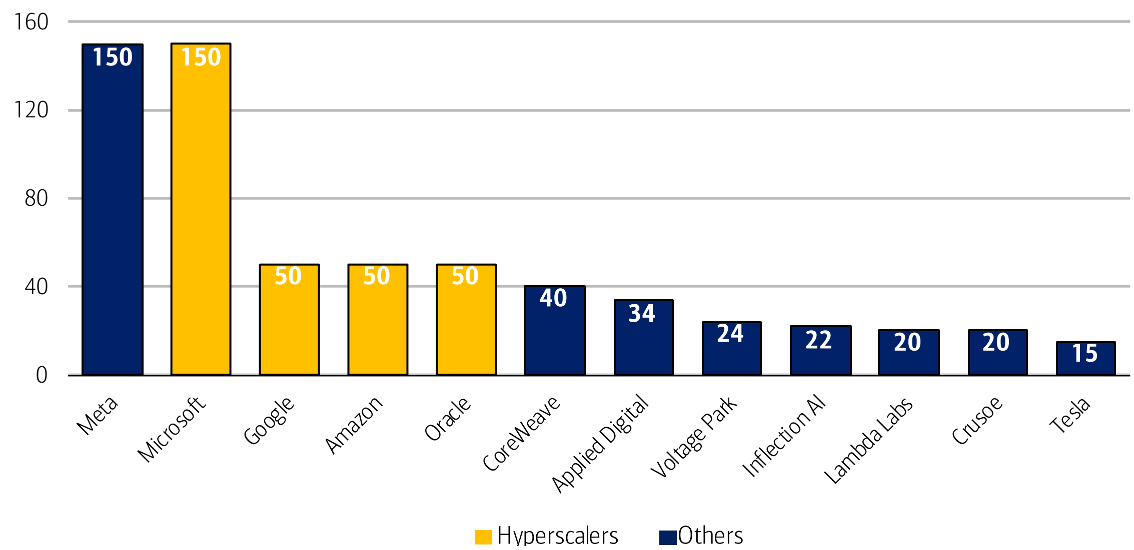
– Safra Catz, Oracle CEO, F2Q24 earnings call

"While the trends from prior quarter continued, growth was ahead of expectations, primarily driven by increased GPU capacity and better-than-expected GPU utilization of our AI services, as well as slightly higher-than-expected growth in our per-user business."

– Amy Hood, Microsoft Executive Vice President and CFO, F2Q24 earnings call

We expect that IT buyers will think of IaaS and PaaS as one bucket over time, but view GPU capacity as likely to remain constrained in 2024, leaving Microsoft, Amazon and Google as best positioned to bring as much GPU capacity online given their scale. We see in the chart below that a disproportionate number of GPUs from Nvidia were allocated to the cloud hyperscalers (Exhibit 38).

Exhibit 38: Microsoft, Google, Amazon and Oracle likely receive an outsized number of Nvidia GPUs in 2023
Nvidia H100s sold in 2023 (expected, $thousands)



Source: BofA Global Research, Yahoo, TechRadar, Data Center Dynamics, The Register, HPCwire, Inflection AI

BofA GLOBAL RESEARCH

Major hyperscalers have begun investing in their own AI chips to curb GPU capacity constraints. For example, Amazon recently revealed its Trainium2 AI chip and Microsoft revealed Maia, while Google continues to iterate on its Tensor Processing Units (TPUs). The hyperscalers have largely offered customers as many choices as possible, though our view remains that customers typically prefer Nvidia GPUs over alternatives, given the performance benefits.

Meaningful CapEx ramp among the hyperscalers

Hyperscalers CapEx is expected to ramp meaningfully in 2024 driven by the build out of additional data centers and capacity. We see incremental CapEx dollars among US hyperscalers reaching an expected +$22,096mn for 2024 from -$299mn in 2023 (Exhibit 39 & Exhibit 40). While a large CapEx ramp could mean gross margin degradation in the

P&L as the depreciation and amortization is recognized over time, our view is that operating margins overall should not compress over the next few years. Hyperscalers are still realizing leverage in their IaaS and PaaS businesses and the runtime fees associated with AI workloads tend be higher, which help to offset the high CapEx and potentially dilutive impact to margins. Lastly, AI workloads can provide higher pull through of other PaaS workloads, which include database, data warehouse, etc.

Exhibit 39: CapEx figures across hyperscalers
CapEx is set to increase meaningfully in 2024

CapEx ($mn)	2015	2016	2017	2018	2019	2020	2021	2022	2023E	2024E	2025E
Google	9,915	10,183	13,184	22,739	23,548	22,281	24,640	31,485	31,183	36,502	39,565
Microsoft	6,552	9,114	8,696	14,223	13,546	17,592	23,216	24,768	35,521	42,202	42,883
Amazon	4,588	7,804	11,343	13,426	16,861	40,141	61,053	63,645	52,638	59,982	69,732
AWS (est)						16,500	22,000	27,800	29,000	34,700	38,300
Oracle	1,606	1,604	2,037	1,468	1,591	1,833	3,118	6,678	6,935	9,687	8,690
Total US	**22,661**	**28,705**	**35,260**	**51,856**	**55,546**	**81,847**	**112,027**	**126,576**	**126,277**	**148,373**	**160,870**
Alibaba	858	1,496	3,681	5,521	4,531	5,575	6,030	5,490	3,005	6,716	7,164
Tencent	1,231	1,819	2,037	3,609	3,271	4,912	5,196	2,703	3,447	4,901	5,356
Baidu	829	626	735	1,284	939	750	1,693	1,217	1,449	1,560	1,555
Total China	**2,918**	**3,941**	**6,453**	**10,414**	**8,741**	**11,237**	**12,919**	**9,410**	**7,901**	**13,177**	**14,075**
Total	**48,240**	**61,351**	**76,973**	**114,126**	**119,833**	**174,931**	**236,973**	**262,562**	**260,455**	**309,923**	**335,815**

Source: BofA Global Research estimates, company report

BofA GLOBAL RESEARCH

Exhibit 40: Corresponding y/y % growth rates
Capex in the US is expected to grow, in aggregate, +17.5% y/y

y/y %	2015	2016	2017	2018	2019	2020	2021	2022	2023E	2024E	2025E
Google	-9.5%	2.7%	29.5%	72.5%	3.6%	-5.4%	10.6%	27.8%	-1.0%	17.1%	8.4%
Microsoft	23.8%	39.1%	-4.6%	63.6%	-4.8%	29.9%	32.0%	6.7%	43.4%	18.8%	1.6%
Amazon	-6.2%	70.1%	45.3%	18.4%	25.6%	138.1%	52.1%	4.2%	-17.3%	14.0%	16.3%
AWS (est)							33.3%	26.4%	4.3%	19.7%	10.4%
Oracle	119.7%	-0.1%	27.0%	-27.9%	8.4%	15.2%	70.1%	114.2%	3.8%	39.7%	-10.3%
Total US	**6.2%**	**26.7%**	**22.8%**	**47.1%**	**7.1%**	**47.3%**	**36.9%**	**13.0%**	**-0.2%**	**17.5%**	**8.4%**
Alibaba	21.6%	74.4%	146.1%	50.0%	-17.9%	23.0%	8.2%	-9.0%	-45.3%	123.5%	6.7%
Tencent	60.3%	47.8%	12.0%	77.2%	-9.4%	50.2%	5.8%	-48.0%	27.5%	42.2%	9.3%
Baidu	6.2%	-24.5%	17.4%	74.7%	-26.9%	-20.1%	125.7%	-28.1%	19.1%	7.7%	-0.3%
Total China	**29.5%**	**35.1%**	**63.7%**	**61.4%**	**-16.1%**	**28.6%**	**15.0%**	**-27.2%**	**-16.0%**	**66.8%**	**6.8%**
Total	**8.2%**	**27.2%**	**25.5%**	**48.3%**	**5.0%**	**46.0%**	**35.5%**	**10.8%**	**-0.8%**	**19.0%**	**8.4%**

Source: BofA Global Research estimates, company report

BofA GLOBAL RESEARCH

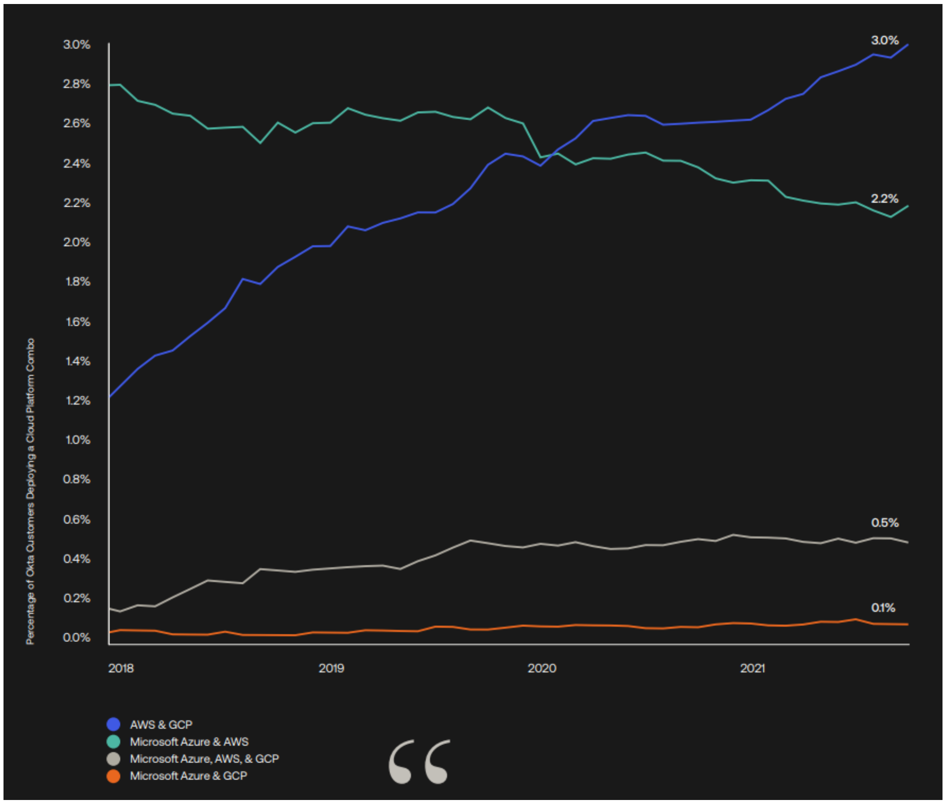
Continued multi-cloud adoption

Through our prior survey work, as well as extensive discussions with partners, management teams, and customers, we believe momentum for adopting a multi-cloud strategy has accelerated over the past several years. Large entities tend to deploy their workloads across numerous clouds to avoid cloud vendor lock-in, but also to optimize for various requirements, such as the PaaS tooling associated with each cloud, security requirements, regional availability, cost, competitive considerations and optimization of workloads for different applications (Exhibit 41).

For example, a social media company that runs computationally intensive workloads may want GCP, Azure or AWS for their AI/ML/NLP models, while also leveraging Oracle Cloud to improve cost-optimization and to host its Oracle HCM instance. We note feedback from many partners that Oracle HCM solutions run very efficiently on Oracle Cloud, but less so on other cloud service providers' infrastructure.

Given the large public cloud runway and accelerating multi-cloud adoption, we expect ample room for numerous cloud vendors to grow at or above industry growth rates.

Exhibit 41: Customers deploying multiple cloud platforms
Okta sees AWS and GCP as the most common multi-cloud deployment pairing



Source: Okta (Business at Work Report, Feb 2023)

BofA GLOBAL RESEARCH

Sizing the public cloud market via several lenses

Amazon added $11.43bn of AWS revenue ($87.9bn TTM revenue; +15% y/y) as of C3Q23, versus an estimated $12.20bn and $6.39bn for Azure and Google Cloud Platform IaaS/PaaS, respectively. While Azure and Google Cloud Platform grew faster in the last 12 months (+30% y/y and +33% y/y as of C3Q23, respectively), Amazon remains the market leader with 55% market share among the big-three cloud vendors and 31% of the total IaaS/PaaS market share.

We observe that PaaS represents a growing portion of cloud revenue and an increasingly bigger differentiator (and margin driver) for cloud service providers. Tooling around training AI models exemplifies this. Microsoft saw a meaningful increase in new customer workloads by leverage an exclusive relationship to expose OpenAI APIs.

> "Because of our overall differentiation more than 18,000 organizations now use Azure OpenAI Services*, including new to Azure customers."
>
> – Satya Nadella, Microsoft CEO, F1Q24 earnings

See Public Cloud Continued in the appendix for more.

Model Revision Framework

Reaccelerating spend in 2H24 drives model revisions

We expect software spending pressure to begin easing in Q1 with potential reacceleration in 2H24 as expectations shift toward a soft-landing scenario, an acceleration in real US GDP growth in 2H24 and rate cuts beginning in 1Q24. We provide scenario analysis to screen for software companies with the potential for the largest revenue reacceleration. We conduct this analysis by revising 2024 revenue/billings estimates across our coverage (Exhibit 42).

Exhibit 42: Our upward revision is driven by NRR and new revenue contribution
Revenue revision framework – across our coverage

Revenue Revision Framework	
Gross revenue retention	No churn change
Net revenue retention (NRR)	+200bps adjustment
New revenue contribution to growth	+50%

Source: BofA Global Research

BofA GLOBAL RESEARCH

Breaking down our revisions across the 3 components of growth

Our current 2024 forecasts are based on published BofA estimates if available or otherwise assume a carry-forward from the 2023 levels. The 2023 levels are based on reported numbers or BofA estimates for companies that do not report NRR. We apply a standard revision methodology across the three components of growth:

1. **Gross revenue retention (GRR)**

   We maintain gross revenue retention at the same levels as 2023 across our coverage universe due to limited management commentary on improving churn.

2. **Net revenue retention (NRR)**

   We adjust net revenue retention growth +200bps from our current 2024 forecast across our coverage universe.

3. **New revenue contribution to growth from new customer signings**

   We adjust new revenue contribution to growth from new customer signings +50% from current 2024 levels across our coverage universe.

We view companies with the highest percentage of revenue growth from new customer signings as best positioned for potential revenue reacceleration. Within Large Cap, we view HubSpot (HUBS), Shopify (SHOP) and Workday (WDAY) as best positioned for potential revenue growth acceleration and Intuit (INTU), Oracle (ORCL) and Bentley Systems (BSY) as worst positioned. Within Mid Cap, we view Dropbox (DBX), Freshworks (FRSH) and Paylocity (PCTY) as best positioned and GitLab (GTLB), Confluent (CFLT) and Informatica (INFA) as worst positioned. Within Small Cap, we view Weave (WEAV), Alarm.com (ALRM) and C3.ai (AI) as best positioned and Vertex (VRTX), HashiCorp (HCP) and Blackbaud (BLKB) as worst positioned.

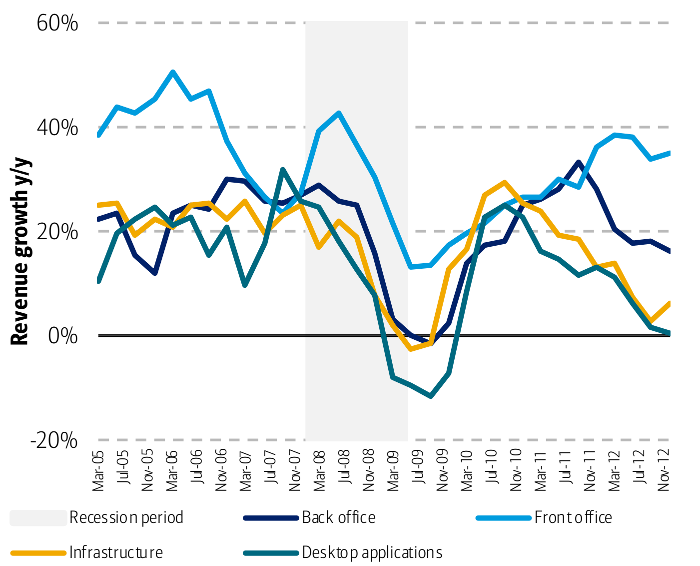
Operating margins have historically held as revenue growth accelerates

We examined margin trends for software companies before, during and exiting the Great Recession and Tech Bubble in our recession testing report. Our analysis indicates that during periods of revenue and billings growth deceleration (Exhibit 43, Exhibit 44, Exhibit 46, Exhibit 47) the software industry experienced margin expansion (Exhibit 45, Exhibit 48), illustrating how leverage inherent in software businesses from sales/marketing scales as the revenue mix shifts to renewals from new customer.

However, margins largely held during the late-Downturn to early-Recovery phases of the business cycle, even as revenue growth had begun to accelerate, likely due to companies reinvesting revenue upside without compromising profitability when coming out of an economic slowdown. We expect software companies to continue executing on a more balanced growth-profitability approach in our revenue reacceleration scenario and, therefore, do not apply a downward revision to our current operating margin estimates for 2024.

Exhibit 43: Great Recession – revenue growth y/y

Front office, back office and infrastructure revenue began to decelerate 3-4 quarters after the recession began and reaccelerated 2-3 quarters after it ended

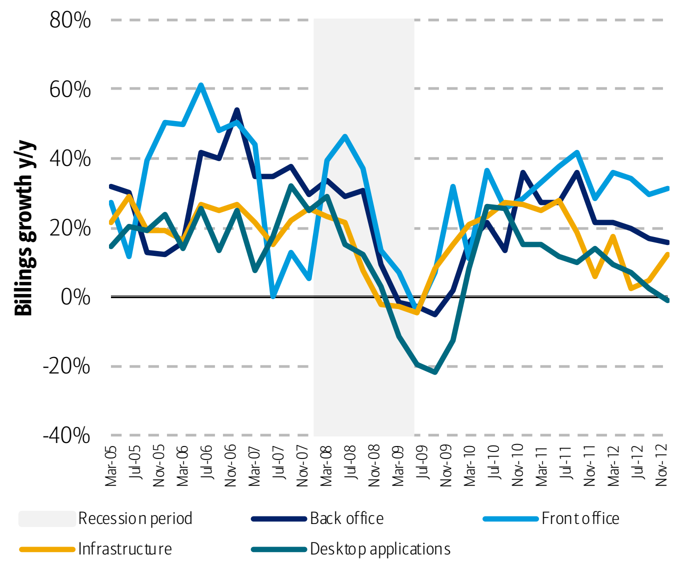


Source: BofA Global Research, Bloomberg

BofA GLOBAL RESEARCH

Exhibit 44: Great Recessions – billings growth y/y

Front office, back office, infrastructure and desktop billings growth reaccelerated 1-3 quarters after the recession ended

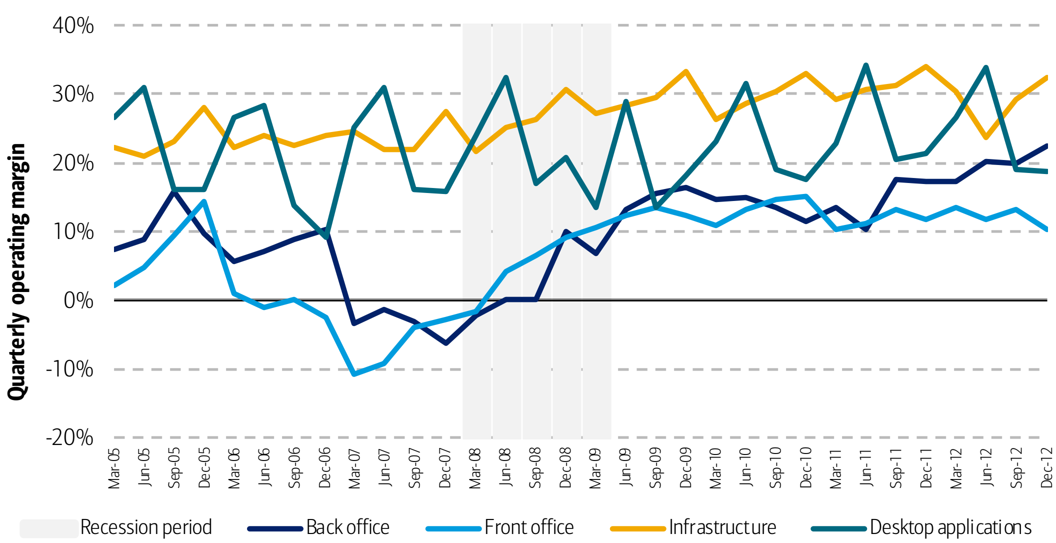


Source: BofA Global Research, Bloomberg

BofA GLOBAL RESEARCH

Exhibit 45: Great Recession – avg quarterly operating margin

Front office, back office and infrastructure operating margins expanded during periods of revenue deceleration

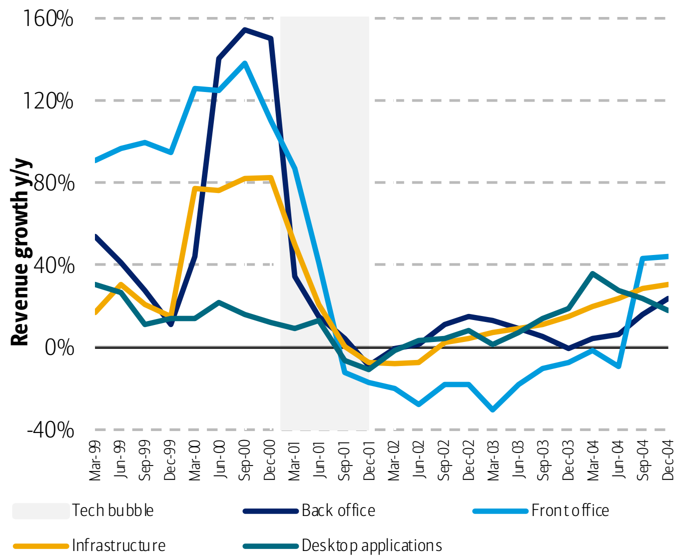


Source: BofA Global Research, Bloomberg

BofA GLOBAL RESEARCH

Exhibit 46: Tech bubble – revenue growth y/y

Front office, back office and infrastructure revenue began to decelerate 1 quarter after the recession began and reaccelerated 3 quarters after it ended

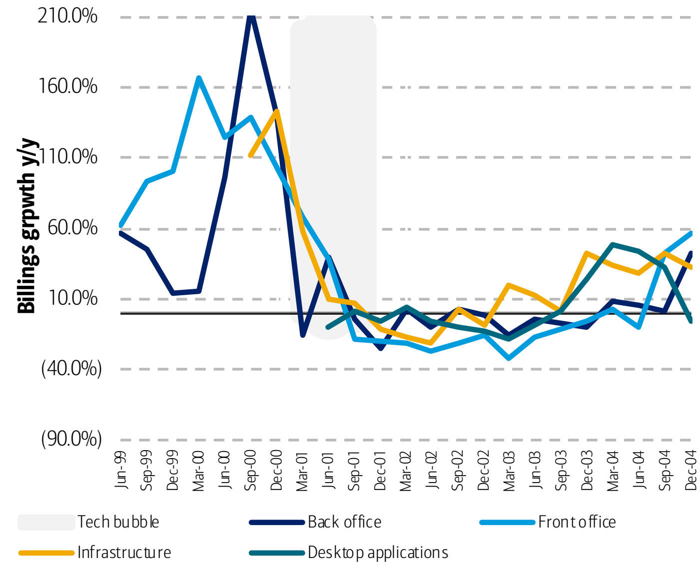


Source: BofA Global Research, Bloomberg

BofA GLOBAL RESEARCH

Exhibit 47: Tech bubble – billings growth y/y

Front office, back office and infrastructure billings growth reaccelerated 3 quarters after the recession ended



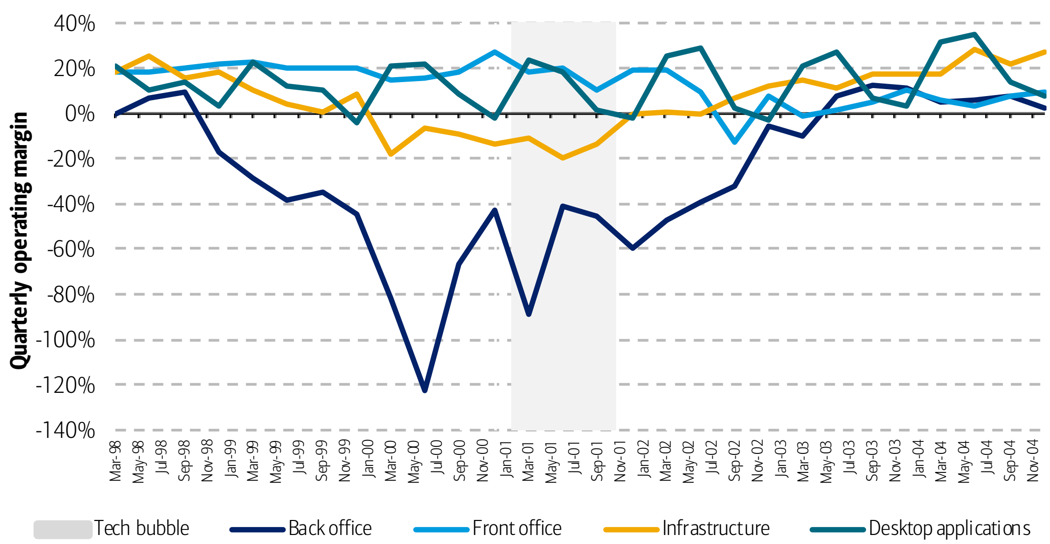
Source: BofA Global Research, Bloomberg

Note that Infrastructure and Desktop have deferred revenue data going back to 4Q20 and1Q20, respectively

BofA GLOBAL RESEARCH

Exhibit 48: Tech bubble – avg quarterly operating margin

Operating margins largely held or moderately expanded during periods of revenue deceleration



Source: BofA Global Research, Bloomberg

BofA GLOBAL RESEARCH

Our Industry Positioning for 2024

Enterprise software TAM likely to expand

The global enterprise software market's total addressable market (TAM) is estimated to reach $920bn in 2024 (12% y/y) with 55% and 22% of total TAM coming from the Infrastructure and ERP & Back Office subsectors, respectively (Exhibit 49 & Exhibit 50). We note Infrastructure is growing at a 14% CAGR, above the industry average of 13%, and ERP & Back Office is growing at a 10% CAGR, below the industry average.

We expect enterprises and SMBs to reprioritize front-office applications after two years of sluggish growth following pandemic-driven overconsumption, which may drive tailwinds for CRM (bullish), but headwinds for ERP & Back Office (mixed) and HCM (mixed).

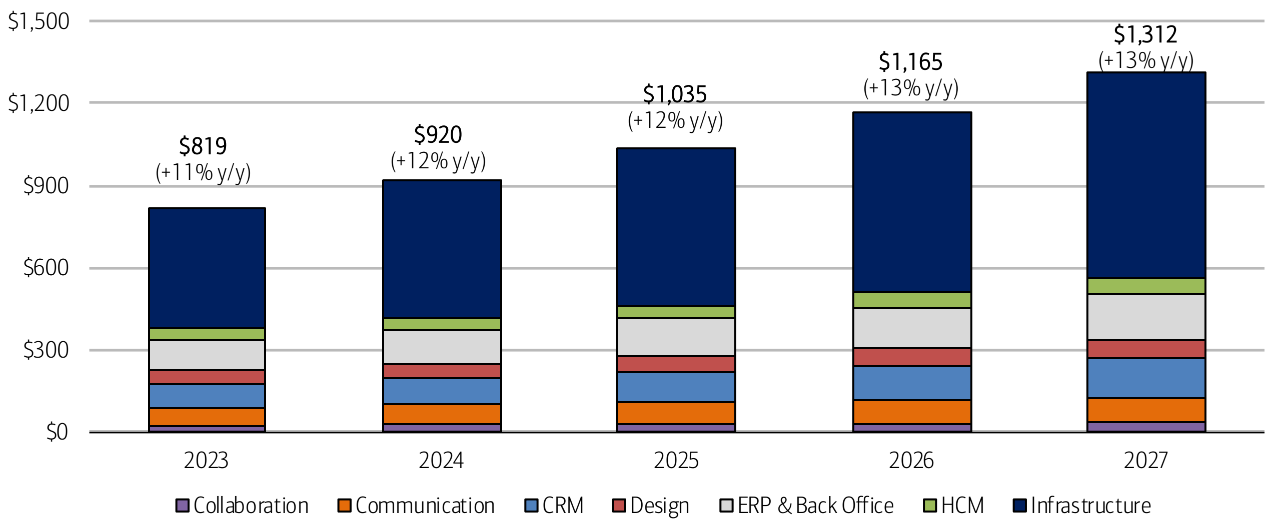
Exhibit 49: The global enterprise software market is expected to grow at a 13% CAGR and reach $920bn in '24 (+12% y/y)
Enterprise software TAM estimates ($bn) and percent change y/y

	Total Addressable Market (TAM) Estimates										
Subsector	2023	% Y/Y	2024	% Y/Y	2025	% Y/Y	2026	% Y/Y	2027	% Y/Y	CAGR ('23-'27
Collaboration	$23	10%	$25	12%	$28	11%	$31	11%	$34	10%	11%
Communication	$68	10%	$74	9%	$80	8%	$86	7%	$92	7%	8%
CRM	$87	12%	$98	13%	$111	13%	$125	13%	$140	12%	13%
Design	$46	9%	$50	9%	$55	9%	$60	9%	$65	9%	9%
ERP & Back Office	$113	9%	$125	10%	$138	10%	$152	11%	$168	11%	10%
HCM	$40	10%	$45	12%	$50	12%	$56	12%	$62	12%	12%
Infrastructure	$442	12%	$503	14%	$573	14%	$655	14%	$749	14%	14%
Total TAM	$819	11%	$920	12%	$1,035	12%	$1,165	13%	$1,312	13%	13%

Source: BofA Global Research, IDC

BofA GLOBAL RESEARCH

Exhibit 50: Infrastructure has the largest estimated 2027 TAM ($749bn), 4.5x larger than ERP/Back Office's
Software subsector TAMs ($bn) and percent change y/y



Source: BofA Global Research, IDC

BofA GLOBAL RESEARCH

Our subsector positioning for 2024

Subsectors most bullish/cautious

We are bullish on the CRM and Infrastructure subsectors and cautious on the Design subsector. Top Buys within CRM include Salesforce (CRM) and HubSpot (HUBS) and top picks within Infrastructure include GitLab (GTLB), MongoDB (MDB), Microsoft (MSFT) and ServiceNow (NOW) (Exhibit 51).

Exhibit 51: We are bullish on the CRM and Infrastructure subsectors
Server & Enterprise Software Coverage Matrix

	Coverage Universe						
	Communications	CRM	Design	ERP & Back Office	HCM	Infrastructure	Vertical
	Mixed	*Bullish*	*Cautious*	*Mixed*	*Mixed*	*Bullish*	*Mixed*
Top Buys	NICE RNG	CRM HUBS	U	BILL	WDAY	GTLB MDB MSFT NOW	CCCS
Top Underperforms	TWLO	–	–	AVDX BL	–	EVBG	ENFN

Source: BofA Global Research

BofA GLOBAL RESEARCH

Communications – *Mixed Outlook*

Industry Overview

The Communications software subsector is a $60bn industry, growing 8% y/y, according to IDC. Communications software encompass three key segments, including 1) unified communication and meetings, 2) contact centers and 3) Communications Platform-as-a-Service (CPaaS). Key adoption cycles are driven by 1) ongoing move to the cloud, 2) bundling and discounting of solutions, 3) seat contraction, stabilization and expansion based on macro cycles and 4) AI-enabled features for added workflow automation.

Industry Outlook

We are mixed on the Communications subsector in 2024 for several reasons. First, we expect seat contraction, which had been driven by post-pandemic and macro uncertainty, has decelerated. Second, our view is that competitive and AI TAM depreciation risks are well understood and priced into valuations for many of the companies in our coverage universe. Our client conversations, as well as short interest positioning (see Institutional Positioning & Short Analytics), indicate negative sentiment for the subsector. However, these factors are likely offset by seat expansion/net additions that will ramp slowly at enterprises. Additionally, Communications software is at greater risk of vendor consolidation, in our view.

Top Buys

We view NICE Ltd (NICE) as likely to take market share in the cloud contact center applications market, which is projected to grow at a 21% CAGR (2023-2026). The company's combination of customer experience (CX), digital and AI automation and global infrastructure makes it uniquely positioned to serve the large enterprise market. We project revenue acceleration and 100bp+ of margin expansion as NICE's cloud business scales. We expect shares to rerate higher from the current 20x C24e FCF as we move through the year and focus shifts to growth potential and margins.

RingCentral (RNG) is a long-term Experience Communications-as-a-Service (xCaaS) winner due to its breadth of offerings, strategic partnerships and financial strength, which provide multiple avenues to drive FCF and value to equity holders. Management has improved profitability and FCF generation, but we also see opportunity for incremental efficiency gains. RNG is inexpensive at 12x C24e FCF and we expect shares a rerate higher as the macro and industry environment shift favorably.

Top Underperforms
We are cautious on Twilio (TWLO) due to 1) increasing competition in CPaaS; 2) our view that Customer Data Platform (CDP) adoption is likely to lag other IT spending priorities in a looser budget environment; and 3) an uncompelling valuation on both an absolute and sum-of-the-parts (SOTP) basis.[9]

CRM – *Bullish Outlook*

Industry Overview
The Customer Relationship Management (CRM) software subsector is a $98.1bn industry, growing 13% y/y, according to IDC. CRM applications encompass four key segments, including 1) sales automation, 2) customer service management, 3) marketing automation and 4) eCommerce. Key adoption cycles are driven by 1) the ongoing move to the cloud, 2) broader suites running on a single platform for an integrated view of a customer across CRM channels and 3) AI-enabled features for added workflow automation.

Industry Outlook
We are bullish on the CRM subsector in 2024 for several reasons. First, we expect enterprises and SMBs to reprioritize CRM and front-office applications after two years of sluggish growth following pandemic-driven overconsumption. Second, we believe the AI opportunity to be significant in the front office applications category. The ROI associated with AI-enabled automation is most compelling for solutions that drive sales productivity, such as CRM, which translates to revenue uplift. The CDP adoption cycle is early stage and expected to continue ramping. We provide a deep dive on the early stage, but ramping, CDP adoption cycle in our industry primer.

Top Buys
Salesforce (CRM) and HubSpot (HUBS) represent top picks in 2024. Reprioritization of CRM spending and contributions from AI offerings, such as Data Cloud, Sales Cloud GPT and Service Cloud GPT, may drive a return to sustained mid-teen revenue growth (from 13% y/y in Q3). Coupled with ongoing productivity efforts that could boost margins by 200-300bps in an upside case, we see the potential for sustainable 30-35% FCF growth in each of the coming three years. We expect shares to rerate higher from the current 18x C25e FCF as we move through the year and focus shifts to its growth potential and margins.

Salesforce (CRM) has had a nice run, rallying 95% in 2023. However, the shares still trade at a discount to the software GARP group (18x versus 27x). The stock is likely to rerate higher with upward to revisions to FCF growth (towards 30% in each of the coming 3 years) due to 1) enduring mid-teen top-line growth and 2) incremental margin expansion. We expect the company to sustain mid-teen top-line growth in the coming years, outpacing industry growth of 13%, driven by growing AI contribution (an underappreciated AI winner), vendor consolidation (as the industry leader) and the ongoing move to the cloud (the CRM cloud leader). With a continued focus on sales productivity under new leadership (still a high 31% of revenue), we believe there is potential for 200-300 basis points margin expansion in each of the coming 3 years.

HubSpot (HUBS) is the winner in the vast SMB segment of the $98bn CRM market given 1) leading installed base (185,000 customers); 2) breadth of offering, spanning marketing, sales, service, content management; and 3) broad channel of hundreds of digital marketing agencies. We believe a long runway for 20%+ growth exists. With a TAM of 5mn US SMBs alone, HubSpot is still in the early stages of market consolidation with the leading cloud offering. The stock is trading at 8.3x C26e sales, or 0.3x adjusted for 25% growth, a meaningful discount to the large cap software group, trading at 0.6x 16% growth on macro driven deceleration in 2023. The next catalyst for the shares is likely to be upward revisions to revenue growth (from current 17% towards mid/high 20s

[9] *CDPs provide a solution for leveraging customer data for personalized sales/marketing targeting.*

growth) from easing macro pressure on the SMB and growing contribution from an impressive line of AI offerings (chatbots, copilots, predictive analytics) to launch in premium Pro and Enterprise Q1.

Design – *Cautious Outlook*

Industry Overview

The Design software subsector is a $50bn industry, growing 8%y/y, according to IDC. Design applications encompasses four key segments, including 1) product engineering and design (CAD/CAM/CAE), 2) process modelling and optimization, 3) asset performance management and 4) product life-cycle management. Key adoption cycles are driven by 1) digitization of workflows, 2) incremental demand from the $1.2tn Infrastructure Investment and Jobs Act (IIJA) and 3) increasing demand for productivity enhancing software solutions due to qualified worker shortages and project backlogs.

Industry Outlook

We are cautious on the Design subsector in 2024. A combination of lower rates, increased IIJA spending and large project backlogs (median of 11 months) will likely drive strong demand across the Design ecosystem. However, we see lower revenue growth upside and multiple expansion for Design software stocks relative to other software subsectors in an improving macro and enterprise IT spending environment.

Top Buys

Unity (U) is our top Design pick in 2024. Unity has been dogged by operational and communication headwinds since early 2022. First, data ingestion and code issues drove market share loss. Second, execution on Runtime fee pricing was received poorly by developers and investors. Finally, the subsequent CEO change added to uncertainty. We are bullish on Unity due to 1) its strong position in the mobile game creation and advertising business, 2) our work quantifying the potential impact of pricing changes that suggest upside to consensus, 3) higher revenue growth and increased profitability and operational following the company's strategic review and 4) an attractive valuation based on our view that annualized EBITDA of $1bn by 4Q24 is achievable.

ERP & Back Office – *Mixed Outlook*

Industry Overview

The Enterprise Resource Planning (ERP) software subsector is a $74.8bn industry, growing 10% y/y, according to IDC. ERP software is used to support departments, such as finance, procurement and manufacturing, and provide a centralized platform for data management. Key adoption cycles are driven by 1) ongoing move to the cloud, 2) advanced analytics for real-time financial planning solutions and 3) peripheral solutions to automate various finance department functions, such as procurement, sales tax and treasury management. We provide a deep dive on ERP adoption trends in our industry primer.

See Back Office Software Overview in the appendix for more.

Industry Outlook

We are mixed on the ERP/Back Office subsector in 2024. The subsector exhibits slower growth relative to others in the enterprise applications space due to fewer innovation cycles than in front office. The effort to migrate financials or supply to the cloud is a costly effort, given the complexity and pervasive integration with other back- and front-office systems. Financials and supply chain systems are at feature parity across vendors, leaving limited ability to differentiate offerings and gain market share. The ERP/back office spending comparisons are tougher in 2024, given post-pandemic spend cycle tailwinds following a period of pandemic-driven project delays and pent up demand.

Top Buys

We highlight small business B2B payments vendor BILL (BILL). Core transaction revenue growth decelerated significantly in 2023 driven by a weakening SMB spend environment and pressure on higher margin transaction services, such as virtual card and cross boarder payments. We have likely seen the bottom, in our view, and expect transaction revenue growth to reaccelerate back to 40%+ as SMB spend improves in line with an improving macro environment.

Top Underperforms

We highlight mid-market B2B payments vendor AvidXchange (AVDX) as a relative underperformer. Given that the company includes a check fee with subscriptions, there is little incentive for customer to add higher-margin services, such as ACH and virtual card. Avid also targets the real estate vertical, which leaves the company exposed to the weakening industry.

We highlight accounting automation vendor BlackLine (BL) as a relative underperformer. While the company is undergoing a revitalization of its core enterprise offerings and go-to-market messaging, stock underperformance is likely until key growth metrics (revenue, RPO, billings, NRR) reaccelerate and/or expand.

HCM – *Mixed Outlook*

Industry Overview

The Human Capital Management (HCM) software subsector is a $44.5bn industry, growing 11% y/y, according to IDC. HCM is a subset of back office software that provides workforce management solutions, including human resources information systems (HRIS), payroll, time and attendance tracking, employee performance management, talent acquisition tools, as well as many others. Key adoption cycles are driven by 1) ongoing move to the cloud, 2) digital services to enable hybrid work and 3) AI-enabled features to automate recruiting and talent management. We provide a deep dive on HCM adoption trends in our industry primer.

Industry Outlook

We are mixed on the HCM subsector in 2024, but a bit more bullish than on financials in Back Office. Similar to Financials, the HCM subsector exhibits slower growth relative to others in the enterprise applications space due to fewer innovation cycles than in front office. However, the HCM subsector is further along in the migration to the cloud with an estimated 75% share of workloads already in cloud vs 43% for financials, according to IDC. A cloud installed base enables easier upsell of peripheral solutions, given less integration effort required, such as those for performance, recruiting and learning. A hybrid work environment is also driving adoption of solutions to manage a distributed workforce, such as self-service portal and voice of the employee. HCM vendors face a tougher comparison in 2024, similar to ERP/financials vendors. However, we expect a larger upsell cycle for the HCM subsector in 2024.

Top Buys

We highlight HCM/ERP cloud leader, Workday (WDAY). We see the potential for Workday revenue growth to accelerate toward mid-20% growth from its current high-teens level due to 1) ongoing progress in cross-selling additional HCM modules, such as learning, performance and recruiting, 2) new platform deals (HCM and FINS) and 3) international penetration. Steady R&D and sales/marketing leverage could drive solid mid-20% FCF growth in an upside case.

Infrastructure – *Bullish Outlook*

Industry Overview

The Infrastructure software subsector, which includes both public cloud and on-premise infrastructure, is a massive $503bn industry, growing 14% y/y, according to IDC. Infrastructure software encompasses seven key segments, including 1) compute/operating systems, 2) storage, 3) networking, 4) data management (database, data warehouse), 5) integration/middleware, 6) analytics and 7) AI platforms. Key adoption cycle are driven by 1) ongoing move to the public cloud, 2) infrastructure running on muti-cloud platforms, 3) suites to manage IT development, security and operations functions in an end-to-end and continuous fashion (DevSecOps), 4) data warehouses to support analytics and 5) AI platforming.[10]

Industry Outlook

We are bullish on the Infrastructure subsector group in 2024 for several reasons. First, we expect tailwinds for consumption-priced public cloud offerings to reverse as the macro environment improves. Recent results from consumption vendors, such as Microsoft Azure, Snowflake, MongoDB and Datadog, indicate that consumption revenue growth has already bottomed on easier comparisons. Our view is that increasingly aggressive workload migration to the cloud is likely as the macro environment improves may provide a path to revenue growth acceleration. Second, the significant secular shift to public cloud infrastructure may drive an increasingly mixed environment of on-premise and multi-cloud technologies, which drives demand for SaaS infrastructure and management tools to manage the incremental complexity. Finally, increasingly mixed infrastructure environments and demand to deploy next-generation applications are driving integrated DevSecOps offerings to automate IT development and operations functions.

Top Buys

Microsoft (MSFT) is ahead of the curve with AI. We believe that there is potential for accelerating top-line growth (towards high teens from current mid-teens) from growing AI contribution in the two core growth franchises. In the commercial office business, gradual adoption of the new Microsoft 365 copilot offering could drive accelerating commercial Office growth to 20%+ growth from the current 17% cc in the coming quarters. In Azure, ongoing ramp of OpenAI and the potential for improving public cloud workload migration exiting the tougher macro are likely to drive upside to our estimates for mid-20s growth. With Microsoft operating at datacenter scale, the company can deliver a healthy 50 to 100 basis points annual margin expansion over the long term. The net is that FCF growth is likely to accelerate nicely from the current mid-teen level.

ServiceNow (NOW) is still early consolidating three large opportunities: IT Service Management (ITSM), IT Operations Management (ITOM) and custom applications, estimated by Gartner to be $21.3bn, $16.5bn and $64.7bn, respectively. Easing macro pressure and contribution from new AI offerings are likely to drive accelerating revenue and backlog growth from already best in class mid 20s level today. Coupled with steady margin expansion, we believe solid, sustained mid/high 20s FCF growth is reasonable.

We highlight MongoDB (MDB), which we view as well-positioned to capture market share in the $108bn database market. MongoDB commands formidable competitive advantages, including 1) a large developer community that has produced 405mn Community Server downloads, 2) a proprietary document storage model, 3) support for 13 programming languages and 4) a multi-channel self-serve and direct sales go-to-market. Channel feedback suggests that Mongo (Atlas) is increasingly viewed and deployed as the database of choice to support growing AI applications. While Q3 results missed upside expectations, our view is that Mongo remains on a path to accelerating ARR growth as core Atlas cloud offering deployments increase in line with large enterprise develop and adopt AI initiatives.

We highlight GitLab (GTLB), which we view as well positioned to be a share gainer in the $50bn+ DevSecOps opportunity which is a part of the broader $503bn infrastructure software category. Over the years, GitLab has successfully developed an end-to-end DevSecOps platform that enables developer teams, IT operations teams, and security teams to efficiently manage application development, deployment, while being secure. We believe the business is setup to deliver 25%+ y/y revenue growth with expanding operating margins and free cash flow margins over the medium term, driven by 1)

[10] *DevSecOps = Development, Security and Operations*

DevSecOps vendor consolidation to its disruptive end-to-end DevSecOps platform; 2) pricing power, demonstrated by its Premium Tier price increase; and 3) ramping AI product add-on ($9/month/user), which became generally available December 21, 2023.

Oracle (ORCL) – reiterate Neutral rating

Disappointing cloud growth in the last two quarters underscores our view that Oracle is more reliant on legacy premise database and applications customers migrating to the cloud, as opposed to new workloads moving to Oracle's cloud offerings (such as Oracle Cloud Infrastructure or Fusion applications). This provides a higher degree of risk for the company to achieve the FY26 top-line target of $65bn. Also, ramping capex to support cloud datacenter growth is likely to weigh on margin, placing risk to the company's FY26 margin target of 45% (flattish from current level).

Top Underperforms

We highlight incident response vendor Everbridge (EVBG) as a relative underperformer. Over the past year, the company has right-sized its operation and is focusing on its core Critical Events Management (CEM) offering to drive growth. However, shares may trail its Infrastructure peers until its durable medium-term revenue growth profile is defined.

Vertical – *Mixed Outlook*

Industry Overview

The Vertical software subsector is a $183bn industry, growing 10% y/y, according to Gartner. Vertical software encompasses stand-alone applications that are unique to a specific market (not modules or extensions of horizontal applications/platforms). For example – claims management software for insurance companies or product engineering and design software for manufacturers. Key adoption cycles are driven by 1) ongoing system modernization/migration to the cloud, 2) increasing digitization of workflows to streamline processes and 3) growing preference for specialized software available out of the box (versus custom development in-house).

See Vertical Software Overview in the appendix for more.

Industry Outlook

Our outlook is mixed on the vertical software subsector in 2024. Vertical software demand is based in large part on end-market cyclical and secular forces. For example, we are mixed on insurance and healthcare software, and skew bullish for financial services and education software. Growth has remained relatively resilient across the vertical software landscape in 2023 due to deep moats and low customer churn, a trend we expect to continue in 2024. We see both less upside and less downside to 2024 consensus revenue estimates across the group when compared to other subcategories such as Infrastructure, and believe valuations adequately reflect the high degree of revenue visibility.

Top Buys

We highlight CCC Intelligent Solutions (CCCS) as a top pick within vertical software, which we believe is well-positioned to grow 8-12% for the foreseeable future. Trends are beginning to inflect positively in CCCS' end-markets as P&C insurance providers steadily overcome inflation-related profitability headwinds. We believe CCCS has a tangible AI monetization opportunity and are bullish on the potential for Estimate STP to drive upside to consensus estimates as the offering scales. The Estimate STP value proposition is compelling (saving P&C Insurance companies ~80% relative to legacy methods) and represents a $150mn+ revenue opportunity. The revenue opportunity for other emerging solutions like Diagnostics is also underappreciated by investors, in our view, and should provide steady support to demand as vehicles grow increasingly complex. The company's progress in reducing PE ownership, high revenue visibility and attractive (~40%) EBITDA margins are also supportive of our bullish view entering 2024.

Top Underperforms

We highlight investment management vertical vendor Enfusion (ENFN) as a relative underperformer. While execution has improved over the past year, the outlook projects a revenue growth + EBITDA margin profile that is below its vertical peers (Rule-of-30 for CY24, vs Rule-of-35+ peers), which could constrain share performance until a faster growth or better margin profile emerges.

Examining Estimates Post-Q3 Earnings

BofA Software base case estimates for 2024

Given the more discretionary nature of software spending and an overall balanced, yet ongoing cautious tone noted earlier in Mgmt macro commentary – read-throughs for spending, we model a net 3.1% revenue deceleration for 2024 y/y, driven by a net 1.7%, 6.3% and 1.6% revenue deceleration for the large, mid and small-cap software groups, respectively (Exhibit 52).

Exhibit 52: We are modeling a net 3.1% deceleration for 2024 relative to 2023

Y/Y revenue growth – BofA Software team estimates

	Revenue Growth Estimates		
	2023E	2024E	Change
BofA Large-Cap Avg	17.0%	15.3%	-1.7%
BofA Mid-Cap Avg	20.5%	14.2%	-6.3%
BofA Small-Cap Avg	13.5%	11.9%	-1.6%
Total Coverage Group Avg	16.7%	13.6%	-3.1%

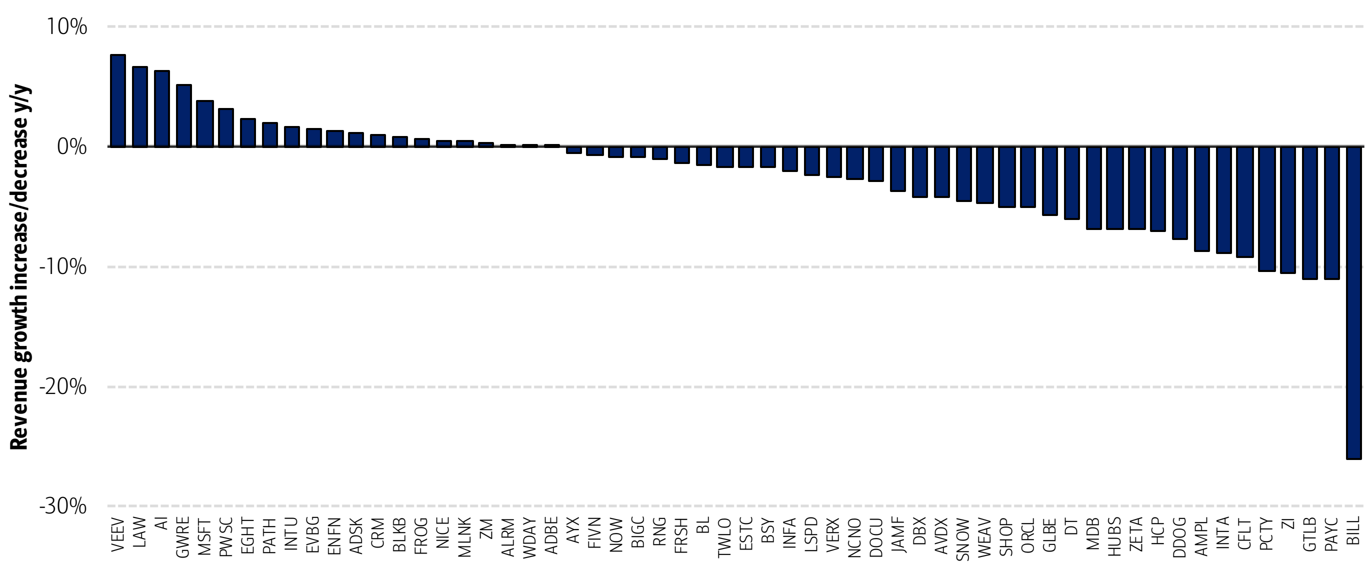
Source: BofA Global Research, company filings

BofA GLOBAL RESEARCH

Across our coverage universe, Veeva (VEEV), CS Disco (LAW), C3.ai (AI), Guidewire (GWRE) and Microsoft (MSFT) have the largest revenue growth increase potential in 2024, and BILL (BILL), Paycom (PAYC), GitLab (GTLB), ZoomInfo (ZI), and Paylocity (PCTY) have the largest revenue growth decrease potential (Exhibit 53).

Exhibit 53: Largest revenue growth increase/decrease potential in '24: Veeva, CS Disco, C3.ai / BILL, Paycom, GitLab

Revenue increase/decrease in 2024 y/y by company



Source: BofA Global Research, company filings

BofA GLOBAL RESEARCH

Enterprise application vendors signal green shoots

Mgmt commentary indicates upside risk to consensus revenue growth rates

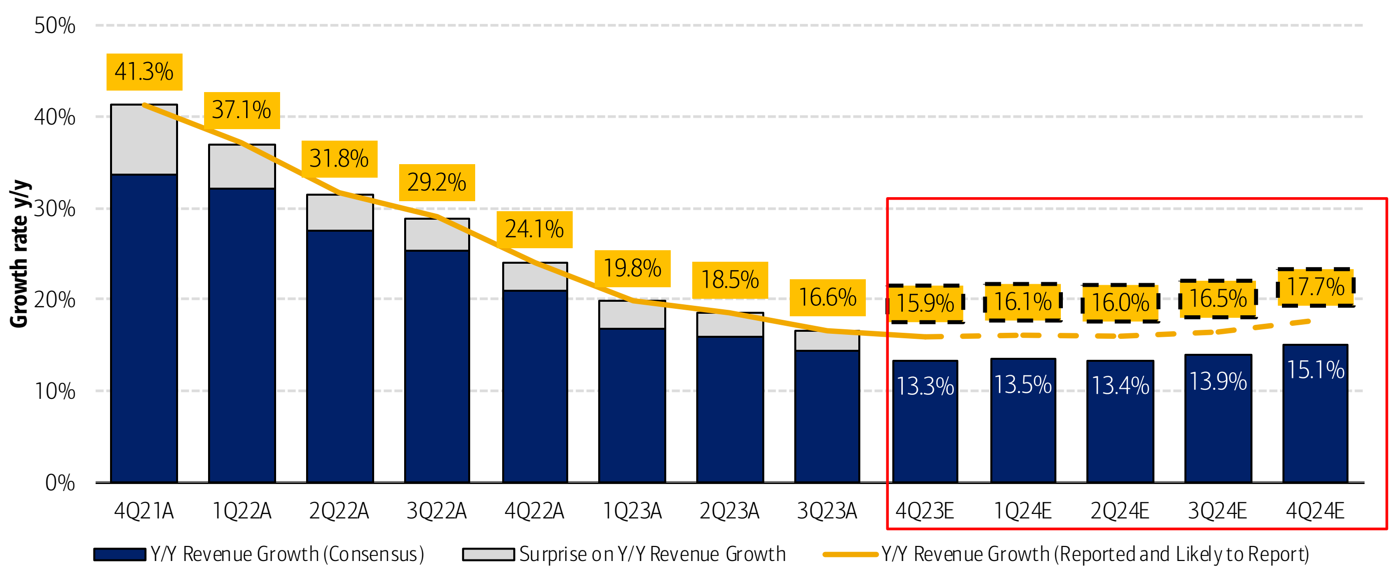
We view our base case estimates as adequately reflecting the stabilizing, yet still cautious, sentiment reflected in management commentary. However, we were encouraged by commentary from a collective of enterprise and cloud-consumption vendors for the first time since early 2022, which leads us to be more constructive on the software sector in 2024.

Revising current consensus revenue growth rates upward given stabilization

For every company earnings report, there is a sell-side estimate and a buy-side bogey, which typically amounts to a beat of the same or greater magnitude as recent quarters. We determined the average revenue growth surprise, calculated as reported growth rate minus consensus growth rate, across our coverage universe. The average revenue growth surprise from 1Q23-3Q23 averaged 2.6% y/y, which we apply to our estimates for upcoming quarters to forecast the average buy-side bogey revenue growth expectation (Exhibit 54).

Our revised revenue growth rate expectations for 4Q23, 1Q24, 2Q24 and 3Q24 are 15.9%, 16.1%, 16.0% and 16.5%, respectively, implying a relatively small deceleration in 4Q23, stabilization in 1H24 and reacceleration in 2H24, which we view as consistent with the current macro environment. Our adjusted revenue growth rate is likely conservative, given a deceleration on easier comparisons. We also expect our adjusted growth rate to be conservative due to our expectations for growth reacceleration in 2024 following better-than-expected Q3 earnings results from large enterprise application vendors, such as Salesforce (CRM), ServiceNow (NOW) and Workday (WDAY). We view better-than-expected earnings from these large enterprise application vendors as a potential leading indicator for the rest of the group, including segments like consumption and SMB that have not yet seen a meaningful uptick in demand.

Exhibit 54: Adjusting the current consensus revenue growth rates upward by 2.6%
4Q23's adjusted growth rate q/q represents a slight deceleration, but we expect stabilization in 1H24 before reacceleration in 2H24



Source: BofA Global Research, Visible Alpha

BofA GLOBAL RESEARCH

Surprise history on revenue growth for the trailing 8 earnings seasons

We compiled the revenue growth surprise history y/y across our coverage over the prior eight earnings seasons (Exhibit 55). The magnitude of reported upside declined to 2.3% in 3Q23 from 7.6% in 4Q21. From 1Q23 to 3Q23, large, mid and small-cap software companies beat on average by 2.8%, 3.1% and 2.1%, respectively. The magnitude of the beat has largely stabilized for large-cap and small-cap. However, for mid-cap names, 3Q23 was an exception, impacted by earnings from Global-e (GLBE), Unity (U), and Paycom (PAYC).

Exhibit 55: Since 1Q23, the magnitude of the beat has largely stabilized for large-cap and small-cap
Surprise on Y/Y revenue growth from 4Q21 to 3Q23*

	Revenue Growth Surprise Y/Y								
	4Q21A	1Q22A	2Q22A	3Q22A	4Q22A	1Q23A	2Q23A	3Q23A	Avg (1Q23-3Q23)
BofA Large-Cap Avg	4.00%	2.80%	2.50%	2.70%	3.40%	2.80%	2.60%	2.90%	2.80%
BofA Mid-Cap Avg	9.30%	5.70%	5.30%	3.60%	3.00%	3.90%	3.50%	1.80%	3.10%
BofA Small-Cap Avg	9.00%	5.30%	4.20%	3.90%	3.10%	2.20%	1.90%	2.30%	2.10%
Total Coverage Group Avg	7.60%	4.70%	4.10%	3.50%	3.20%	2.90%	2.60%	2.30%	2.60%

Source: BofA Global Research, Visible Alpha
*Surprise on growth is calculated as reported growth minus pre-quarter consensus growth.

BofA GLOBAL RESEARCH

Consensus revision on 4Q23 growth pre- and post-3Q23 earnings

Current consensus models a 0.6% downward revision on average across our coverage universe, driven by 0.9%, -2.0%, and -0.6% revisions for the large, mid and small-cap groups, respectively (Exhibit 56). The large-cap group's positive revision, in contrast to negative revisions for the mid and small-cap groups, stood out to us. MongoDB (MDB) +7.4%, Microsoft (MSFT) +5.9%, Datadog (DDOG) +5.1% and Snowflake (SNOW) +3.1% had the largest positive revisions among the large-cap group. Across our coverage universe, GitLab (GTLB) and Weave (WEAV) had the largest positive revisions in 4Q23, and CS Disco (LAW), Global-e (GLBE), Paycom (PAYC) and BILL (BILL) had the largest negative revisions (Exhibit 57).

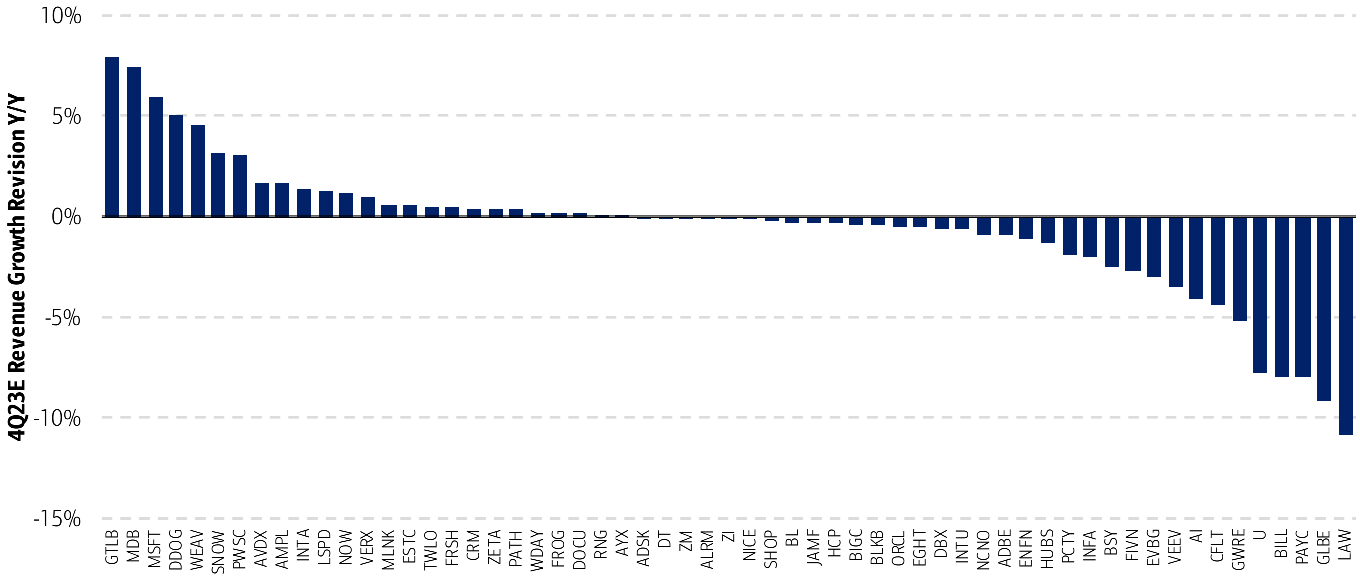
Exhibit 56: The large-cap's overall positive revision (+0.9%) stood out to us
Consensus revision on 4Q23 growth before and after 3Q23 earnings

	Y/Y Revenue Growth (4Q23E)		
	Pre 3Q23	Post 3Q23	Variance
BofA Large-Cap Avg	13.10%	14.10%	0.90%
BofA Mid-Cap Avg	16.40%	14.50%	-2.00%
BofA Small-Cap Avg	12.50%	11.90%	-0.60%
Total Coverage Group Avg	13.90%	13.30%	-0.60%

Source: BofA Global Research, Visible Alpha

BofA GLOBAL RESEARCH

Exhibit 57: Largest positive/downward revision in 4Q23: GitLab, MongoDB, Microsoft / CS Disco, Global-e, Paycom, BILL
Consensus revision on 4Q23 growth rate y/y by company



Source: BofA Global Research, Visible Alpha

BofA GLOBAL RESEARCH

Digital Assets & Tokenization

Tokenization – an infrastructure evolution

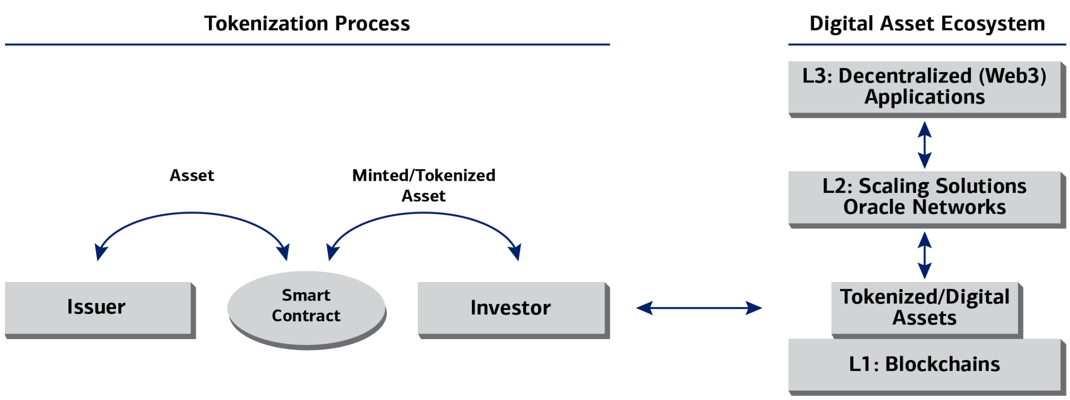
We are on the verge of an infrastructure evolution that may reshape how value is transferred, settled and stored across every industry. Tokenization is just one distributed ledger technology/blockchain technology (DLT/BCT) application, but this one application may transform financial and non-financial infrastructure and public and private financial markets over the next 5-15 years.[11] Disruptive innovations like the radio, television and email took 30 years to reach mainstream adoption. We expect a far shorter road for digital assets.

> "I actually believe this technology is going to be very important…I believe the next generation for markets, the next generation for securities, will be tokenization of securities."
>
> – Larry Fink, BlackRock chairman & CEO, Nov'22

Efficiencies and reduced cost for every industry

Financial institutions (FIs) are increasingly leveraging DLT/BCT, smart contracts and tokenization to enable 24/7 real-time or customizable settlement; reduce credit risk; lower settlement, financing and operational costs; increase liquidity for previously illiquid assets like physical gold, private equity and venture capital; and allocate capital more efficiently (Exhibit 58). Corporates are leveraging the same technology to generate incremental revenues, automate manual processes, optimize supply chains, increase customer loyalty, offset contributions to climate change and combat counterfeiting. We expect DLT/BCT implementation to accelerate among FIs and corporates as the opportunity cost of uncaptured efficiencies increases.

Exhibit 58: Tokenized assets and funds enable efficiencies that may drive digital asset adoption to accelerate
The tokenization process facilitates the use of traditional assets within the digital asset ecosystem



Source: BofA Global Research
Smart contracts are self-executing contracts. L1, L2, L3 = Layer 1, Layer 2, Layer 3.
Note that the tokenization process shown above is simplified.

BofA GLOBAL RESEARCH

Why now for tokenization? Pilots reach maturity

Despite 2022's digital asset market correction, financial institution, central bank and corporate interest remained, and industry development accelerated for private permissioned distributed ledgers and third-generation blockchains. Our view is that customizable distributed ledgers, blockchain subnetworks (subnets) and smart contracts have reached maturity and production after years of development.

[11] *Tokenization refers to the process of creating digital representations of traditional financial and non-financial assets that can be exchanged and tracked on distributed ledgers or blockchains.*

In contrast to public permissionless blockchains, private permissioned distributed ledgers and blockchain subnets integrate separate systems into one and enable the efficiencies provided by distributed (shared) ledgers, but with enhanced functionality and reduced regulatory and reputational risk. We expect DLT/BCT implementation to accelerate as the opportunity costs of uncaptured efficiencies and reduced costs increase.

TradFi and corporate adoption accelerates rapidly[12]

FI and corporate tokenization use cases are diverse and expanding. Citi issued a tokenized letter of credit (LC) to decrease processing time to 3 hours from 5-10 days. The European Investment Bank (EIB) issued a tokenized €100mn bond with T+0 settlement. KKR and Hamilton Lane tokenized private equity funds to reduce minimum investments to $10k-$100k from $5mn. Broadridge's DLT platform settles $1.4tn a month of tokenized repurchase agreements (repos). Nike generated $93mn+ in secondary non-fungible token (NFT) sales by tokenizing royalty streams. Pharma companies are tokenizing supply chains to combat drug counterfeiting that results in a million deaths a year. The California DMV tokenized vehicle titles to reduce issuance to minutes from weeks.

Tokenized traditional assets aren't "crypto"

Blockchains are a type of distributed ledger that allow open access to network data (public) and the network (permissionless). Memecoins receive outsized attention, but blockchains require tokens to reward network participants for processing transactions and to secure the network by ensuring participants have "skin in the game."[13] In contrast, distributed ledgers facilitate regulated FI and corporate use cases by restricting access to network data (private) and the network (permissioned). Distributed ledgers do not require tokens to reward network participants for processing transactions or to secure the network because participants already have "skin in the game" – their reputations.[14]

Welcome to the token economy

Tokenization is just one of many DLT/BCT applications, but we expect this one application to lead to new and more efficient primary and secondary markets for financial and non-financial products. In the not-too-distant future, institutional and retail investors may open an iPhone app to check the real-time market value of their portfolio holdings, which include tokenized dollars, Apple (AAPL) stock, corporate bonds and interests in a private equity fund and commercial building that's located on a different continent. Portfolio holdings may also include carbon credits, rights to royalties generated from Rihanna and Diplo songs, interest in a diversified blue-chip art fund, bitcoin (BTC) and other tokens that provide holders with a call on cash flows and power smart contract-enabled blockchain operating systems.

Ownership of these (tokenized) assets will be immutably recorded on one of the 5-15 distributed ledgers or blockchains that survive consolidation, some of which are public (full data transparency for transactions since inception) and permissionless (anyone can join the network) and some of which are private and permissioned. Within the same app, you may fractionalize and sell 47.62765% of your interest in a private equity fund at 5:15pm EST to 20 different institutional or retail buyers (with whom you've never interacted) in a liquid secondary market with 24/7 real-time settlement and smart contracts performing anti-money laundering/know your client (AML/KYC) requirements. It's difficult to overstate how transformative DLT/BCT, tokenization and the thousands

---

12 *TradFi = Traditional Finance*

13 *Memecoins are tokens with no utility or intrinsic value that are used primarily for speculative trading.*

14 *Network participants of public permissionless blockchains like Bitcoin and Ethereum are decentralized, which limits scalability and potential use cases. Network participants of private permissioned and customizable distributed ledgers are centralized consortiums of FIs or corporates, which expands scalability. Scalability and customization for regulatory requirements expands potential use cases well beyond speculative token trading.*

of decentralized apps that have yet to be created could be. We expect tokenized assets to become so ubiquitous that "token portfolios" will simply be referred to as "portfolios."

> "I could see a day in the not-too-distant future when a client's portfolio is not 10% to 15% alternatives, but 50%."
>
> – Marc Rowan, Apollo CEO, May'22

Disruption potential should not be ignored

Just as there was an explosion of simple to complex websites in the 1990s that altered how we shop and interact, in the coming years, we could see the tokenization and decentralization of many aspects of the economy. Distributed ledgers and blockchains provide back-end infrastructure, but some investors may underappreciate how this disruptive technology is powering an infrastructure evolution that may touch every industry. We believe the lack of user-friendly front-end interfaces and a disproportionate focus on bitcoin, memecoins, regulatory headwinds and illicit activity are overshadowing the rapid development of real-world use cases that are in active production today.

> "I was initially a crypto skeptic, but…I think crypto is here to stay and with proper oversight and regulation, it has the potential to greatly benefit society and grow the global economy."
>
> – Bill Ackman, Pershing Square Capital Management founder & CEO, Nov'22

We expect the tokenization of assets and funds within markets that are the least efficient and most intermediated to be tokenized first, and assets and funds within markets where the reverse is true to be tokenized last. Consultants expect the value of tokenized assets to reach 10% of global GDP ($16.1tn) by 2030. However, our view is that forecasting the value of tokenized assets over the next 10 years may signal tokenization's disruption potential, but ultimately distracts from the largest transformation of infrastructure and markets in over 50 years, efficiencies that DLT/BCT enables and new products and applications that become economically viable.

The more things change, the more they stay the same

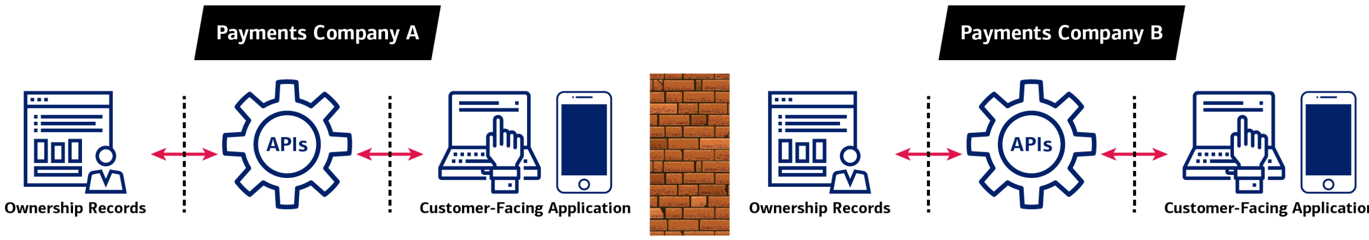
The digitization of financial assets began in 1971 when Nasdaq introduced infrastructure enabling the world's first electronic stock exchange, but it wasn't until 2001 that US stock markets fully transitioned to decimalization of asset prices, which drove smaller order sizes and heightened liquidity.[15] However, 27% of settlement systems today still leverage legacy infrastructure that is over 20 years old.[16] Today's financial systems continue to be built on centralized (company-owned) and fragmented infrastructure that requires third-party intermediaries, which limits efficiencies, interoperability, innovation and functionality; increases time to settlement and costs; and prevents the efficient allocation of capital (Exhibit 59).

---

15 *SEC: Commission Notice: Decimals Implementation Plan for the Equities and Options Markets*

16 *Digital Asset and The ValueExchange: Doing Tokenisation Right*

Exhibit 59: Today's financial systems are built on centralized, fragmented and non-interoperable infrastructure
Traditional financial infrastructure



Source: BofA Global Research

BofA GLOBAL RESEARCH

Blurred lines – tokenized assets vs blockchain-native

Tokens will likely become so ubiquitous that "tokenized assets" and "token portfolios" will simply be referred to as "assets" and "portfolios" over the longer term. Our view is that there is limited reason to distinguish between tokens that represent ownership of Treasuries and physical gold, tokens representing ownership of a corporate bond issued in tokenized form and tokens powering blockchain operating systems and decentralized storage protocols. We expect the lines to blur between tokenized pre-existing traditional assets, assets issued in tokenized form and blockchain-native assets (Exhibit 60).

Exhibit 60: We expect the lines to blur between token types over time as tokenized issuances become the norm
A breakdown of token types and how we define them

Token Types	Token Type Definitions
Tokenized pre-existing traditional assets	The tokenization of pre-existing traditional assets refers to the process of transforming an asset that was originally issued off-chain through a primary or secondary offering and recorded in book entry form on a traditional ledger, such as a central securities depository, into a token. The token represents digital ownership of the off-chain asset, embeds the rights of the asset and can be traded or pledged as collateral on a DLT/BCT-powered secondary market or within a DLT/BCT-powered application. The pre-existing traditional asset, which is held by a custodian within a special purpose vehicle, continues to exist off-chain in the "real world" but also exists within the digital asset ecosystem with ownership changes recorded on a distributed ledger or blockchain.
Tokenized traditional assets	Tokenized traditional assets refer to traditional assets that were originally issued on-chain in tokenized form through a primary offering, also known as a security token offering (STO), with token ownership recorded on a distributed ledger or blockchain. The token represents ownership of an asset that exists exclusively within the digital asset ecosystem and can be traded or pledged as collateral on a DLT/BCT-powered secondary market or within an DLT/BCT-powered application. At no point was token ownership recorded on a traditional ledger.
Blockchain-native assets	Blockchain-native assets, such as Bitcoin (BTC), Ethereum (ETH), Solana (SOL), Avalanche (AVAX), Uniswap (UNI) and Shiba Inu (SHIB), refer to tokens that were originally issued on-chain in tokenized form through an initial coin offering (ICO) or as a reward to network participants in exchange for securing the network and processing transactions. Token ownership is recorded on a distributed ledger or blockchain. The token exists exclusively within the digital asset ecosystem and can be traded or pledged as collateral on a DLT/BCT-powered secondary market or within a DLT/BCT-powered application. At no point was token ownership recorded on a traditional ledger.

Source: BofA Global Research

BofA GLOBAL RESEARCH

Our view is that digital asset adoption by banks, financial institutions and corporates is likely to drive ecosystem synergies, leading to the accelerated development of decentralized Web3 applications that may gradually capture market share across most industries over time (Exhibit 61).

Exhibit 61: Web2 to Web3 – the transition from internet renters to owners
Web1 through Web3 from the perspective of content generation, governance, trust, ownership and profit

	Web1	Web2	Web3
	1990 – 2004	**2004 – Present**	**Present – ???**
Content Creation	Platform Operators Create	Platform Users Create	Platform Users Create
Governance / Control	Platform Operators Govern	Platform Operators Govern	Platform Users Govern
Trust	Non-Verifiable	Non-Verifiable	Verifiable
Ownership	Platform Operators Own	Platform Operators Own	Platform Users Own
Profit	Platform Operators Profit	Platform Operators Profit	Platform Users Profit

Exhibit 61: Web2 to Web3 – the transition from internet renters to owners
Web1 through Web3 from the perspective of content generation, governance, trust, ownership and profit

Web1	Web2	Web3

Source: BofA Global Research

BofA GLOBAL RESEARCH

The next evolution of software has only just begun

Bitcoin's blockchain launched 14 years ago, Ethereum's launched eight years ago and the first decentralized applications launched seven years ago, but many of the newest blockchains and applications are less than three years old and remain early in their development roadmaps. However, distributed ledgers and blockchain subnets intended for institutional and corporate use cases are even more nascent than the newest blockchains and require time to mature, despite numerous use cases already executed and ongoing.

Software M&A in 2024

Potential for M&A reacceleration in 2024

Although valuations remained compressed in 2023, software M&A activity was lighter relative to 2022's, likely due to elevated interest rates. Strategic deal value fell to $48bn in 2023 from $137bn in 2022 (Exhibit 62). We note that 84% of 2023's deal value originated from only two deals. We expect acquisitions among software leaders to accelerate, given opportunities to provide incremental cross- and up-sell technologies, as well as produce competitive advantages. However, our client conversations indicate a focus on companies that continue to prioritize efficiencies and cost cutting over those that shift to prioritizing M&A (and hiring) as rates likely begin to fall.

Takeout multiples in '23 indicate accelerating deal values in '24

Strategic acquisition takeout multiples expanded in 2023 y/y with the average takeout EV/TTM Sales multiple reaching 9.1x in 2023 vs 6.3x in 2022. Although the 2023 takeout multiple was in line with the historical average of 8.9x, we expect elevated takeout multiple in 2023 to indicate increased focus on and demand for acquisitions that generate synergies and incremental revenue as companies aim to increasingly consolidate market shares and produce competitive advantages through inorganic growth in 2024. We also note that takeout valuation multiples for strategic deals have historically been higher than for PE deals (Exhibit 63).

Exhibit 62: Strategic M&A in 2023 was lighter in the software group compared to 2022, likely due to elevated interest rates
Software M&A Activity – Strategic

Announce Date	Target Name	Acquirer Name	Deal Value ($mn)	EV/TTM Sales	EV/TTM EBITDA	EV/FCF
12/13/2023	Pagero Group AB	Vertex	555	8.3x		
10/12/2023	Loom Inc.	Atlassian	975			
10/4/2023	LiveVox	NICE	350	2.4x		
9/21/2023	Splunk	Cisco	29,400	7.7x	34.7x	36.5x
8/9/2023	Hopin	RingCentral	50			
8/7/2023	Aceyus	Five9	82			
8/3/2023	Tagger Media	Sprout Social	140			
7/31/2023	Rookout	Dynatrace	55			
7/6/2023	Paperspace	DigitalOcean	111			
6/27/2023	BluBracket	HashiCorp	30			
6/26/2023	Apptio	IBM	4,600	9.2x		
6/12/2023	Adenza	Nasdaq	10,500	17.8x		
5/24/2023	Neeva	Snowflake	150			
5/12/2023	G2K	ServiceNow	500			
4/14/2023	Workvivo	Zoom	215			
1/25/2023	Cloudify	Dell Technologies	100			
9/6/2022	ChannelAdvisor Corp	CommerceHub	588	3.4x	26.8x	20.9x
5/23/2022	VMware	Broadcom	61,000	4.7x	15.6x	15.3x
4/11/2022	Datto	Kaseya	6,200	10.0x	35.0x	79.4x
1/18/2022	Activision Blizzard	Microsoft	68,700	6.9x	16.6x	22.3x
12/20/2021	Cerner	Oracle	29,005	5.1x	21.0x	25.2x
12/1/2021	Blue Prism	SS&C Technologies	1,483	7.3x		
12/1/2021	Fuze	8x8	250			
11/18/2021	Vndly	Workday	510			
11/17/2021	SimpleNexus	nCino	1,195			
11/17/2021	Power Line Systems	Bentley Systems	700			
11/9/2021	Weta Digital	Unity Software	1,600			
10/11/2021	Aspen Technology	Emerson Electric	8,497	11.6x	22.1x	31.0x
8/18/2021	HazardHub	Guidewire Software	53			
7/29/2021	Clarabridge	Qualtrics International	1,125			
5/17/2021	Zipwhip	Twilio	850			
5/11/2021	Seequent	Bentley Systems	1,050			
5/7/2021	DivvyPay	BILL Holdings	2,500			
4/23/2021	Blue Yonder	Panasonic	7,100	10.6x	60.1x	78.6x
4/12/2021	Nuance Communications	Microsoft	17,241	12.7x	85.0x	90.2x

Exhibit 62: Strategic M&A in 2023 was lighter in the software group compared to 2022, likely due to elevated interest rates
Software M&A Activity – Strategic

Announce Date	Target Name	Acquirer Name	Deal Value ($mn)	EV/TTM Sales	EV/TTM EBITDA	EV/FCF
2/24/2021	Innovyze	Autodesk	1,000			
1/28/2021	Peakon ApS	Workday	700			
12/1/2020	Slack Technologies	salesforce.com	25,766	26.4x		414.2x
11/9/2020	Workfront	Adobe	1,500			
11/2/2020	LLamasoft	Coupa Software	1,500			
10/12/2020	Segment.io	Twilio	3,200			
9/28/2020	MobileIron	Ivanti	749	3.5x		
2/25/2020	Vlocity	salesforce.com	1,330			
2/24/2020	Credit Karma	Intuit	7,100			
2/24/2020	Saba Software	Cornerstone OnDemand	1,295	10.7x		606.8x
Average ('16-'23)				**8.9x**	**42.4x**	**52.0x**
Average (2023)			**47,813**	**9.1x**	**34.7x**	**36.5x**
Average (2022)			**136,488**	**6.3x**	**23.5x**	**34.5x**
Average (2021)			**74,859**	**9.5x**	**47.0x**	**56.2x**
Average (2020)			**42,440**	**13.5x**	**NA**	**NA**

Source: Company filings, Bloomberg

BofA GLOBAL RESEARCH

Exhibit 63: Historically, the takeout valuation multiples are higher for strategic deals compared to their private equity counterparts
Software M&A Activity - Private Equity

Announce Date	Target Name	Acquirer Name	Deal Value ($mn)	EV/TTM sales	EV/TTM EBITDA	EV/FCF
12/18/2023	Alteryx	Clearlake Capital Insight Partners	4,400	4.8x	68.2x	
10/23/2023	Engagesmart	Vista Equity Partners	4,000	11.6x	82.1x	79.2x
7/31/2023	New Relic	TPG Capital Francisco Partners	6,500	7.0x	66.4x	192.3x
5/11/2023	Absolute Software	Crosspoint Capital	830	3.7x	24.3x	22.5x
3/14/2023	Cvent	Blackstone Abu Dhabi Investment Authority	4,235	6.4x	67.2x	57.7x
3/13/2023	Momentive Global	Consortium led by STG	1,446	3.0x	37.8x	
3/13/2023	Qualtrics International	Silver Lake CPP Investments	12,500	8.6x	80.5x	
2/9/2023	Sumo Logic	Francisco Partners	1,700	5.7x		
1/23/2023	Magnet Forensics	Thoma Bravo	1,340	13.5x	103.9x	42.9x
1/9/2023	Duck Creek Technologies	Vista Equity Partners	2,600	8.4x	309.5x	91.9x
12/12/2022	Coupa Software	Thoma Bravo	8,000	9.8x	97.4x	40.7x
10/27/2022	UserTesting	Thoma Bravo Sunstone Partners	920	5.0x		
9/28/2022	Billtrust Holding	EQT	1,413	7.9x		
8/8/2022	Avalara	Vista Equity Partners	8,400	11.2x		
8/3/2022	Ping Identity	Thoma Bravo	2,800	9.1x		
6/24/2022	Zendesk	Hellman & Friedman Permira	10,200	7.1x		88.4x
4/11/2022	SailPoint Technologies	Thoma Bravo	6,131	14.0x		
3/20/2022	Anaplan	Thoma Bravo	10,400	16.5x		
1/31/2022	Citrix Systems	Vista Equity Partners Elliot Investment	14,475	4.5x	19.1x	24.6x
9/28/2021	Blue Prism Group	Vista Equity Partners	1,471	7.3x		
9/23/2021	athenahealth	Bain Capital Private Equity Hellman & Friedman	17,000	13.0x	53.4x	105.6x
8/5/2021	Cornerstone OnDemand	Clearlake Capital	4,840	5.8x	25.8x	53.1x
7/26/2021	Medallia	Thoma Bravo	5,477	10.4x		
6/28/2021	QAD	Thoma Bravo	1,719	5.2x	97.8x	55.5x
6/1/2021	Cloudera	Clayton Dubilier & Rice KKR & Co	4,610	5.1x		31.6x
3/10/2021	Talend	Thoma Bravo	2,151	6.9x		
12/21/2020	RealPage	Thoma Bravo	9,753	8.4x	37.7x	45.8x
12/13/2020	Pluralsight	Vista Equity Partners	2,862	7.3x		

Exhibit 63: Historically, the takeout valuation multiples are higher for strategic deals compared to their private equity counterparts
Software M&A Activity - Private Equity

Announce Date	Target Name	Acquirer Name	Deal Value ($mn)	EV/TTM sales	EV/TTM EBITDA	EV/FCF
12/2/2020	CommerceHub	Insight Partners	1,900	16.8x	61.6x	51.7x
11/10/2020	Planview	TPG Capital TA Associates	1,600			
1/9/2020	Veeam Software	Insight Partners	5,000			
Average ('16-'23)				**7.2x**	**46.7x**	**44.1x**
Average (2023)			**39,551**	**7.3x**	**60.9x**	**49.0x**
Average (2022)			**62,738**	**9.4x**	**58.3x**	**51.2x**
Average (2021)			**37,269**	**7.7x**	**59.0x**	**46.8x**
Average (2020)			**21,114**	**10.9x**	**49.7x**	**48.7x**

Source: Company filings, Bloomberg
STG = Symphony Technology Group, CPP Investments = Canada Pension Plan Investment Board

BofA GLOBAL RESEARCH

Institutional Positioning & Short Analytics

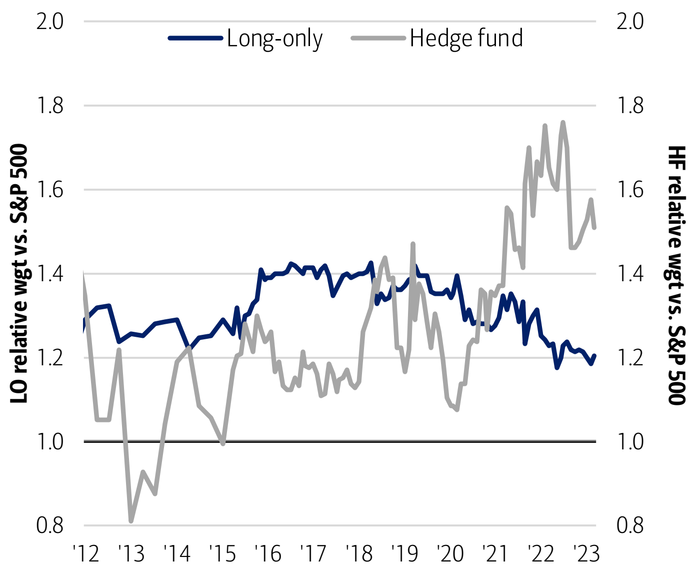
Declining institutional software exposure (if excl. MSFT)

We worked with our US Equity & Quant Strategy colleagues to produce proprietary analysis of long-only (LO) and hedge fund (HF) Software weightings relative to the S&P's. HFs are currently more overweight S&P software stocks than LOs.

Both LOs and HFs remained overweight S&P Software in 2023 as LO exposure remained relatively constant and HF exposure decreased moderately (Exhibit 64). Our analysis indicates that HFs increased exposure to MSFT from Feb through Apr as the stock rallied 24% before selling into strength from Apr through Nov as the stock rose an additional 23% (Exhibit 65).

A value of 1 represents market weight, a value greater than 1 represents overweight and a value less than 1 represents underweight. See Savita Subramanian's active managers' holdings note for calculation methodology.

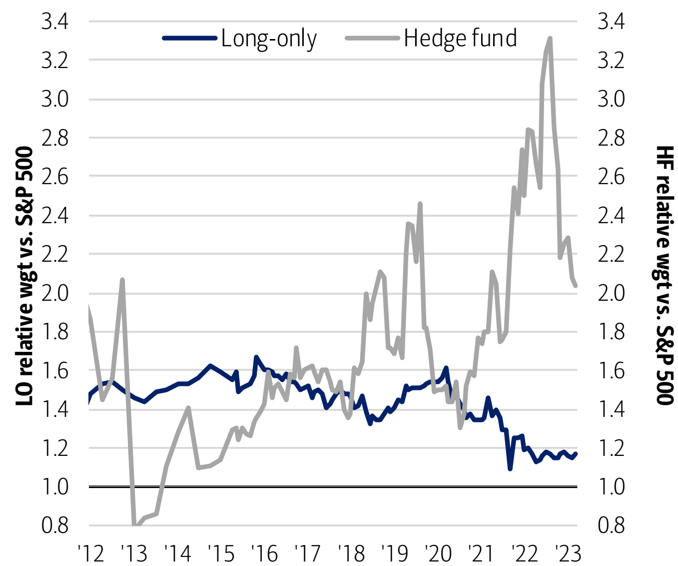
Exhibit 64: Both LOs & HFs remained overweight S&P Software in '24
Institutional S&P Software weightings as of 11/30/23



Source: BofA Global Research, FactSet Ownership

BofA GLOBAL RESEARCH

Exhibit 65: HFs decreased MSFT exposure as the stock rose from Apr-Nov
Institutional S&P Software weightings ex-MISFT as of 11/30/23



Source: BofA Global Research, FactSet Ownership

BofA GLOBAL RESEARCH

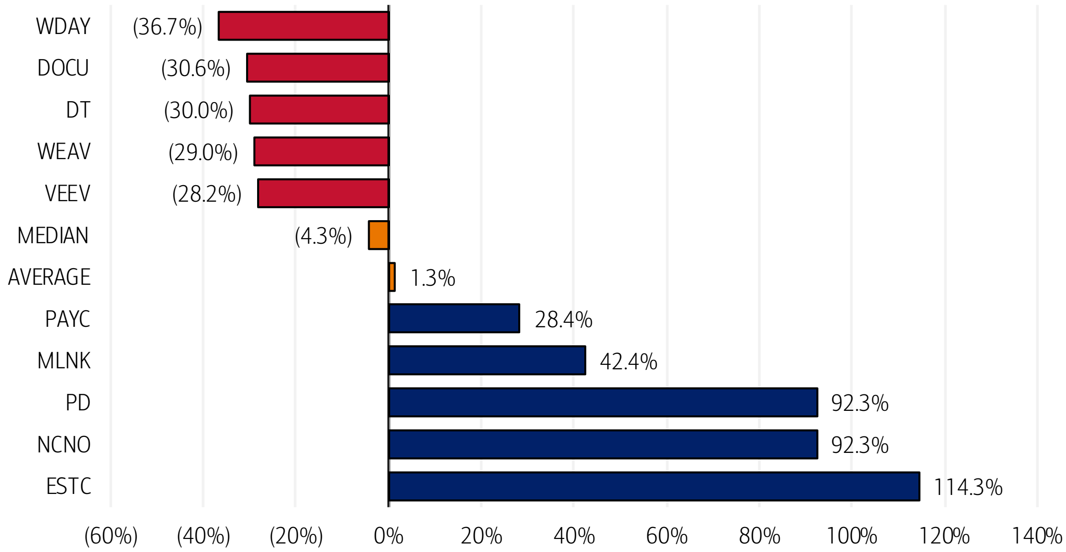
Big moves could show up again in 4Q23 results

We present an analysis of short interest and short ratio data in the exhibits below, which highlight some of the highest magnitude increases and decreases across our software coverage universe. For our analysis, we looked at the change in short interest and short ratio from Oct 6, 2023, which was prior to the 3Q23 earnings cycle, to Dec 29, 2023, to evaluate how short positioning has changed.

Elastic's/Workday's short interest increased/decreased the most

The top 5 increases in short interest from 10/6/23 to 12/29/23 include 1) ESTC +114%, 2) NCNO +92%, 3) PD +92%, 4) MLNK +42% and 5) PAYC +28%. The top 5 decreases in short interest include 1) WDAY -37%, 2) DOCU -31%, 3) DT -30%, 4) WEAV -29% and 5) VEEV -28% (Exhibit 66). The average change in short interest was +1.3% and the median was -4.3% (Exhibit 67).

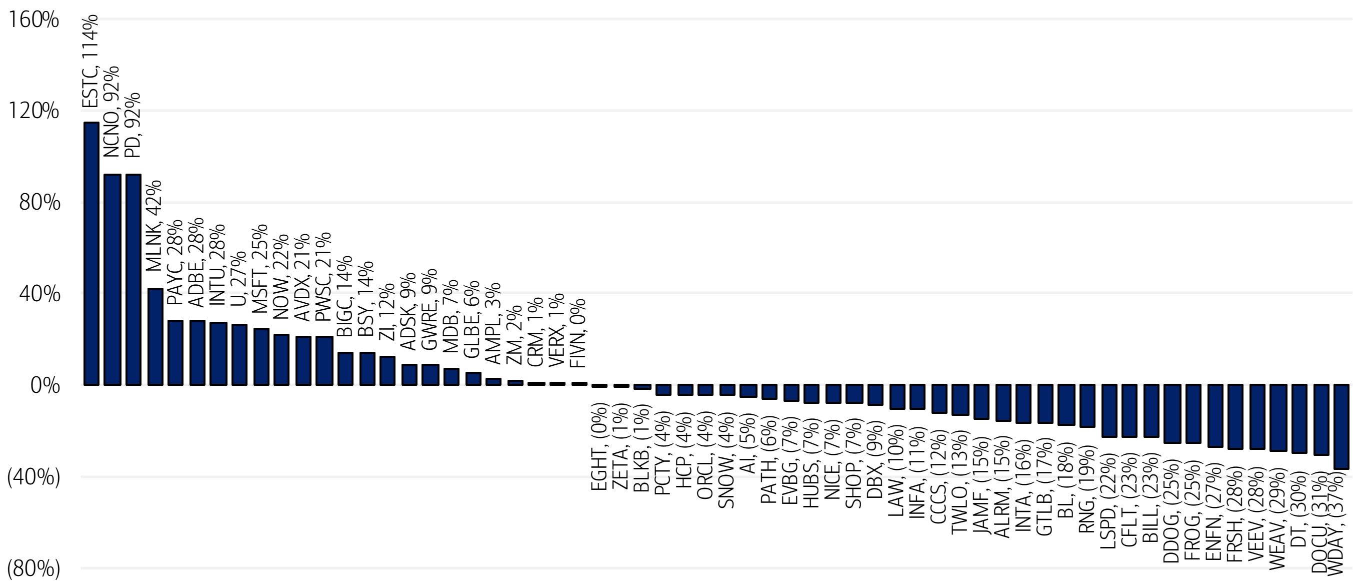
Exhibit 66: Top 5 short interest increases/decreases across our software coverage universe
WDAY, DOCU, DT, WEAV, and VEEV displayed the highest magnitude decrease in short interest (10/6/23-12/29/23)



Source: Bloomberg, BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 67: Change in short interest across our software coverage universe
38% of our coverage universe (23 out of 60) experienced an increase in short interest (10/6/23-12/29/23)



Source: Bloomberg, BofA Global Research

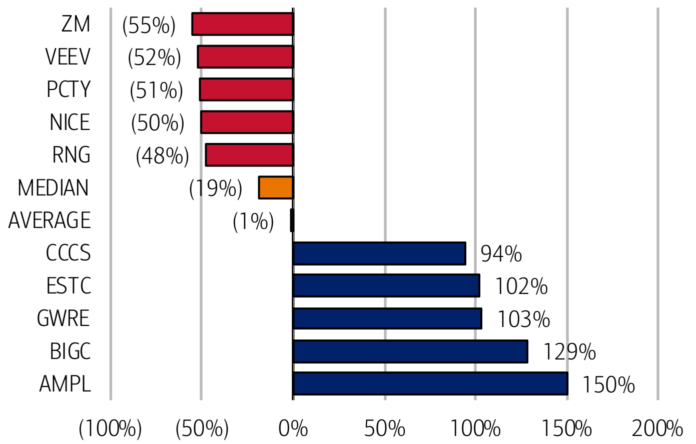
BofA GLOBAL RESEARCH

AMPL's short ratio increased the most, MLNK's days-to-cover highest

We display the top 5 increases and decreases in short ratios from Oct 6, 2023-Dec 29, 2023 across our software coverage universe. The top 5 increases in short ratio include 1) AMPL +150%, 2) BIGC +129%, 3) GWRE +103%, 4) ESTC +102% and 5) CCCS +94%. The top 5 decreases were 1) ZM -55%, 2) VEEV -52%, 3) PCTY -51%, 4) NICE -50% and 5) RNG -48% (Exhibit 68). The average change in short interest across our coverage universe was -1% and the median was -19%.

We also look the actual short ratio (or days-to-cover) as a potential indicator of outsized moves within our coverage universe. The top 5 highest short ratios include 1) MLNK at 12.9, 2) BSY at 12.4, 3) AMPL at 10.4, 4) EGHT at 9.7 and 5) ZETA at 9.6. The top 5 lowest short ratios include 1) WDAY at 1.1, 2) CRM at 1.2, 3) ADSK at 1.3, 4) VERX at 1.5 and 5) PAYC at 1.6 (Exhibit 69 & Exhibit 70).

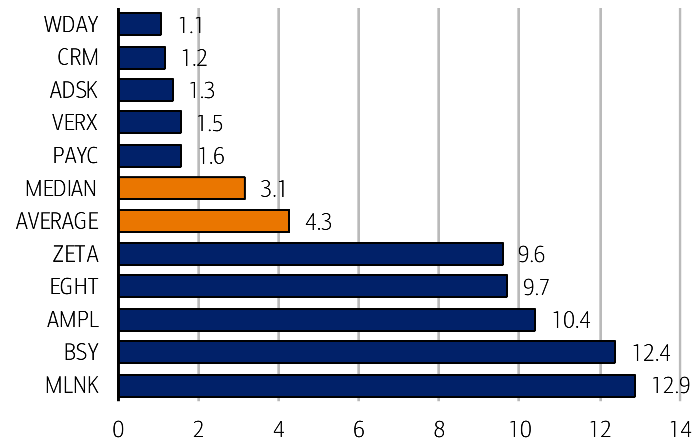
Exhibit 68: Top 5 % short ratio increase/decrease in our coverage universe
ZM and VEEV had the highest % decrease in short ratio (10/6/23-12/29/23)



Source: Bloomberg, BofA Global Research

BofA GLOBAL RESEARCH

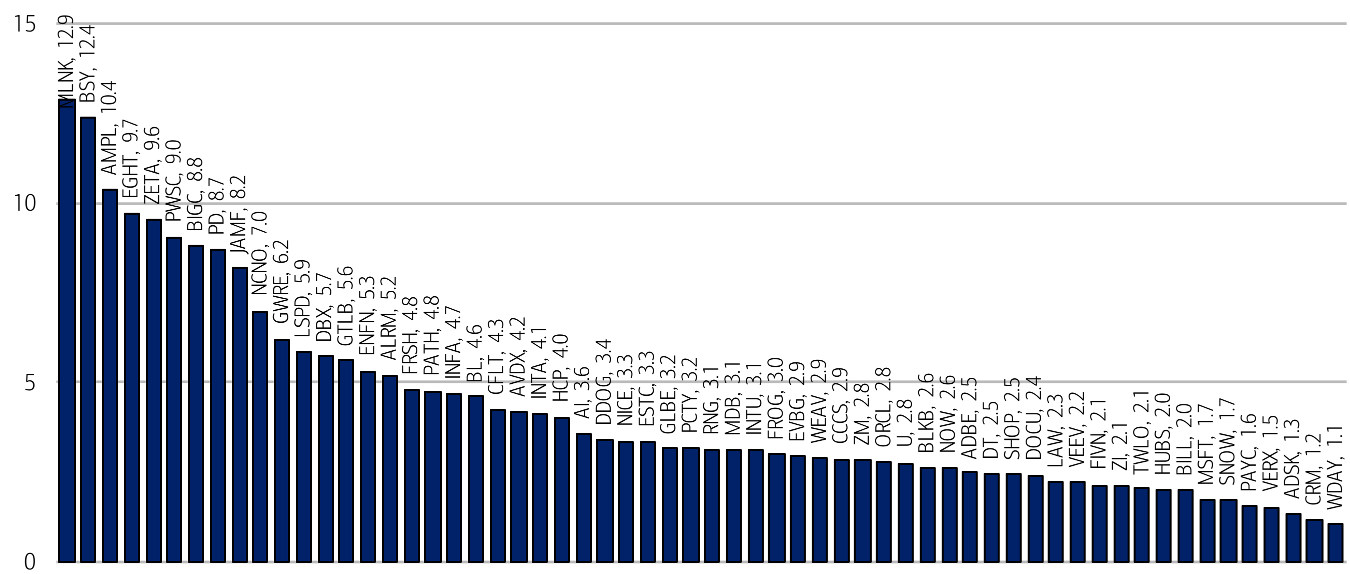
Exhibit 69:Top 5 highest/lowest short ratio in our coverage universe
WDAY and CRM had the lowest short ratio (days-to-cover) as of 12/29/23



Source: Bloomberg, BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 70: Short ratio across our coverage universe
The average short ratio was 4.3 and the median short ratio was 3.1 as of 12/29/23



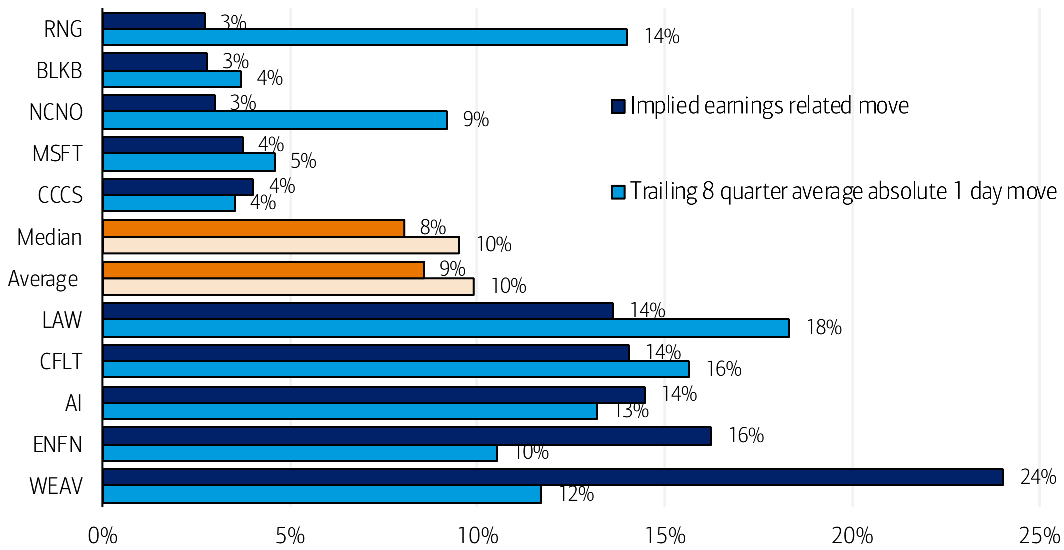
Source: Bloomberg, BofA Global Research

BofA GLOBAL RESEARCH

Weave/RingCentral have the highest/lowest implied move

We present an analysis of the top 5 highest and lowest implied moves across our coverage universe as of Dec 29, 2023 (Exhibit 71). As part of our analysis, we compare the current implied one-day move against the trailing 8 quarter average of the absolute day-after-reported-earnings performance, or day of if reported before the market open, as a potential indicator of stock positioning or sentiment change. As of Dec 29, 2023, the stock with highest implied one-day move was Weave (WEAV) at 24%, while RingCentral (RNG) had the lowest at 3%. The average implied one-day move across our coverage universe was 9% and the median was 8%.

Exhibit 71: Top 5 highest/lowest implied earnings related moves across our coverage universe
WEAV displays the highest implied earnings related move as of 12/29/23



Source: Bloomberg, BofA Global Research

BofA GLOBAL RESEARCH

Coverage Summary

Note that our company ratings are driven by a combination of earnings expectations and valuation and indicate performance expectations over the next 12 months (Exhibit 72). Our company ratings are relative to the performance of our coverage universe overall and not relative to individual analyst coverage or relative to their respective subsector.

Exhibit 72: 31 Buys, 17 Neutrals and 12 Underperforms across our coverage
Ratings, Price Objective, Upside/Downside across our covered companies

Subsector	Stock	Rating	PO	Upside/Downside
Collaboration	DBX	Buy	$34	19%
Communication	EGHT	Buy	$6	66%
	FIVN	Underperform	$61	-18%
	NICE	Buy	$285	47%
	RNG	Buy	$55	77%
	TWLO	Underperform	$55	-20%
	ZM	Neutral	$90	35%
CRM	BIGC	Neutral	$11	30%
	CRM	Buy	$300	19%
	FRSH	Neutral	$23	7%
	GLBE	Buy	$48	30%
	HUBS	Buy	$600	13%
	LSPD	Neutral	$20	7%
	SHOP	Neutral	$85	16%
	ZETA	Buy	$14	74%
	ZI	Neutral	$20	19%
Design	ADBE	Buy	$700	23%
	ADSK	Neutral	$235	3%
	BSY	Neutral	$57	21%
	U	Buy	$46	24%
ERP & Back Office	AVDX	Underperform	$10	-13%
	BILL	Buy	$80	8%
	BL	Underperform	$52	-7%
	DOCU	Neutral	$60	9%
	INTU	Buy	$650	11%
	LAW	Underperform	$6	-17%
	VERX	Underperform	$23	-10%
HCM	PAYC	Neutral	$210	7%
	PCTY	Neutral	$180	12%
	WDAY	Buy	$300	12%
Infrastructure	AI	Underperform	$18	-35%
	AMPL	Buy	$14	19%
	CFLT	Underperform	$24	11%
	DDOG	Neutral	$120	6%
	DT	Buy	$60	16%
	ESTC	Buy	$108	5%
	EVBG	Underperform	$22	1%
	FROG	Buy	$36	14%
	GTLB	Buy	$74	29%
	HCP	Neutral	$24	10%
	INFA	Buy	$33	25%
	JAMF	Neutral	$22	25%
	MDB	Buy	$480	32%
	MSFT	Buy	$430	17%
	NOW	Buy	$750	12%
	ORCL	Neutral	$122	19%
	PATH	Buy	$26	15%
	PD	Buy	$30	40%
	SNOW	Neutral	$220	20%
Security	ALRM	Buy	$75	21%
Vertical	BLKB	Underperform	$70	-16%
	CCCS	Buy	$14	31%
	ENFN	Underperform	$8	-13%

Exhibit 72: 31 Buys, 17 Neutrals and 12 Underperforms across our coverage
Ratings, Price Objective, Upside/Downside across our covered companies

Subsector	Stock	Rating	PO	Upside/Downside
	GWRE	Underperform	$80	-24%
	INTA	Buy	$50	37%
	MLNK	Buy	$24	5%
	NCNO	Buy	$34	2%
	PWSC	Buy	$30	30%
	VEEV	Neutral	$200	7%
	WEAV	Buy	$14	25%

Source: BofA Global Research

BofA GLOBAL RESEARCH

We update our POs for the following companies for recent peer group valuation multiples expansion.

Exhibit 73: Price Objective (PO) Changes
We revise our POs on the following companies

Company	Ticker	New PO	New PO Reasoning	Previous PO	Previous PO Reasoning
Datadog	DDOG	$120	16.3x CY24E Revenue	$110	14.9x CY24E Revenue
HubSpot	HUBS	$600	10.0x CY25 Revenue	$520	8.6x CY25 Revenue
ServiceNow	NOW	$750	36x EV/C25E FCF	$660	31x EV/C25E FCF
Paycom	PAYC	$210	34x EV/C24E FCF	$185	29x EV/C24E FCF

Source: BofA Global Research

BofA GLOBAL RESEARCH

Rating changes in 2023

- Upgraded Vertex to Neutral from Underperform (published on 3/8/23)
- Upgraded Shopify to Neutral from Underperform (published on 5/4/23)
- Downgraded HashiCorp to Neutral from Buy (published on 6/8/23)
- Upgraded Adobe to Buy from Neutral (published on 8/17/23)
- Downgraded Confluent to Underperform from Neutral (published on 11/2/23)
- Downgraded Paycom to Neutral from Buy (published on 11/1/23)
- Downgraded Datadog to Neutral from Buy (published 10/9/23)
- Upgraded Unity to Buy from Neutral (published on 9/15/23)

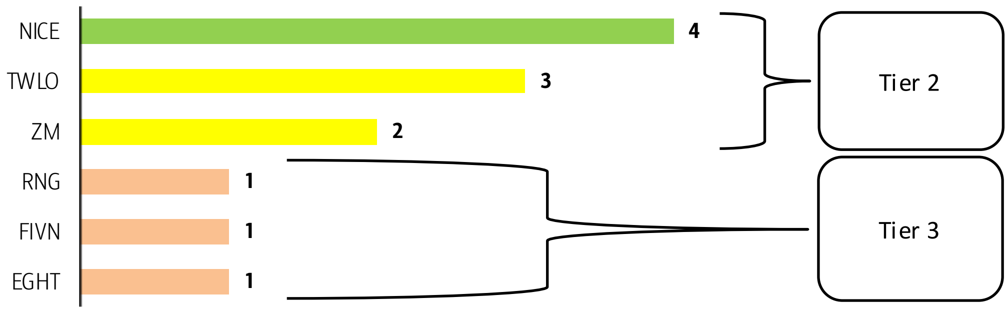
Appendix

Proprietary AI Framework Continued

Coverage universe scores by subsector

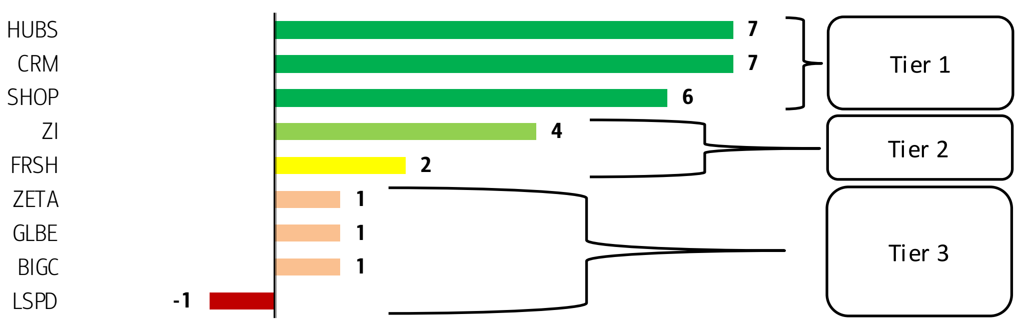
We applied our proprietary AI framework to our coverage universe and presented results by sorting companies from highest to lowest scores in Exhibit 12. We include the same analysis, but present results by sorting companies from highest to lowest scores by subsector in Exhibit 74-Exhibit 80.

Exhibit 74: NICE screens most favorably in the Communications subsector
Communications – leveraging our AI framework to produce scores and tiers for covered companies



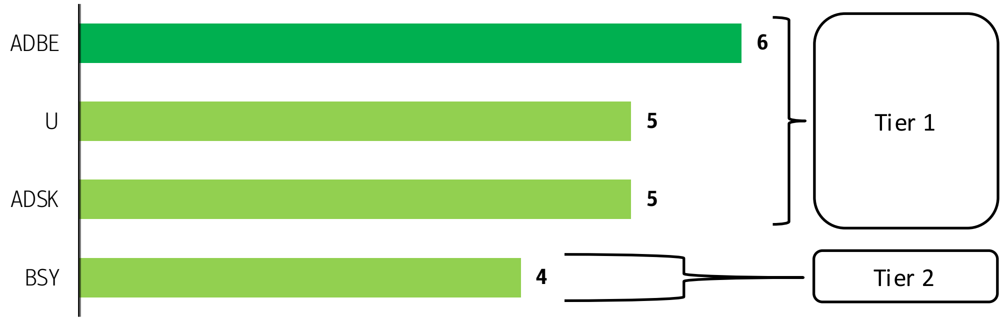
Source: BofA Global Research
This screen is not a recommended list either individually or as a group of stocks. Investors should consider the fundamentals of the companies and their own individual circumstances/objectives before making any investment decisions. This screen is intended to be an indicative metric only and may not be used for reference purposes or as a measure of performance for any financial instrument or contract, or otherwise relied upon by third parties for any other purpose, without the prior written consent of BofA Global Research. The screen was not created to act as a benchmark.
BofA GLOBAL RESEARCH

Exhibit 75: HubSpot and Salesforce screen most favorably in the CRM subsector
CRM – leveraging our AI framework to produce scores and tiers for covered companies



Source: BofA Global Research
This screen is not a recommended list either individually or as a group of stocks. Investors should consider the fundamentals of the companies and their own individual circumstances/objectives before making any investment decisions. This screen is intended to be an indicative metric only and may not be used for reference purposes or as a measure of performance for any financial instrument or contract, or otherwise relied upon by third parties for any other purpose, without the prior written consent of BofA Global Research. The screen was not created to act as a benchmark.
BofA GLOBAL RESEARCH

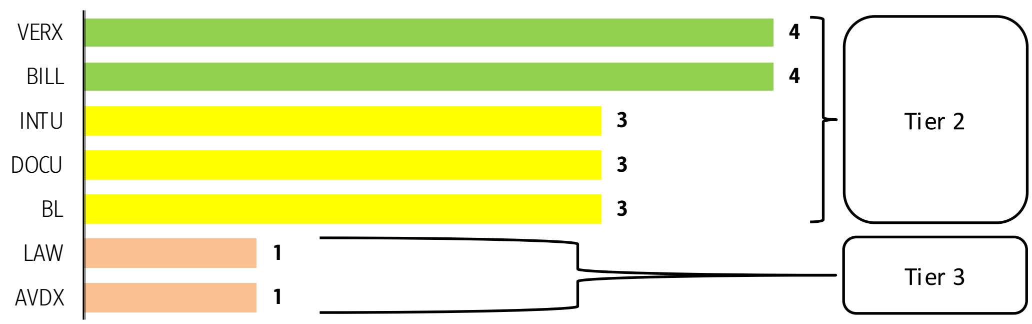
Exhibit 76: Adobe screens most favorably in the Design subsector
Design – leveraging our AI framework to produce scores and tiers for covered companies



Source: BofA Global Research
This screen is not a recommended list either individually or as a group of stocks. Investors should consider the fundamentals of the companies and their own individual circumstances/objectives before making any investment decisions. This screen is intended to be an indicative metric only and may not be used for reference purposes or as a measure of performance for any financial instrument or contract, or otherwise relied upon by third parties for any other purpose, without the prior written consent of BofA Global Research. The screen was not created to act as a benchmark.

BofA GLOBAL RESEARCH

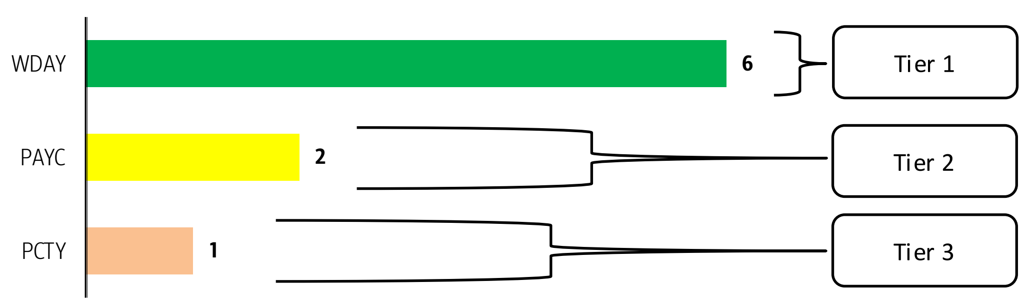
Exhibit 77: Vertex and BILL screen most favorably in the ERP & Back Office subsector
ERP & Back Office – leveraging our AI framework to produce scores and tiers for covered companies



Source: BofA Global Research
This screen is not a recommended list either individually or as a group of stocks. Investors should consider the fundamentals of the companies and their own individual circumstances/objectives before making any investment decisions. This screen is intended to be an indicative metric only and may not be used for reference purposes or as a measure of performance for any financial instrument or contract, or otherwise relied upon by third parties for any other purpose, without the prior written consent of BofA Global Research. The screen was not created to act as a benchmark.

BofA GLOBAL RESEARCH

Exhibit 78: Workday screens most favorably in the HCM subsector
HCM – leveraging our AI framework to produce scores and tiers for covered companies



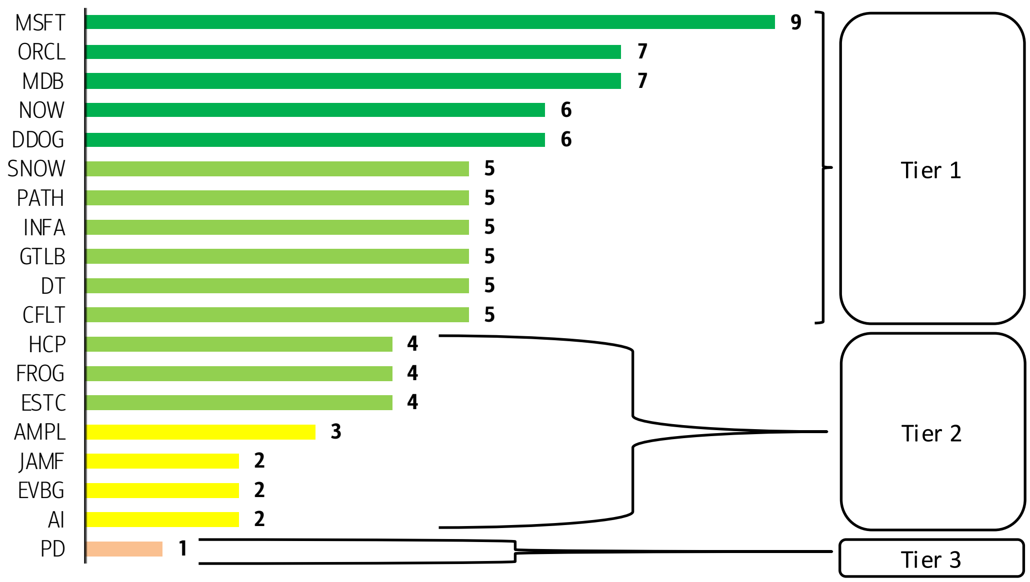
Source: BofA Global Research

Exhibit 78: Workday screens most favorably in the HCM subsector
HCM – leveraging our AI framework to produce scores and tiers for covered companies

This screen is not a recommended list either individually or as a group of stocks. Investors should consider the fundamentals of the companies and their own individual circumstances/objectives before making any investment decisions. This screen is intended to be an indicative metric only and may not be used for reference purposes or as a measure of performance for any financial instrument or contract, or otherwise relied upon by third parties for any other purpose, without the prior written consent of BofA Global Research. The screen was not created to act as a benchmark.

BofA GLOBAL RESEARCH

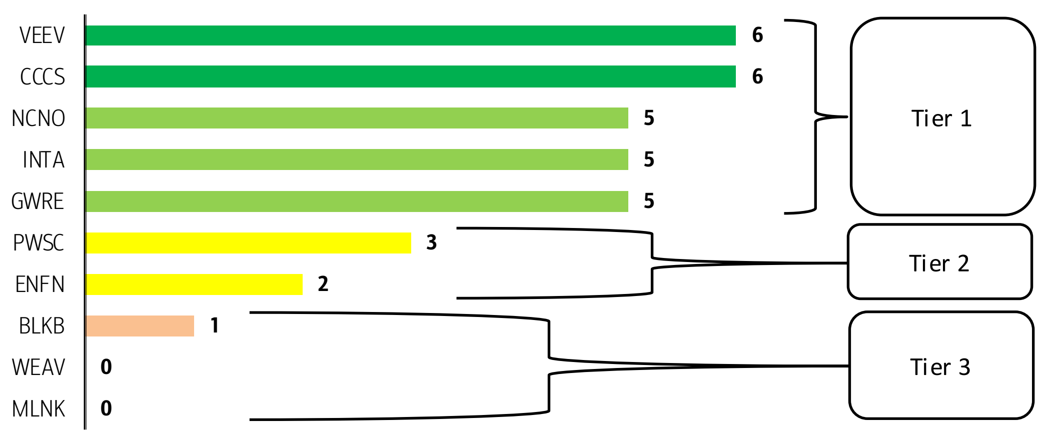
Exhibit 79: Microsoft screens most favorably in the Infrastructure subsector
Infrastructure – leveraging our AI framework to produce scores and tiers for covered companies



Source: BofA Global Research
This screen is not a recommended list either individually or as a group of stocks. Investors should consider the fundamentals of the companies and their own individual circumstances/objectives before making any investment decisions. This screen is intended to be an indicative metric only and may not be used for reference purposes or as a measure of performance for any financial instrument or contract, or otherwise relied upon by third parties for any other purpose, without the prior written consent of BofA Global Research. The screen was not created to act as a benchmark.

BofA GLOBAL RESEARCH

Exhibit 80: Veeva Systems and CCC Intelligent Solutions screen most favorably in the Vertical subsector
Vertical – leveraging our AI framework to produce scores and tiers for covered companies



Source: BofA Global Research
This screen is not a recommended list either individually or as a group of stocks. Investors should consider the fundamentals of the companies and their own individual circumstances/objectives before making any investment decisions. This screen is intended to be an indicative metric only and may not be used for reference purposes or as a measure of performance for any financial instrument or contract, or otherwise relied upon by third parties for any other purpose, without the prior written consent of BofA Global Research. The screen was not created to act as a benchmark.

Exhibit 80: Veeva Systems and CCC Intelligent Solutions screen most favorably in the Vertical subsector
Vertical – leveraging our AI framework to produce scores and tiers for covered companies

BofA GLOBAL RESEARCH

IT Spending Survey Continued

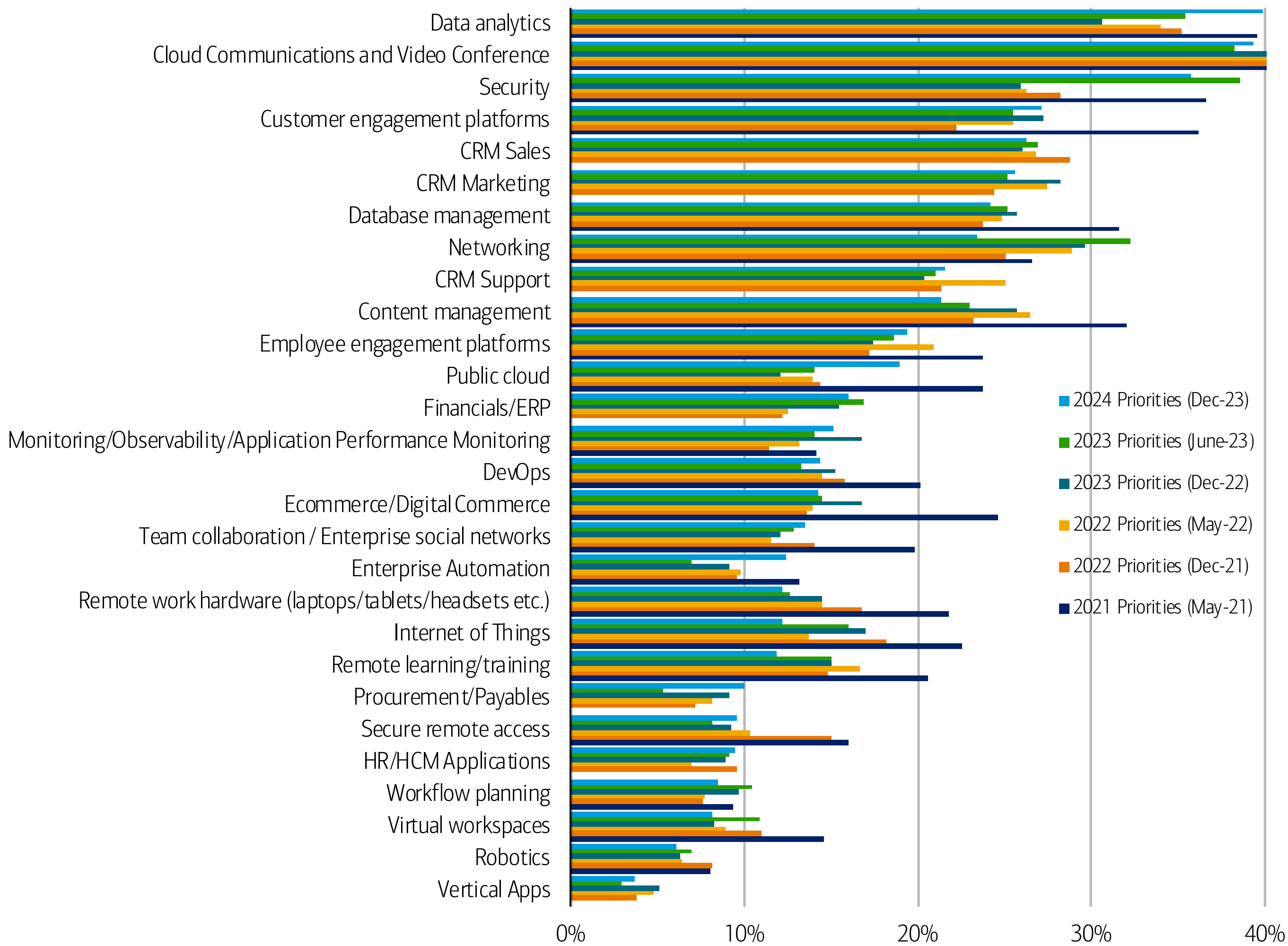
Spending priority trends over the past 6 BofA surveys

We have conducted our survey every six months beginning in May'21 and can analyze trends across the six surveys. In the exhibits below, we present some trends between surveys (Exhibit 81).

- Cloud Communications and Video Conferencing has been a top 2 priority since our first survey held May'21, consistently being ranked number 1 for the first four surveys and falling to number 2 in the Jun'23 survey and staying in second in our Dec'23 survey.
- Networking has historically been a top five priority since being added as a new category in our Dec'21 survey, but slipped to number 8 in our Dec'23 survey.
- Content Management has consistently decreased as a spending priority, from being ranked 5 in our inaugural May'21 survey to its current spot of 10 in our Jun'23 survey.

Exhibit 81: What are your company's priorities for your budget? (Across our six surveys beginning May'21)

Data analytics has frequently been in the top three and finally reached the top spot in our Dec'23 survey.



Source: BofA Global Research

BofA GLOBAL RESEARCH

Vendor Consolidation Continued

Consolidation drives opportunity for wallet share capture

Software vendors that offer applications with broad functionality and the potential to bundle offerings with attractive total cost of ownership (TCO) may capture incremental wallet share as contracts expire, in our view. We expect vendor consolidation to be most prevalent in the Communications and Infrastructure categories in 2024. We provide deep-dive analyses below.

Communications subsector deep-dive

Vendor consolidation is an important theme within the Communication software category. By bundling offerings, customers can drive down TCO while also improving user experiences and enhancing efficiency. According to a report by Forrester, tightly integrated UCaaS/CCaaS solutions can reduce call handling times by up to 45%. Another Forrester study suggests that customers can save more than 60% on licensing costs alone when consolidating onto Microsoft 365 from point solutions.

While the consolidation of communications software onto the Microsoft platform is not new, it continues to be a relevant consideration when evaluating stocks in the category. However, the risks associated with Microsoft are well-understood and reflected in communications stock valuations, in our view. Importantly, Microsoft is likely not the only beneficiary of vendor consolidation within Communications software, in our view. We believe other communications software vendors that can provide comprehensive communications software packages via natively developed capabilities or via partnership are likely to gain share.

Customers have expressed a preference for purchasing UCaaS and CCaaS solutions together from a single vendor. For example, RingCentral noted at 3Q23 earnings that 60%+ of its large $1mn+ deals included both UCaaS and CCaaS. While relatively long contract durations (typically 2-3 years) and challenges associated with vendor migration (particularly in CCaaS) are likely to extend the manifestation of this trend over several years, early indications of wallet share shifts are likely to impact valuations more immediately.

We present the following quotes from the key vendors in the Communications software category below for additional context:

- "Platformization is an extremely powerful undercurrent of growth. It enables the convergence of all CX assets and facilitates the transition from a multi-vendor, multi-point solution environment to one that is consolidating onto a single platform" – **NICE Ltd. 3Q23 earnings, November 16, 2023.**
- "Two to three years ago, if you talk about UC and CC bundling, it was not a topic customers would often share with you. But today, given the economic situation, quite often customers would like to consolidate multiple vendors into one or two just for the sake of cost." – **Zoom Video Communications, competitor conference, September 5, 2023.**
- "When there's consolidation in the industry, we do very well in the productivity space. Everybody has a million vendors for everything from video conferencing to chat, all of the sudden Teams becomes really interesting." – **Microsoft, competitor conference, May 31, 2023.**
- "We very, very frequently have customers proactively come to me and say, hey, I'm using Zoom. I'm using Slack. But there's no reason for me to double pay. As I think about rationalizing my IT budget, what can you do for me?" – **Microsoft, competitor conference, December 6, 2022.**

Infrastructure subsector deep-dive

Over the last decade, vendor sprawl has created a complicated web of integrated point solutions and processes that has become difficult to manage. For example, the DevSecOps category is fragmented, with multiple platform vendors and many point application vendors addressing different aspects of the toolchain (Exhibit 82).

Exhibit 82: There are dozens of vendors in the DevSecOps category
Summary of the DevSecOps competitive landscape

Plan	Create	Verify	Secure	Preproduction	Release	Configure	Monitor
Asana	Atlassian	Atlassian	Apiiro	Atlassian	Atlassian	Ansible	AppDynamics (Cisco)
JIRA (Atlassian)	Chef (Progress)	Circle CI	Bionic	AWS	Chef (Progress)	Atlassian	BigPanda
Fogbugz	Circle Ci	Delphix	Checkmarx	CodeFresh	CloudBees	CA Technologies	CA Technologies
GitLab	CloudBees	GitLab	Invicti	Docker	GitHub (Microsoft)	Chef (Progress)	Datadog
IBM	GitLab	Jenkins	Jaroona (Veracode)	GitLab	GitLab	GitLab	Dynatrace
Jama Software	Harness	JetBrains	OpenText	HashiCorp	Optimizely	HashiCorp	Elastic
OpenText	Microsoft	JFrog	Snyk	Inedo	HashiCorp	Inedo	NewRelic
Microsoft	Puppet (Perforce)	Microsoft	Sqreen (Datadog)	JFrog	JFrog	Microsoft	Raygun
Planview	RedHat (IBM)	Pantheon	Synopsys	Microsoft	LaunchDarkly	Puppet (Perforce)	SolarWinds
Slack (Salesforce)	SaltStack	Travis CI	Veracode	RedHat	Microsoft	RedHat (IBM)	Splunk
Zoho	Subversion	Tricentis	Wallarm	Sonatype	RedHat (IBM)	VMware (Broadcom)	Sumo Logic

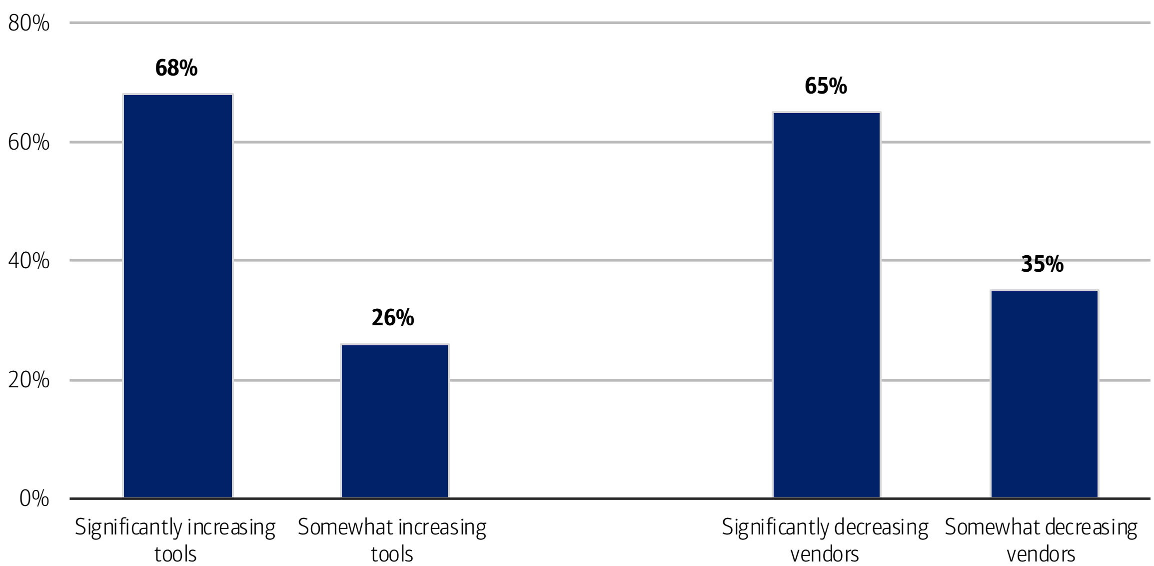
Source: BofA Global Research

BofA GLOBAL RESEARCH

However, the continued maturation of end-to-end platform vendors has enabled organizations to standardize. We believe enterprise infrastructure software is ripe for vendor consolidation as organizations look to "platformize" ahead of an acceleration in digital transformation initiatives. Although the consolidation theme is still early innings, we expect increasing enterprise focus on artificial intelligence to catalyze consolidation initiatives in 2024 as organizations re-evaluate pre-requisites for successful AI-driven use cases.

Our conversations with channel partners and executive management teams suggest that enterprises are increasingly looking to consolidate infrastructure software providers. In observability, for example, while enterprise tool count is expanding rapidly, vendor count per organization is trending lower (Exhibit 83).

Exhibit 83: Nearly 95% of leaders surveyed indicated increasing tool count and decreasing vendor count
Summary of observability survey results from 112 application development and IT operations leaders



Source: BofA Global Research, Enterprise Strategy Group *n=112

BofA GLOBAL RESEARCH

We note that 94% of respondents indicated they were either significantly or somewhat increasing observability tool count, while 100% reported that they were significantly or somewhat decreasing vendor count.

While point solution providers often offer best-of-breed functionality, leveraging a disjointed set of narrow point solutions provides less flexibility and can be more challenging than standardizing onto platforms with comprehensive feature sets. Vendors that provide support for a wide variety of use cases enable customers to run most workloads on a centralized platform – significantly reducing cost, complexity, and risk. Platformization can also result in 1) in more elegant interfaces, 2) more centralized data stores and simpler data architecture, 3) standardized workflows, 4) and reduced need for time-consuming and costly implementation/integration.

We present the following quotes from the key vendors in the Infrastructure software category below for additional context:

- "Finally, our customers remain focused on cost management. They're looking to do more with less by consolidating vendors and reducing the complexity of their data architecture" – **MongoDB 3Q24 earnings, December 5, 2023.**
- "There were a number of customers that are using our infrastructure and are using another vendor open source. And the consolidation that we've all been talking about is largely coming from that" – **Datadog, competitor conference, November 28, 2023.**

- "Vendor consolidation and standardization across their organizations are key priorities. Observability decisions that have previously been made at the department or even application level, especially in large, complex enterprises, are increasingly centralizing" – **Dynatrace, 2Q24 earnings, November 2, 2023.**

Public Cloud Continued

Cloud total addressable market

Method 1: BofA estimates and Gartner Cloud forecast

Within IaaS and PaaS, we estimate that the total market opportunity for public cloud is $289.2bn in 2023, predicted to grow at a 25% compound annual growth rate through 2025. We arrive at this total addressable market number by aggregating the revenue (and forecasted revenue) values for the major cloud providers. We leverage Gartner data for the Other Vendors estimate.

Exhibit 84: IaaS + PaaS total addressable market
We estimate IaaS + PaaS growth of +21% y/y for 2023

Totals (Iaas + PaaS portions)	2019	2020	2021	2022	2023E	2024E	2025E	'19-23	'23-25
AWS	$35,026	$45,370	$62,202	$80,096	$90,625	$105,280	$121,599	27%	16%
Microsoft Azure	$12,686	$20,066	$30,929	$43,435	$56,288	$72,182	$91,294	45%	27%
Google	$5,979	$9,758	$14,986	$21,140	$27,343	$33,819	$41,155	46%	23%
Alibaba	$4,974	$8,614	$11,215	$11,360	$12,967	$11,655	$14,214	27%	5%
Oracle	$2,155	$2,404	$2,569	$3,390	$5,307	$7,340	$9,464	25%	34%
Digital Ocean	$255	$318	$429	$576	$690	$751	$857	28%	11%
Other vendors	$49,356	$66,971	$66,836	$79,915	$96,028	$127,688	$173,505	18%	34%
Total	**$110,431**	**$153,501**	**$189,166**	**$239,912**	**$289,248**	**$358,715**	**$452,088**	**27%**	**25%**
y/y %	*93%*	*39%*	*23%*	*27%*	*21%*	*24%*	*26%*		

Source: BofA Global Research estimates, company report, Gartner (Forecast: Public Cloud Services, Worldwide, 2021-2027, 3Q23 Update)

BofA GLOBAL RESEARCH

Exhibit 85: Incremental revenue dollars added per year
Microsoft Azure is expected to add the most incremental revenue dollars among the cloud providers for 2023 and 2024, though the gap with AWS is closing

Net New $ added	2019	2020	2021	2022	2023E	2024E	2025E
AWS	**$9,370**	**$10,344**	**$16,832**	**$17,894**	**$10,529**	**$14,655**	**$16,319**
y/y	14%	10%	63%	6%	-41%	39%	11%
% of incremental IaaS/PaaS $	19%	15%	25%	22%	11%	11%	9%
Microsoft Azure	**$2,211**	**$7,380**	**$10,864**	**$12,506**	**$12,853**	**$15,894**	**$19,112**
y/y	-53%	234%	47%	15%	3%	24%	20%
% of incremental IaaS/PaaS $	4%	11%	16%	16%	13%	12%	11%
Google	**$2,590**	**$3,779**	**$5,228**	**$6,154**	**$6,203**	**$6,476**	**$7,336**
y/y	108%	46%	38%	18%	1%	4%	13%
% of incremental IaaS/PaaS $	5%	6%	8%	8%	6%	5%	4%
Alibaba	**$1,755**	**$3,640**	**$2,601**	**$145**	**$1,607**	**($1,312)**	**$2,559**
y/y	-45%	107%	-29%	-94%	1011%	-182%	-295%
% of incremental IaaS/PaaS $	4%	5%	4%	0%	2%	-1%	1%
Oracle	**$269**	**$249**	**$165**	**$821**	**$1,917**	**$2,033**	**$2,124**
y/y	-27%	-7%	-34%	398%	133%	6%	4%
% of incremental IaaS/PaaS $	1%	0%	0%	1%	2%	2%	1%
Digital Ocean	**$52**	**$64**	**$110**	**$147**	**$114**	**$60**	**$107**
y/y	n/a	23%	73%	34%	-22%	-47%	77%
% of incremental IaaS/PaaS $	0%	0%	0%	0%	0%	0%	0%

Source: BofA Global Research estimates, company report, Gartner (Forecast: Public Cloud Services, Worldwide, 2021-2027, 3Q23 Update)

BofA GLOBAL RESEARCH

Exhibit 86: IaaS + PaaS growth rates
We see the imprint of consumption / spend optimization apparent in the 2023 public cloud growth rate(s). AWS experienced the largest slowdown/

IaaS + PaaS growth rates	2019	2020	2021	2022	2023E	2024E	2025E
AWS	36.5%	29.5%	37.1%	28.8%	13.1%	16.2%	15.5%
Microsoft Azure	21.1%	58.2%	54.1%	40.4%	29.6%	28.2%	26.5%

Exhibit 86: IaaS + PaaS growth rates

We see the imprint of consumption/ spend optimization apparent in the 2023 public cloud growth rate(s). AWS experienced the largest slowdown/

IaaS + PaaS growth rates	2019	2020	2021	2022	2023E	2024E	2025E
Google	76.4%	63.2%	53.6%	41.1%	29.3%	23.7%	21.7%
Alibaba	54.5%	73.2%	30.2%	1.3%	14.1%	-10.1%	22.0%
Oracle	14.3%	11.6%	6.9%	32.0%	56.5%	38.3%	28.9%
Digital Ocean	25.4%	25.0%	34.6%	34.4%	19.9%	8.7%	14.2%
Other Vendors	97.5%	35.7%	-0.2%	19.6%	20.2%	33.0%	35.9%
Total	**58.2%**	**39.0%**	**23.2%**	**26.8%**	**20.6%**	**24.0%**	**26.0%**

Source: BofA Global Research estimates, company report, Gartner (Forecast: Public Cloud Services, Worldwide, 2021-2027, 3Q23 Update)

BofA GLOBAL RESEARCH

Exhibit 87: Cloud provider market share

AWS, Azure, and Google combined represent >60% of total public cloud market share and expect to hold in 2024

IaaS + PaaS market share	2019	2020	2021	2022	2023E	2024E	2025E
AWS	31.7%	29.6%	32.9%	33.4%	31.3%	29.3%	26.9%
Microsoft Azure	11.5%	13.1%	16.4%	18.1%	19.5%	20.1%	20.2%
Google	5.4%	6.4%	7.9%	8.8%	9.5%	9.4%	9.1%
Alibaba	4.5%	5.6%	5.9%	4.7%	4.5%	3.2%	3.1%
Oracle	2.0%	1.6%	1.4%	1.4%	1.8%	2.0%	2.1%
Digital Ocean	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Other Vendors	44.7%	43.6%	35.3%	33.3%	33.2%	35.6%	38.4%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: BofA Global Research estimates, company report, Gartner (Forecast: Public Cloud Services, Worldwide, 2021-2027, 3Q23 Update)

BofA GLOBAL RESEARCH

Method 2: IDC IaaS + PaaS estimates

In method 2 we estimate the total size of the public cloud market by summing both IaaS and PaaS estimates from IDC. Using these estimates, the total implied market size for 2023 is $259bn, growing at a 26% compound annual growth rate through 2025.

Exhibit 88: IaaS aggregate revenue breakdown

Compute spend continues to outpace storage spend within IaaS

Segment	2022	2023	2024	2025	2026	2027	5-yr CAGR
Storage	47.7	59.9	74.3	90.6	108.6	127.8	21.8%
Compute	64.9	81.4	102.2	127.1	156.4	189.5	23.9%
Total	**112.6**	**141.3**	**176.5**	**217.7**	**265**	**317.3**	**23.0%**

Source: BofA Global Research estimates, IDC (Worldwide Public Cloud Infrastructure as a Service Forecast, 2023–2027)

BofA GLOBAL RESEARCH

Exhibit 89: IaaS revenue mix

Compute represents a growing percentage of total IaaS, though relatively consistent

Geography	2022	2023	2024	2025	2026	2027	5-yr Delta
Storage	42.4%	42.4%	42.1%	41.6%	41.0%	40.3%	-1.0%
Compute	57.6%	57.6%	57.9%	58.4%	59.0%	59.7%	0.7%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**0.0%**

Source: BofA Global Research estimates, IDC (Worldwide Public Cloud Infrastructure as a Service Forecast, 2023–2027)

BofA GLOBAL RESEARCH

Exhibit 90: PaaS aggregate revenue breakdown

AI platforms is expected to represent a growing mix of total PaaS

Segment	2022	2023	2024	2025	2026	2027	5-yr CAGR
Analytics and business intelligence software	11.9	14.7	18.1	21.8	25.9	30.5	20.6%
Application development software	1.5	1.7	2.1	2.6	3.1	3.8	20.9%
Application platforms	12.6	15.7	19.5	24.3	29.8	35.2	22.9%
AI platforms	8.6	12.9	19.4	28.9	42.4	61.6	48.2%
Data management software	40.6	50.4	62.5	76.2	91.2	107.4	21.5%
Integration and orchestration middleware	11.7	15.2	20.1	26.1	34.0	44.4	30.5%
Software quality and life-cycle tools	5.5	7.2	9.3	12.0	15.3	19.2	28.5%
Total	**92.4**	**117.7**	**151.0**	**191.9**	**241.7**	**302.1**	**26.7%**
y/y		**27.4%**	**28.3%**	**27.1%**	**26.0%**	**25.0%**	

Exhibit 90: PaaS aggregate revenue breakdown

AI platforms is expected to represent a growing mix of total PaaS

Segment	2022	2023	2024	2025	2026	2027	5-yr CAGR

Source: BofA Global Research estimates, IDC (Worldwide Public Cloud Platform as a Service Forecast, 2023–2027)

BofA GLOBAL RESEARCH

Exhibit 91: PaaS revenue mix

AI platforms is increasingly making up a larger % of total PaaS spend

Segment	2022	2023	2024	2025	2026	2027	5-yr Delta
Analytics and business intelligence software	12.9%	12.5%	12.0%	11.4%	10.7%	10.1%	-4.8%
Application development software	1.6%	1.5%	1.4%	1.4%	1.3%	1.2%	-4.6%
Application platforms	13.6%	13.3%	12.9%	12.7%	12.3%	11.7%	-3.1%
AI platforms	9.3%	10.9%	12.9%	15.1%	17.5%	20.4%	16.9%
Data management software	43.9%	42.8%	41.4%	39.7%	37.7%	35.6%	-4.1%
Integration and orchestration middleware	12.7%	12.9%	13.3%	13.6%	14.1%	14.7%	3.0%
Software quality and life-cycle tools	5.9%	6.1%	6.2%	6.2%	6.3%	6.3%	1.4%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	

Source: BofA Global Research estimates, IDC (Worldwide Public Cloud Platform as a Service Forecast, 2023–2027)

BofA GLOBAL RESEARCH

Exhibit 92: Public cloud (IaaS + PaaS) market forecast

IDC forecasts the public cloud market to grow to $619.4bn by 2027

IaaS + PaaS	2022	2023	2024	2025	2026	2027	5-yr CAGR
IaaS	112.6	141.3	176.5	217.7	265.0	317.3	23.0%
PaaS	92.4	117.7	150.9	191.9	241.8	302.1	26.7%
Total	**205.0**	**259.0**	**327.4**	**409.6**	**506.8**	**619.4**	**24.8%**
y/y		**26.3%**	**26.4%**	**25.1%**	**23.7%**	**22.2%**	

Source: BofA Global Research estimates, IDC

BofA GLOBAL RESEARCH

Exhibit 93: Public cloud revenue composition

PaaS is increasingly a larger % of revenue within total public cloud spend

IaaS vs. PaaS	2022	2023	2024	2025	2026	2027	5-yr Delta
IaaS	54.9%	54.6%	53.9%	53.1%	52.3%	51.2%	-3.7%
PaaS	45.1%	45.4%	46.1%	46.9%	47.7%	48.8%	3.7%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	

Source: BofA Global Research estimates, IDC

BofA GLOBAL RESEARCH

Exhibit 94: Public cloud revenue by geographies

Growth between the three major geographies largely similar

Geography	2022	2023	2024	2025	2026	2027	5-yr CAGR
Americas	113.2	143.3	180.5	225.3	279.0	342.9	24.8%
Asia/Pacific	56.4	71.3	90.6	113.7	140.9	171.0	24.8%
EMEA	35.4	44.4	56.4	70.5	87.0	105.5	24.4%
Total	**205.0**	**259.0**	**327.4**	**409.6**	**506.9**	**619.4**	**24.8%**
y/y		**26.3%**	**26.4%**	**25.1%**	**23.8%**	**22.2%**	

Source: BofA Global Research estimates, IDC

BofA GLOBAL RESEARCH

Exhibit 95: Public cloud revenue by geography mix

The Americas region represents 55%+ of public cloud revenue

Geography %	2022	2023	2024	2025	2026	2027	5-yr Delta
Americas	55.2%	55.3%	55.1%	55.0%	55.0%	55.4%	0.1%
Asia/Pacific	27.5%	27.5%	27.7%	27.8%	27.8%	27.6%	0.1%
EMEA	17.3%	17.1%	17.2%	17.2%	17.2%	17.0%	-0.2%

Source: BofA Global Research estimates, IDC

BofA GLOBAL RESEARCH

Method 3: Price x Quantity bottom-up build

In method 3, we do a simple Price x Quantity calculation to estimate the worldwide public cloud TAM. First, we make an attempt for what we believe is reasonable average annual spend per customer (according to channel feedback) within each company size segment to spend on cloud and multiply this by the number of companies within each segment (based on Census data). Using this methodology, we arrive at a TAM of $389.2bn for 2023, growing at a CAGR of +24% through 2028.

Exhibit 96: Bottom-up P*Q TAM build for public cloud
We estimate a $389.2bn TAM for 2023

Cloud TAM Assumptions/Data Points

Digital Ocean data points for small businesses 20-500 employees
Annual spend: $996 ($83 average monthly ARPU from BofA model)

Data points for mid-market and larger - informed by a Top 5 Cloud Services Partner for hyerpscalers
Avg spend per mid-market: $2m/yr
Avg spend per large enterprise: $10mn/yr
Avg. spend per G2K: $100m/yr

2023 Cloud TAM Calculation

	Self-employed	Very small businesses (< 20)	Small Businesses (20 - 500)	Mid market (500 - 2,500)	Large Enterprise (>2,500)	Global 2000	Total/ Average
# companies (US)	44,000,000	5,305,960	629,025	15,567	3,132	1,000	5,954,684
# companies (rest of world)	88,000,000	10,611,920	1,258,050	31,134	6,264	1,000	11,908,368
Total #	132,000,000	15,917,880	1,887,075	46,701	9,396	2,000	17,863,052
Estimated Avg. Spend per Segment	$0	$0	$996	$2,000,000	$10,000,000	$100,000,000	
Cloud TAM - 2023 ($mn)	**$ -**	**$ -**	**$1,880**	**$93,402**	**$93,960**	**$200,000**	**$389,242**

2028 Cloud TAM Calculation

	Self-employed	Very small businesses (< 20)	Small Businesses (20 - 500)	Mid market (500 - 2,500)	Large Enterprise (>2,500)	Global 2000	Total/ Average
Total # companies (assume +3% y/y):	153,024,178	18,453,186	2,187,637	54,139	10,893	2,000	
Avg. spender per segment (assume +22% y/y)	$0	$0	$2,206	$4,430,669	$22,153,346	$221,533,456	
Cloud TAM - 2028 ($mn)	**$ -**	**$ -**	**$4,827**	**$239,873**	**$241,306**	**$443,067**	**$929,073**
TAM CAGR							**24.3%**

Source: BofA Global Research estimates, company report

BofA GLOBAL RESEARCH

Method 4: On-premise server conversion to cloud

In method 4, we input parameters into the AWS pricing calculator to get an annual server cost of $14,526. From here, we take the sum of servers shipped in the last six years (many companies, Microsoft included, estimate a useful life for its servers to be six years), giving us 77.3mn servers. We then multiply this by the annual cost per server for a cloud server. From this, we arrive at a total addressable market of $1.123tn, which grows to $1.490tn by 2028, representing a compound annual growth rate of 5.8%.

We note that this represents a blue-sky scenario in which all compute today was converted to cloud. This market estimate also implies that roughly 25% of total compute is currently done via cloud (dividing the Gartner or IDC existing cloud spend estimate by this estimate) and suggests a long runway for further conversion of workloads and addition of new workloads to the cloud.

Exhibit 97: Cloud addressable market by calculating AWS pricing multiplied by # of servers
We estimate a total addressable market of $1.123tn, growing to $1.490tn in 2028

Cloud TAM Assumptions/Data Points

Server Price (AWS EC2 pricing calculator):
OS: Red Hat Enterprise Linux with HA SQL And Server Enterprise
vCPUs per instance: 16
Memory (GB): 64
Utilization: 20%

Exhibit 97: Cloud addressable market by calculating AWS pricing multiplied by # of servers

We estimate a total addressable market of $1.123tn, growing to $1.490tn in 2028

Storage per instance (GB): 10,000
Total monthly: $1,211
2023 Annual Server Cost: $14,526
Assume server cost goes up +3% y/y
2028 Annual Server Cost: $16,840

***Assume average server life of 6 years (consistent with Microsoft's cloud infrastructure)**

Server shipments (Gartner):
2018: 12.956mn
2019: 12.537mn
2020: 12.672mn
2021: 12.918mn
2022: 13.827mn
2023: 12.421mn
2024: 13.245mn
2025: 14.183mn
2026: 15.270mn
2027: 16.189mn
2028: 17.160mn (BofA estimate - carry forward 2027 growth rate)

# of active servers in 2023: 77.331mn (summation of 2018-2023)
# of servers in 2028: 88.468mn (summation of 2023-2028)

2023 Cloud TAM Calculation	
# of servers (mn)	**77.331**
x Cost per server annually:	**$14,526**
Annual compute spend ($mn):	**$1,123,337**
Cloud TAM - 2023 ($mn)	**$1,123,337**

2028 Cloud TAM Calculation	
# of servers (mn)	**88.468**
x Cost per server annually:	**$16,840**
Annual compute spend ($mn):	**$1,489,803**
Cloud TAM - 2028 ($mn)	**$1,489,803**
TAM CAGR	**5.8%**

Source: BofA Global Research estimates, Gartner (Forecast: Servers, All Countries, 2021-2027, 3Q23 Update)

BofA GLOBAL RESEARCH

Key categories and use cases

Data and data management use cases, which includes AI training and inferencing, are currently the largest use case within public cloud, representing roughly 40% of total public cloud spend. The AI life cycle sub-category within it is expected to grow at a 41% compound annual growth rate over the next five years. The second largest public cloud use case is application development and testing, representing almost 20% of total cloud spend. Developer workflows have shifted over time to agile methodologies from waterfall, which has proliferated usage of more application development and testing taking place via cloud computing. Third is general-purpose infrastructure use cases for tasks such as client computing, infrastructure, and networking and security, representing almost 15% of total public cloud spend.

Exhibit 98: Detailed breakdown of workloads (by revenue) deployed to public cloud

Data management is the largest spend category for workloads deployed to public cloud

Category	Sub-category	2022	2023	2024	2025	2026	2027	5-yr CAGR
Application development & testing		**40,120.2**	**50,325.5**	**63,502.3**	**79,488.9**	**98,894.6**	**121,405.8**	**24.8%**
	Development tools and applications	40,120.2	50,325.5	63,502.3	79,488.9	98,894.6	121,405.8	24.8%
Business applications		**24,532.4**	**31,029.7**	**39,045.4**	**48,476.7**	**59,351.3**	**71,370.9**	**23.8%**
	CRM	7,378.6	9,335.8	11,740.0	14,560.5	17,802.5	21,378.6	23.7%

Exhibit 98: Detailed breakdown of workloads (by revenue) deployed to public cloud

Data management is the largest spend category for workloads deployed to public cloud

Category	Sub-category	2022	2023	2024	2025	2026	2027	5-yr CAGR
	ERP	5,349.2	6,766.7	8,501.8	10,532.6	12,862.5	15,428.6	23.6%
	HCM	2,461.8	3,032.6	3,737.4	4,549.5	5,465.3	6,436.3	21.2%
	Vertical applications	3,543.1	4,513.0	5,726.0	7,177.7	8,882.0	10,806.6	25.0%
	SCM	5,799.7	7,381.6	9,340.2	11,656.4	14,339.0	17,320.8	24.5%
Data management		**81,987.4**	**103,591.5**	**131,684.5**	**165,961.1**	**207,406.9**	**257,582.9**	**25.7%**
	AI life cycle	5,013.9	7,335.2	10,595.9	14,976.5	20,689.5	28,223.6	41.3%
	BI/data analytics	19,913.3	24,789.6	30,781.7	37,597.8	45,272.3	53,808.0	22.0%
	Structured database/data management	43,055.9	51,622.8	62,098.8	74,338.3	87,840.1	102,478.0	18.9%
	Text and media analytics	7,643.3	11,106.8	16,489.5	24,374.3	35,804.1	52,166.6	46.8%
	Unstructured database	6,361.0	8,737.1	11,718.6	14,674.2	17,800.9	20,906.7	26.9%
Digital services		**3,887.4**	**5,215.0**	**6,849.7**	**8,736.2**	**10,838.9**	**13,084.3**	**27.5%**
	Digital services	3,887.4	5,215.0	6,849.7	8,736.2	10,838.9	13,084.3	27.5%
Email/collaborative and content applications		**21,404.1**	**27,141.6**	**34,099.1**	**41,964.9**	**50,709.2**	**59,914.1**	**22.9%**
	Content applications	5,532.5	6,420.7	7,342.7	8,188.5	8,862.6	9,220.8	10.8%
	Content delivery	10,923.8	14,605.8	19,259.6	24,890.4	31,546.0	39,096.3	29.0%
	Email/collaborative/social	4,947.8	6,115.1	7,496.8	8,886.0	10,300.6	11,597.0	18.6%
Infrastructure		**28,641.3**	**36,016.0**	**45,080.6**	**55,958.5**	**68,548.5**	**82,533.6**	**23.6%**
	Client computing	4,641.0	5,879.9	7,430.0	9,228.5	11,308.4	13,617.2	24.0%
	Infrastructure	10,955.9	13,429.5	16,360.0	19,568.6	22,920.6	26,121.8	19.0%
	Networking and security	13,044.4	16,706.6	21,290.6	27,161.4	34,319.5	42,794.6	26.8%
Technical applications		**4,626.0**	**5,871.0**	**7,424.2**	**9,279.0**	**11,449.2**	**13,890.5**	**24.6%**
	Engineering/technical (CAD/CAM, HPC)	4,626.0	5,871.0	7,424.2	9,279.0	11,449.2	13,890.5	24.6%
Total		**205,198.8**	**259,190.3**	**327,685.8**	**409,865.3**	**507,198.6**	**619,782.1**	**24.7%**
y/y			**26.3%**	**26.4%**	**25.1%**	**23.7%**	**22.2%**	

Source: BofA Global Research estimates, IDC (Worldwide Public Cloud IaaS and PaaS Workloads Forecast, 2023–2027)

BofA GLOBAL RESEARCH

Exhibit 99: Workloads deployed to public cloud by revenue mix %

We see that text and media analytics as well as AI life cycle are expected to grow as a % of total cloud spend

Category	Sub-category	2022	2023	2024	2025	2026	2027	5-yr Delta
Application development & testing		**19.6%**	**19.4%**	**19.4%**	**19.4%**	**19.5%**	**19.6%**	**0.0%**
	Development tools and applications	19.6%	19.4%	19.4%	19.4%	19.5%	19.6%	0.0%
Business applications		**12.0%**	**12.0%**	**11.9%**	**11.8%**	**11.7%**	**11.5%**	**-0.4%**
	CRM	3.6%	3.6%	3.6%	3.6%	3.5%	3.4%	-0.1%
	ERP	2.6%	2.6%	2.6%	2.6%	2.5%	2.5%	-0.1%
	HCM	1.2%	1.2%	1.1%	1.1%	1.1%	1.0%	-0.2%
	Vertical applications	1.7%	1.7%	1.7%	1.8%	1.8%	1.7%	0.0%
	SCM	2.8%	2.8%	2.9%	2.8%	2.8%	2.8%	0.0%
Data management		**40.0%**	**40.0%**	**40.2%**	**40.5%**	**40.9%**	**41.6%**	**1.6%**
	AI life cycle	2.4%	2.8%	3.2%	3.7%	4.1%	4.6%	2.1%
	BI/data analytics	9.7%	9.6%	9.4%	9.2%	8.9%	8.7%	-1.0%
	Structured database/data management	21.0%	19.9%	19.0%	18.1%	17.3%	16.5%	-4.4%
	Text and media analytics	3.7%	4.3%	5.0%	5.9%	7.1%	8.4%	4.7%
	Unstructured database	3.1%	3.4%	3.6%	3.6%	3.5%	3.4%	0.3%
Digital services		**1.9%**	**2.0%**	**2.1%**	**2.1%**	**2.1%**	**2.1%**	**0.2%**
	Digital services	1.9%	2.0%	2.1%	2.1%	2.1%	2.1%	0.2%
Email/collaborative and content applications		**10.4%**	**10.5%**	**10.4%**	**10.2%**	**10.0%**	**9.7%**	**-0.8%**
	Content applications	2.7%	2.5%	2.2%	2.0%	1.7%	1.5%	-1.2%
	Content delivery	5.3%	5.6%	5.9%	6.1%	6.2%	6.3%	1.0%
	Email/collaborative/social	2.4%	2.4%	2.3%	2.2%	2.0%	1.9%	-0.5%
Infrastructure		**14.0%**	**13.9%**	**13.8%**	**13.7%**	**13.5%**	**13.3%**	**-0.6%**
	Client computing	2.3%	2.3%	2.3%	2.3%	2.2%	2.2%	-0.1%
	Infrastructure	5.3%	5.2%	5.0%	4.8%	4.5%	4.2%	-1.1%
	Networking and security	6.4%	6.4%	6.5%	6.6%	6.8%	6.9%	0.5%
Technical applications		**2.3%**	**2.3%**	**2.3%**	**2.3%**	**2.3%**	**2.2%**	**0.0%**
	Engineering/technical (CAD/CAM, HPC)	2.3%	2.3%	2.3%	2.3%	2.3%	2.2%	0.0%
Total		**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	

Source: BofA Global Research estimates, IDC (Worldwide Public Cloud IaaS and PaaS Workloads Forecast, 2023–2027)

BofA GLOBAL RESEARCH

Key vendors and market share trends

As companies shift to the cloud, we believe many are likely to adopt a multi-cloud approach given it provides an ability to minimize vendor lock-in, optimize based off specific use-cases and products (e.g. using AWS for DynamoDB for one use case and using GCP for Tensorflow for another), and reduce costs.

The big three cloud providers

Exhibit 100: Key components of the big three cloud providers

Each of the big three cloud providers has analogous offerings for most major product categories

Product	AWS	Azure	GCP
Compute	EC2	Azure Virtual Machine	Compute Engine
Storage	S3	Azure Blob Storage	Cloud Storage
Web hosting	Amplify	Web Apps	Firebase
Container management	Amazon Elastic Kubernetes Service (EKS)	Azure Kubernetes Service (AKS)	Kubernetes Engine
Functions as a service	Lambda	Azure Functions	Google Cloud Functions
Non-relational DBs	DynamoDB	CosmosDB	Cloud Datstore & Firestore
Machine Learning platform	SageMaker	Azure Machine Learning	TensorFlow
Data warehousing	RedShift	Synapse Analytics	BigQuery
Gaming platform	Amazon GameLift, Lumberyard	Game Stack	Game Servers
Secrets management	Secrets Manager	Key Vault	Secret Manager
Single sign-on	Single Sign-On	Microsoft Entra ID	Cloud Identity
Threat Detection	GuardDuty	Sentinel	Chronicle

Source: BofA Global Research estimates, AWS, Azure, and GCP

BofA GLOBAL RESEARCH

Amazon Web Services (Amazon covered by Justin Post)

Founded in 2002, Amazon Web Services was an early cloud pioneer and is expected to capture 55% market share among the Big-3 cloud providers in 2022. Amazon introduced some of the industry's most well-known services such as S3 (Simple Storage Service) and EC2 (Elastic Compute Cloud). AWS is now available in 32 regions (+2 in 2023) with 102 availability zones. According to W3Techs, Amazon hosts 6% of all websites and is the largest host provider by >1.5pts. As of 3Q23, AWS was at a $92bn+ revenue run rate growing +12% y/y.

Microsoft Azure

Azure is Microsoft's cloud computing service for building, test, deploying, and managing applications. Azure was announced in late 2008 and formally released in early 2010 and has continued to see rapid adoption. A notable contributor to Azure's favorable reputation among the practitioner community was Microsoft's acquisition of GitHub, which helped win the mindshare of many developers. Microsoft Azure is second in market share with an estimated ~20% share among cloud providers for 2023E.

Developers/customers whom we spoke to cite the compatibility with .NET frameworks, Microsoft Entra (identity management such as SSO and multi-factor authentication), AI & ML tooling, and native integration with Microsoft Visual Studio/GitHub as several notable differentiators over competing cloud vendors. As of 3Q23, Azure was at a $69bn revenue run rate growing +28% y/y.

As part of our coverage, we check-in with Microsoft/Azure channel partners (resellers and integration partners) on a quarterly basis. Feedback from our discussions continue to suggest healthy growth in the Azure business, with growth expected to sustain at heightened rates for the next several years. Growth is driven by increasing perception that Azure is the best option for Enterprises for a number of reasons: 1) Microsoft's presence in the enterprise is already well established and has high goodwill with IT departments and CIOs, given a strong price to value perception of the Microsoft stack in general. As a result, adoption of Azure is a natural extension of the existing relationship with Microsoft given its trusted nature, seamless integration with other Microsoft applications, and favorable economics when bundled together with existing contracts/licenses. Several partners note perceptibly higher win rates against AWS if the organization has an existing relationship with Microsoft. Additionally, a key point we hear frequently from partners (and customers) is the competitive friction between Amazon's various business units is driving many enterprises (especially in retail, CPG, and grocery) to migrate workloads off AWS and onto Azure.

Google Cloud Platform (Alphabet covered by Justin Post)

Alphabet launched App Engine in 1H08, a platform for developers to host web applications on Google's Infrastructure (PaaS). The product had traction and Google to expanded its services in 2011 and add on compute, storage, analytics, and ML services to the Google Cloud Platform. GCP is now in 39 regions and 109 zones and is the second largest data center provider (6.4% usage) and largest traffic analytics tool provider (54.2% usage), according to W3Techs. As of 3Q23, GCP (including Google Workspace) was at a $34bn annual revenue run rate (+22% y/y).

Other cloud vendors

Oracle

Oracle offers cloud computing services for IaaS and PaaS, which includes its marque offering known as Oracle Cloud or Oracle Cloud Infrastructure (OCI). OCI was made generally available in the fall of 2016 under the name Oracle Bare Metal Cloud services. While not a cloud provider that is first to mind for many developers, our checks indicate to us that OCI is highly performant when running Oracle applications. We note that Oracle has numerous high-profile customers who utilize it such as Zoom, Uber, Dropbox (for transaction processing, not storage of data), 8x8, Mazda, and FedEx. As of F2Q24, Oracle's Cloud Infrastructure business operates at a $6.4bn revenue run rate, growing +52% y/y, with OCI consumption growing +71% y/y.

Salesforce

Salesforce acquired Heroku in 2010. Heroku is a primarily PaaS provider and offers numerous key products, including its core Heroku Platform, which allows customers to run apps in virtual containers, Heroku Postgres, a cloud database service for Heroku based on PostgresSQL, Heroku Redis, which is a customized distribution of Redis from Heroku, Heroku Connect, which allows users to create Heroku apps that can easily integrate with Salesforce deployments, among others.

IBM (covered by Wamsi Mohan)

IBM offers IBM Cloud, a set of cloud computing services that combines PaaS with IaaS. IBM acquired SoftLayer, a public cloud platform, in 2013, which served as the foundation for IBM Cloud. From the, IBM has purchased companies like Bluemix and Red Hat to bolster its PaaS offerings. IBM Cloud differentiates itself from other cloud providers by providing performant compute infrastructure through its Power Systems products to support workloads such as SAP HANA and Oracle ERP. Our limited discussions on IBM Cloud inform us that IBM Cloud's best are for lift and shift use cases of older workloads.

Alibaba (covered by Eddie Leung)

Through its subsidiary Alibaba Cloud (also known as Aliyun in China), Alibaba offers cloud computing services and is the largest cloud computing company in China with a strong presence as well in Southeast Asia. Alibaba Cloud was founded in late 2009 and proved to be capable of supporting Alibaba's Single's Day e-commerce holiday. Much like AWS, Azure, and GCP, Alibaba Cloud also offers analogous PaaS services popular for development. We have found that conglomerates with presence in China will sometimes opt to use Alibaba Cloud for their IT footprint in China; however, we note that we anecdotally hear from partners that sometimes non Chinese companies shy away from leveraging Alibaba Cloud due to the concern that their data is being stored "in" China. In its most recent quarter, Alibaba Cloud was at a ~$11.7bn revenue run-rate (-6% y/y). Alibaba Cloud currently operates in 89 availability zones in 30 regions around the world (59 in China mainland and 30 outside of China mainland).

Tencent (covered by Eddie Leung)

Tencent offers Tencent Cloud, which is popular in China and Southeast Asia. Much like AWS, Azure, and GCP, Tencent Cloud also offers analogous PaaS services popular for development. Tencent Cloud currently operates in 70 availability zones in 26 regions around the world. Tencent Cloud differentiates through its strong presence and availability in China and is considered best-suited for gaming and cloud-native workloads. We note that Tencent Cloud is currently the only cloud provider with a region in Russia.

DigitalOcean (covered by Wamsi Mohan)

DigitalOcean's customer base is primarily smaller organizations. DigitalOcean has differentiated itself through offering a simple, easy-to-use product with highly predictable pricing with strong support for its customers. The company also offers thousands of tutorials and question & answer threads for prospective and current customers to learn while also providing a strong emphasis for customer support. In its most recent quarter (3Q23), Digital Ocean was at a $713mn revenue run rate (Digital Ocean discloses ARR), growing +16% y/y. Digital Ocean offers its services via 15 data centers across 9 regions.

Other key cloud ecosystem vendors

Broadcom (VMware)

VMware, now owned by Broadcom, is a leading provider of software to help customers manage their IT resources across their data centers, private clouds, and complex multi-cloud environments. While VMware does not offer a consumable cloud service (IaaS/PaaS), its solution set enables firms to be creative and flexible with their IT configurations. For example, a mature company with a traditional data center (where it owns/leases the hardware) can modernize its data center by turning it into a private cloud or bridge its on premise solutions to act in unison with other public cloud deployments it may be leveraging or act as a single pane of glass to manage an entity's full tech footprint. Ultimately VMware offers unique value proposition of its offering with its high interoperability between the different major cloud providers to enable multi-cloud for customers, helping customers avoid cloud vendor lock-in. Broadcom completed the acquisition of VMware in November 2023.

HashiCorp

HashiCorp provides a software which enables a consistent cloud operating model with workflows and a standard approach to automating the critical processes involved in delivering cloud applications. The company has a product portfolio that spans infrastructure, provisioning, security, networking, and application deployment. Some liken HashiCorp to be the "modern VMware," in that it is a centralized console for all of one's cloud platforms (AWS, Azure, GCP, for example), just as VMware was a centralized console for managing numerous (virtualized) data centers.

Gartner Peer Insight competitive discussion

Gartner Peer Insight reviews show that AWS, Azure, and GCP score very closely with one another. Of course, we see that AWS has the most number of reviews, given its leading market share position. We do also note that the spread and variance between customer ratings between the big three hyperscalers is minimal. This is mostly unsurprising given analogous IaaS and PaaS tooling offered by the top providers. Lastly, we note that Digital Ocean scored the highest in overall rating, with a perfect 5.0 score. We caveat this by noting it is on a smaller number of reviews.

Exhibit 101: Gartner Peer Insight ratings for top cloud service providers

Among the big three cloud providers, AWS and GCP received a 4.5 overall rating, and Azure received a 4.4 overall rating

customer experience metrics	product capability metrics

Exhibit 101: Gartner Peer Insight ratings for top cloud service providers
Among the big three cloud providers, AWS and GCP received a 4.5 overall rating, and Azure received a 4.4 overall rating

	evaluation & contracting	integration & deployment	service & support	user management	security & compliance	dev services	middleware capabilities	architecture flexibility	big data enablement	operations management	resilience	overall rating	# of reviews
AWS	4.4	4.6	4.5	4.5	4.6	4.5	4.5	4.5	4.4	4.5	4.5	4.5	3,577
Azure	4.4	4.5	4.4	4.4	4.6	4.4	4.4	4.3	4.4	4.5	4.4	4.4	2,106
GCP	4.5	4.5	4.5	4.4	4.6	4.4	4.4	4.5	4.5	4.4	4.4	4.5	1,228
OCI	4.3	4.3	4.3	4.2	4.4	4.2	4.2	4.2	4.1	4.2	4.3	4.3	343
Alibaba Cloud	4.3	4.2	4.3	4.2	4.2	4.1	4.2	4.0	4.0	4.1	4.0	4.3	116
Huawei Cloud	4.7	4.7	4.8	4.8	4.7	4.7	4.7	4.6	4.6	4.7	4.6	4.7	127
Digital Ocean	4.7	4.8	4.8	4.2	4.6	4.8	4.5	NA	4.5	4.5	4.8	5.0	32
Tencent Cloud	4.5	4.4	4.3	4.3	4.4	3.9	4.2	5.0	4.4	4.7	4.4	4.6	25

Source: BofA Global Research, Gartner Peer Insights

BofA GLOBAL RESEARCH

For reference, we also see that AWS scores the highest among cloud service providers by Gartner. We see that AWS had a strong lead over its two closest competitors in 2022, however, this gap has narrowed in the 2023 Magic Quadrant, with Oracle gaining a position in the top right quadrant.

Exhibit 102: Gartner 2022 Magic Quadrant
AWS, Microsoft, and Google are in the top quadrant

Source: Gartner (Magic Quadrant for Cloud Infrastructure & Platform Services, October 2022)

BofA GLOBAL RESEARCH

Exhibit 103: Gartner 2023 Magic Quadrant
AWS, Microsoft, Google, and Oracle are in the top quadrant

Source: Gartner (Magic Quadrant for Cloud Infrastructure & Platform Services, December 2023)

BofA GLOBAL RESEARCH

Additionally, Gartner also now has a Magic Quadrant for Cloud AI Developer Services. We see here that there is no clear winner between AWS and Microsoft.

Exhibit 104: Magic Quadrant for Cloud AI Developer Services

All three major cloud service provides, Google (GCP), Microsoft (Azure) and Amazon (AWS)were named leaders in 2023 Gartner Magic Quadrant for Cloud AI Developer Services (CAIDS)

Source: Gartner (Magic Quadrant for Cloud AI Developer Services, May 2023)

BofA GLOBAL RESEARCH

Category definitions & appendix

IaaS

Infrastructure as a Service is increasingly becoming the go-to way for companies to manage their data center technology footprint. IaaS provides users with computing infrastructure, including servers, networks, operating systems, storage, memory, through virtualization technology, such that the end user does not need to buy or configure any hardware themselves. Minimal configuration, typically done through an easy-to-use web dashboard, is required to set up a cloud instance through an IaaS provider. Examples of IaaS providers: AWS, Microsoft Azure, GCP, Alibaba, Tencent Cloud, DigitalOcean.

Key Advantages

- Easy to scale. IaaS allows end users to buy additional compute resources on demand in near real-time, thus dramatically lowering the time to scale an application deployment
- Flexibility. IaaS providers provide support for numerous operating systems, programming languages, web application platforms, database, and services an end user may need without having to worry about hardware requirements that may be associated with each.
- Reliability. IaaS providers invest heavy resources into providing maximum uptime for their services. Major cloud providers offer 99.9%+ uptime for their platforms.
- Reduced capex. IaaS is typically priced on a pay-as-you-go subscription model to help reduce upfront hardware costs and maintenance.

Possible Disadvantages

- At scale, consuming IaaS services vs. owning the data center/hardware footprint may be more expensive. As an example, Dropbox moved off of AWS and built its own data centers for more favorable cost/unit economics as it related to their infrastructure deployment.

PaaS

Platform as a Service is increasingly becoming the de facto way for companies (and developers) to design, create, and deploy applications. PaaS allows end users (mostly developers) to leverage pre-existing frameworks to develop or customize applications. PaaS is often used interchangeably with IaaS given the intertwined nature of numerous PaaS offerings with IaaS. To formally define this, PaaS is considered a superset of IaaS, in that it is IaaS offered with the middleware layer managed by the provider along with additional features such as development frameworks, analytics features, or other services such application versioning, application instrumentation, security, workflow, scheduling, etc. Examples of PaaS providers (typically same as IaaS, cloud hyperscaler/providers tend to offer both): AWS, Microsoft Azure, GCP, Alibaba, Tencent Cloud, DigitalOcean.

Key Advantages – all the advantages of IaaS, plus

- Faster code delivery. PaaS development tools accelerate developers to use pre-coded or pre-configured services or components that come with the platform, such as search, directory services, software repositories, etc.
- Tooling is often more affordable vs. best of breed options. PaaS tools often offer the basic functionality of their best of breed counterparts at a more affordable price. As an example, in some instances Amazon RedShift will come out cheaper than Snowflake.

Possible Disadvantages

- Vendor lock-in. Each PaaS service has specialized set of APIs & products that are unique to them (though competing PaaS vendors will have analogous services), and sometimes switching between PaaS providers may mean re-writing portions of applications if a development tool or module is only offered on one cloud.

FaaS (commonly known as Serverless)

Function as a service, a serverless compute architecture requires no scaling configurations and developers are effectively fully obscured from the underlying infrastructure. Serverless computing allows developers to purchase backend services on a flexible 'pay-as-you-go' basis, meaning that developers only have to pay for the services they use. A popular example to illustrate this is the following: "being on a cell phone data plan with a monthly fixed limit would be akin to using IaaS/PaaS vs. being on one that only charges for each byte of data that's used is akin to serverless." We note that the term 'serverless' may be somewhat misleading, as there are still servers providing these backend services, but all the server space and infrastructure concerns are handled by the vendor. Serverless architectures are typically used for smaller snippets of code that may be dependencies for larger, longer-running tasks.

Key Advantages

- Cheaper in specific use cases
- Developer does not need to make infrastructure considerations

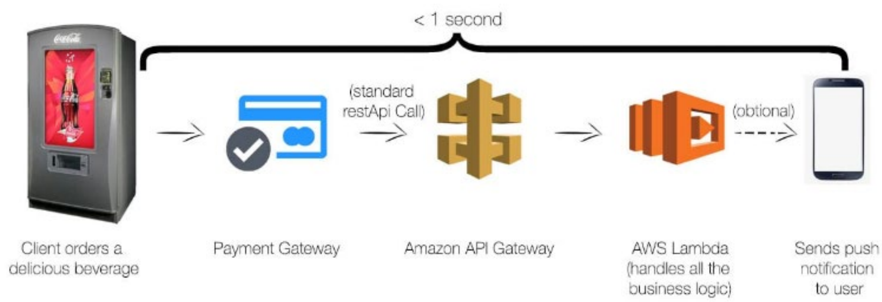
Possible Disadvantages

- May end up being more expensive for long-running tasks
- Multitenancy can reduce application performance
- Less control over the application and underlying optimization with compute later

As an example, Coca-Cola shared at AWS re:invent in 2016 how they leveraged serverless architecture to reduce the cost of operating the software for its vending machines. Prior to adopting a serverless architecture with AWS, Coca-Cola was using EC2 instances (IaaS) which they deployed their software to that costed them $12,864/yr.

When they moved to a serverless architecture the cost annual cost came down to $4,490. Coca-Cola's vending machines were taking roughly 30mn requests per month, each of which is a discrete event, thus serverless (FaaS) architecture was well suited for this use case. The company shared that the breakeven with FaaS for running the software using IaaS was around 80mn calls per month, thus we see here that in use cases that are more constant/long-running, IaaS/PaaS makes more sense.

Exhibit 105: Coca-Cola usage of Serverless architecture
Serverless is good for highly ephemeral workloads



Source: Dashbird.io, AWS, Coca-cola

BofA GLOBAL RESEARCH

SaaS

Software as a Service is the most commonly used method of product delivery for newer software companies, where the company delivers its software that is hosted on behalf of the end user on either its own infrastructure or on a third-party cloud provider (such as AWS, Azure, GCP). Many SaaS providers deliver their software as web applications, meaning no download or installation is required by the end user. Examples of SaaS applications include: Microsoft's M365, Salesforce Sales Cloud, Workday HCM/FINS offerings, Adobe Creative Cloud offerings, Intuit's QuickBooks Online or TurboTax (Web), and Zoom.

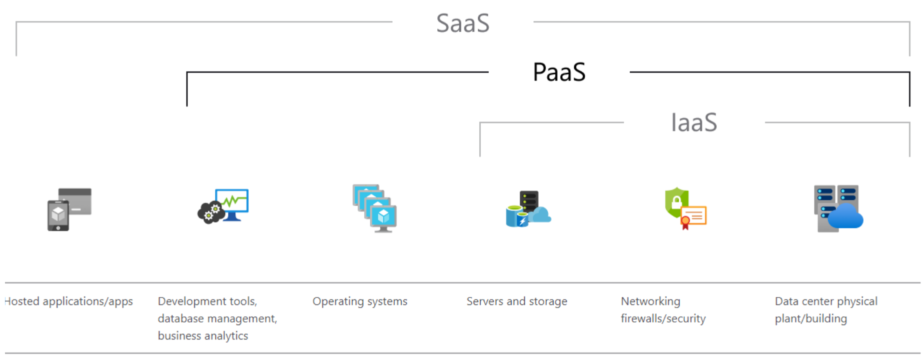
Key Advantages

- Quicker time to value. Easier to set up vs. buying an on premise license and installing on personal (or cloud) hardware
- No need to allocate software engineers/adjacent resources to create an in-house solution
- Less technical overhead required. Hardware or software updates are managed by the vendor and not the user, which reduces IT/technical staff requirements

Possible Disadvantages

- Less control in security. Customers/end users may require strong security features (for example, a public sector, financial services, or medical customer), and some newer SaaS vendors may still be ramping on security features and security certifications such as FedRAMP or HIPAA. Additionally, some software providers may only provide their applications through a multi-tenant configuration, which can be a deal breaker to some prospective users/buyers.
- Less customization that home-grown software

Exhibit 106: Visual Depiction of SaaS vs. PaaS vs. IaaS
IaaS is a subset of PaaS, which is a subset of SaaS



Source: Microsoft

BofA GLOBAL RESEARCH

Vertical Software Overview

Framing the Vertical Software Landscape

Exhibit 107: The vertical software landscape is fragmented and competitive, with dozens of public vendors
We provide an illustrative list of vendors in the fragmented vertical software market below

Education
PowerSchool
Blackbaud
2U
Chegg
Coursera
D2L
Instructure
Parchment
Turnitin
Udemy

AEC
Autodesk
Bentley Systems
Unity Software
Ansys
Aspen Tech
AVEVA
Dassault Systems
Hexagon
Nemetschek
Procore
PTC
Trimble

Insurance
Guidewire
CCC Intelligent Solutions
Duck Creek
Insurity
Majesco
Mitchell International
OneShield
Sapiens
Solera

Retail
Lightspeed
Agilysys
Olo
PAR Technology
Shift4
SPS Commerce
Toast

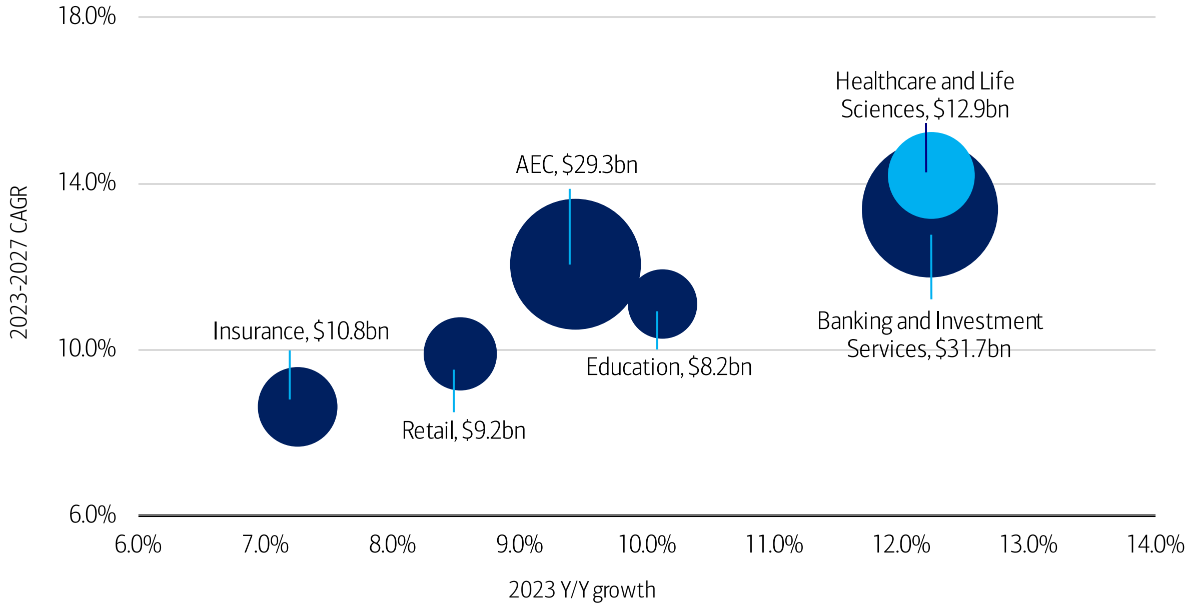
Banking & Investment Services
nCino
Intapp
MeridianLink
Enfusion
Clearwater Analytics

Healthcare & Life Science
Veeva Systems
Definitive Healthcare
IQVIA
Weave Communications
Model N
Solutionreach

Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 108: Banking & investment services industries spend $31bn+ annually on vertical software
We present the relative sizes and growth rates of the vertical-specific software markets by industry below



Source: BofA Global Research, Gartner

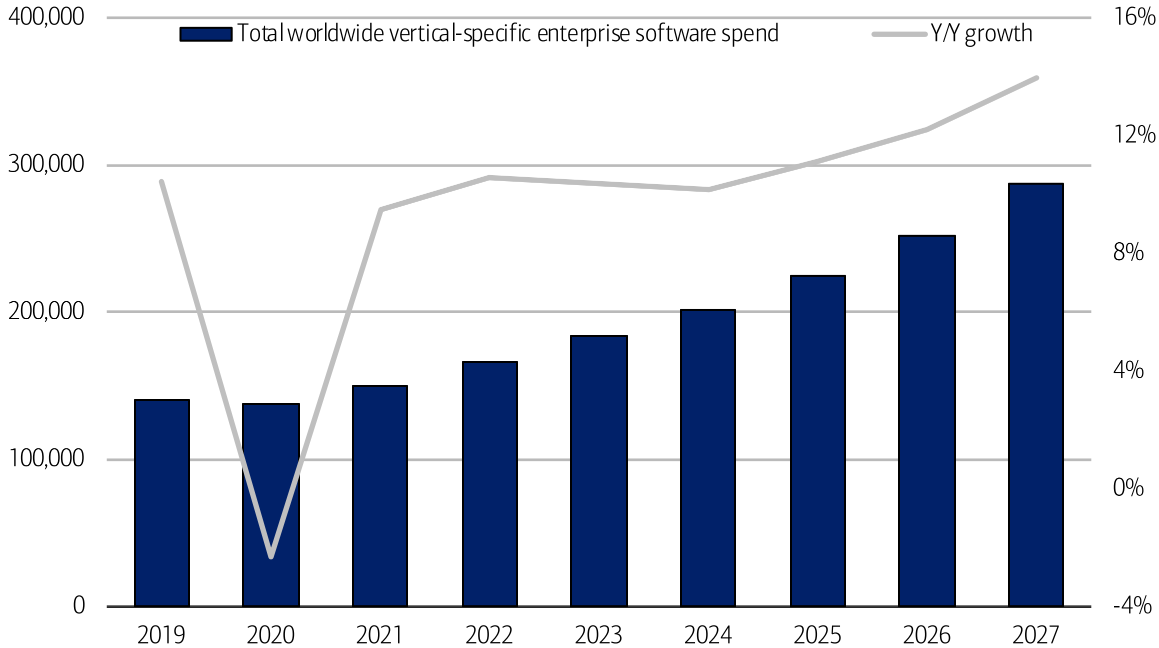
BofA GLOBAL RESEARCH

Vertical-specific SaaS – a new and improved approach

As detailed in our Vertical Software Primer published on December 12, 2023, vertical software is a $183bn market projected to double over the next seven years, according to Gartner. Vertical-specific software (VSS) is defined as software applications that are unique to a vertical industry. These are stand-alone applications that are not modules or extensions of horizontal applications/platforms and do not include custom-developed applications. For example – claims management software for insurance companies or product engineering and design software for manufacturers.

Historically, businesses have developed custom solutions in-house on legacy systems to address unique company or industry-specific needs. However, industry-specific on-premise applications often have short-comings that vertical software vendors can address as businesses modernize and migrate to the cloud. Building verticalized applications internally is time consuming and costly, and ongoing maintenance can be challenging – creating opportunities for vertical SaaS vendors to introduce flexible and scalable solutions.

Exhibit 109: Growth in worldwide vertical-specific software (VSS) spend is expected to accelerate from 2025-2027
Worldwide vertical-specific enterprise software spend ($mn)



Source: BofA Global Research, Gartner

BofA GLOBAL RESEARCH

Vertical software tends to be relatively uncorrelated with broader market trends. Low customer churn and deep domain expertise contribute to high barriers to entry, and valuable industry-specific data advantages yield powerful AI monetization opportunities. In many cases, vertical software companies address underserved end-markets still relatively early in adoption cycles, contributing to long-tail opportunities which can drive long-term top-line growth. Vertical-specific applications software is deeply embedded in customer workflows, resulting in sticky customer bases (95%+ renewal rate on average) that underpin powerful expansion/upsell motions.

Specialized functionality can be used to meet the unique needs and workflow of industries such as manufacturing, healthcare, or financial services. By providing industry-specific features, vertical software vendors can offer solutions that are more ready out of the box and compliant with their target sectors. This not only streamlines implementation and reduces customization efforts, but also demonstrates an understanding of the specific challenges and nuances faced by certain industries which is key in the selling cycle.

Exhibit 110: Y/Y growth in VSS spend is expected to accelerate during the 2025-2027 period for all verticals detailed below
Growth in VSS spend ($mn) in healthcare and life sciences is expected to accelerate to 16.7% by 2027

($mns)	2022	2023	2024	2025	2026	2027
VSS spend - Banking and Investment Services	**31,683**	**35,557**	**39,762**	**44,761**	**50,910**	**58,737**
Y/Y growth	12.5%	12.2%	11.8%	12.6%	13.7%	15.4%
Y/Y growth accel/decel	2.2%	-0.3%	-0.4%	0.7%	1.2%	1.6%
VSS spend - Insurance	**10,841**	**11,627**	**12,437**	**13,438**	**14,644**	**16,184**
Y/Y growth	7.8%	7.3%	7.0%	8.0%	9.0%	10.5%
Y/Y growth accel/decel	0.0%	-0.5%	-0.3%	1.1%	0.9%	1.5%
VSS spend - AEC	**29,298**	**32,063**	**35,307**	**39,230**	**44,149**	**50,544**
Y/Y growth	8.9%	9.4%	10.1%	11.1%	12.5%	14.5%
Y/Y growth accel/decel	1.3%	0.6%	0.7%	1.0%	1.4%	1.9%
VSS spend - Healthcare and Life Sciences	**12,898**	**14,476**	**16,197**	**18,367**	**21,095**	**24,611**
Y/Y growth	12.7%	12.2%	11.9%	13.4%	14.9%	16.7%
Y/Y growth accel/decel	-1.3%	-0.5%	-0.3%	1.5%	1.4%	1.8%
VSS spend - Retail	**9,179**	**9,962**	**10,799**	**11,812**	**13,016**	**14,530**

Exhibit 110: Y/Y growth in VSS spend is expected to accelerate during the 2025-2027 period for all verticals detailed below
Growth in VSS spend ($mn) in healthcare and life sciences is expected to accelerate to 16.7% by 2027

($mns)	2022	2023	2024	2025	2026	2027
Y/Y growth	9.0%	8.5%	8.4%	9.4%	10.2%	11.6%
Y/Y growth accel/decel	-2.7%	-0.5%	-0.1%	1.0%	0.8%	1.4%
VSS spend - Education	**8,241**	**9,076**	**9,957**	**10,985**	**12,238**	**13,824**
Y/Y growth	13.0%	10.1%	9.7%	10.3%	11.4%	13.0%
Y/Y growth accel/decel	0.5%	-2.9%	-0.4%	0.6%	1.1%	1.5%

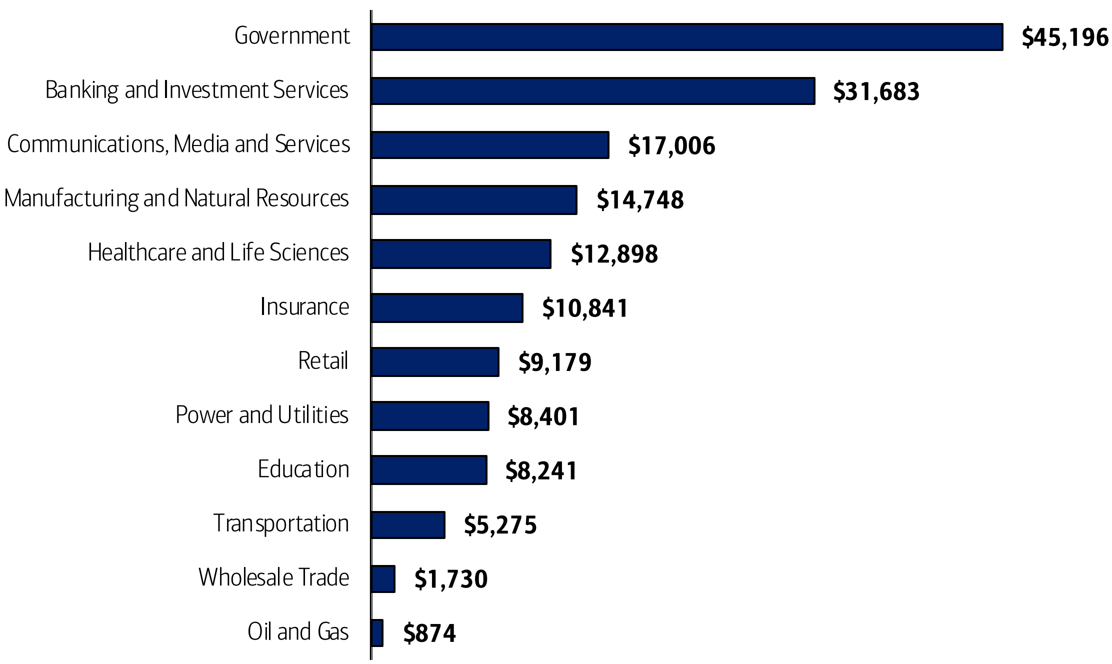
Source: BofA Global Research, Gartner

BofA GLOBAL RESEARCH

Migration of legacy systems and digitization of previously manual tasks remains the primary theme in vertical SaaS. Based on our conversations with channel partners and company management teams, we estimate that many industries have migrated less than 20% of systems to vertical SaaS providers. We attribute the relative late adoption cycles to: 1) the mission critical nature of many vertical-specific software solutions; 2) change fatigue and wariness among CIOs who may be hesitant to engage in lengthy negotiations and migrations; 3) Institutional inertia; 4) invested capital 5) and regulatory and compliance concerns.

However, movement to SaaS-based solutions is inevitable, in our view. Legacy systems become cost-prohibitive over time as hardware, systems-patching, and upgrade costs outweigh the benefits. While ripping and replacing legacy applications can be costly given deep integrations with existing systems, the benefits (application scalability, platform flexibility, security, and cross-platform compatibility) are clear. Within the insurance vertical for example, 95% of Guidewire's customers report a reduction in developer effort comparing cloud updates to minor on-prem product upgrades, and carriers now receive 3 new cloud releases per year (significantly faster than the on-prem cadence).

Exhibit 111: Governments spent the most on vertical-specific enterprise software in 2022 at $45.2bn
Worldwide vertical-specific enterprise software spend by vertical, 2022 ($mn)

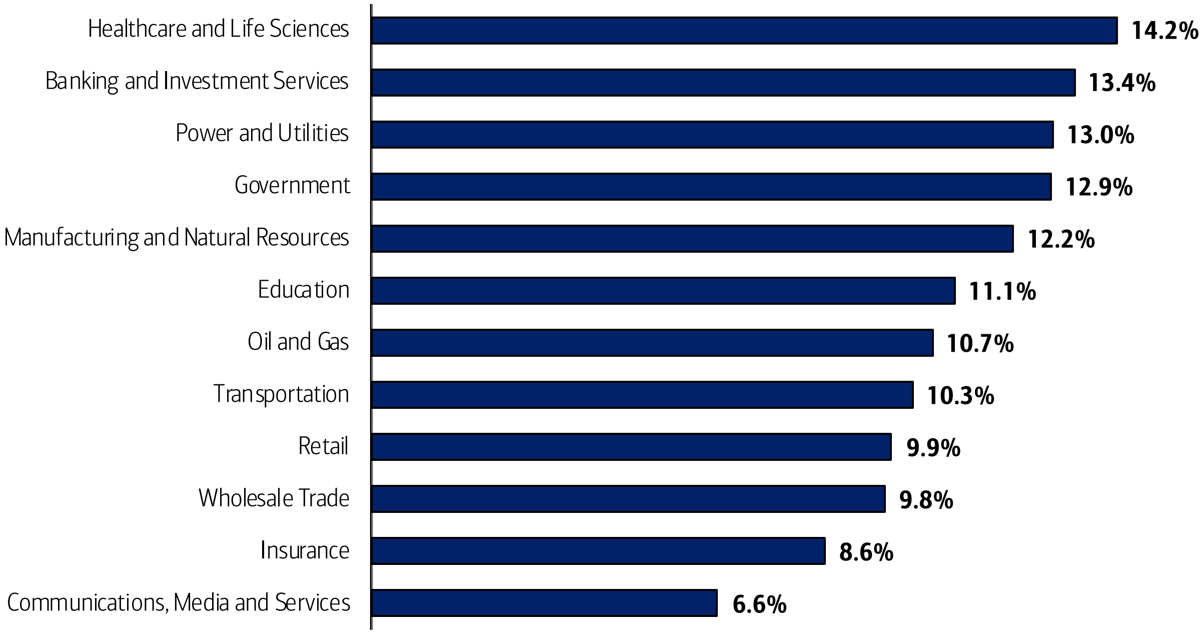


Source: BofA Global Research, Gartner

BofA GLOBAL RESEARCH

Exhibit 112: Healthcare and Life Sciences VSS spend is expected to grow at the highest CAGR

Expected 2023-2027 CAGR of Worldwide Vertical-specific Enterprise Software Spend by Vertical

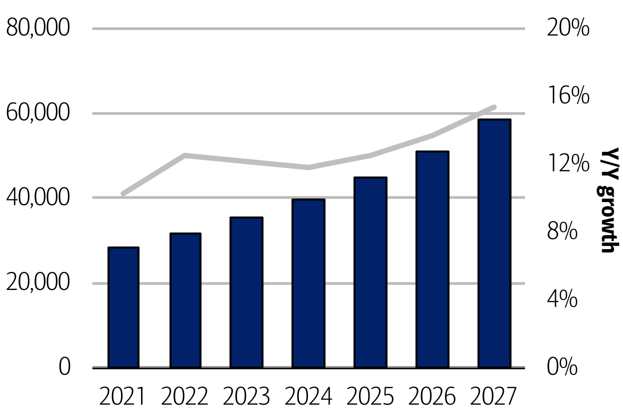


Source: BofA Global Research, Gartner

BofA GLOBAL RESEARCH

Exhibit 113: Banking and investment services VSS spend growth is expected to accelerate to 15%+

Banking and investment services VSS spend ($mn)

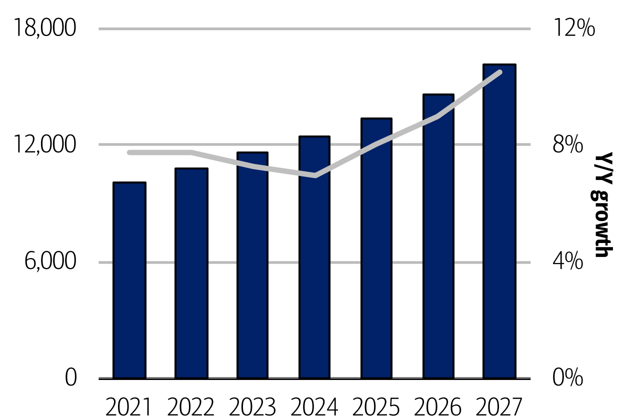


Source: BofA Global Research, Gartner

BofA GLOBAL RESEARCH

Exhibit 114: Insurance VSS spend growth is expected to accelerate to 10%+

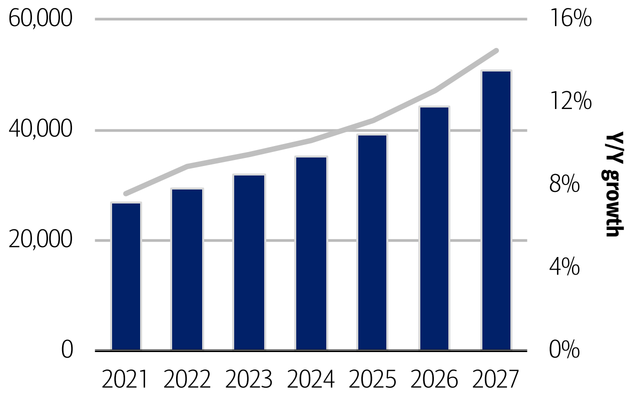
Insurance VSS spend ($mn)



Source: BofA Global Research, Gartner

BofA GLOBAL RESEARCH

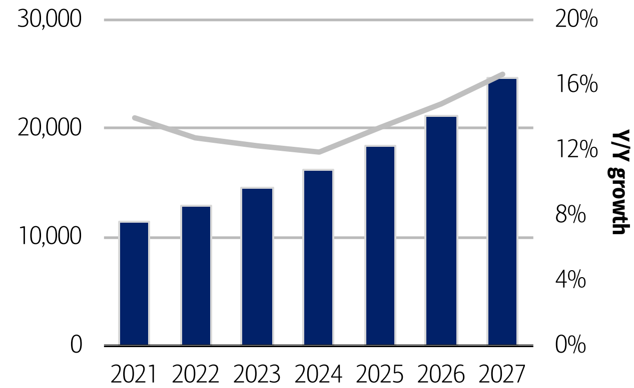
Exhibit 115: Architecture, engineering, and construction (AEC) VSS spend growth is expected to accelerate to 14%+
Architecture, engineering, construction (AEC) VSS spend ($mn)



Source: BofA Global Research, Gartner

BofA GLOBAL RESEARCH

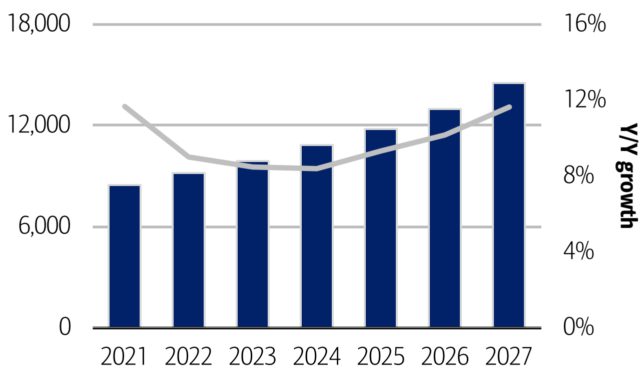
Exhibit 116: Healthcare and life sciences VSS spend growth is expected to accelerate to 16%+
Healthcare and life sciences VSS spend ($mn)



Source: BofA Global Research, Gartner

BofA GLOBAL RESEARCH

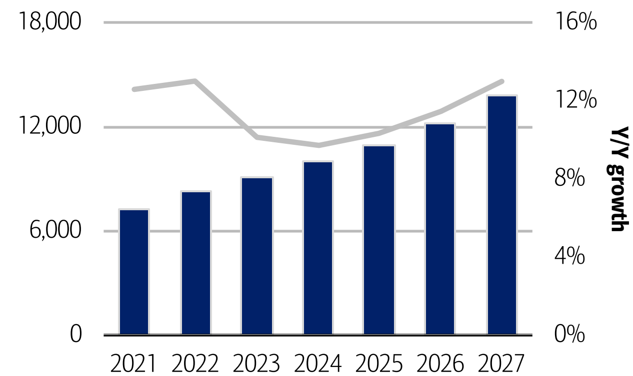
Exhibit 117: Retail VSS spend growth is expected to accelerate to 11%+
Retail VSS spend ($mn)



Source: BofA Global Research, Gartner

BofA GLOBAL RESEARCH

Exhibit 118: Education VSS spend growth to accelerate to 13%+
Education VSS spend ($mn)



Source: BofA Global Research, Gartner

BofA GLOBAL RESEARCH

Back Office Software Overview

In November, we published deep dive on the back office applications industry, titled Back Office Moving to the Front of Innovation Curve thematic report. In the report, we provide an overview of the market size, key secular trends shaping the category and an overview of the competitive landscape. We provide a summary of the report here.

A large, growing, mission critical segment

Back office software refers to the category of business applications that facilitate and streamline internal operations and administrative functions within an organization. The key distinction versus front office applications is that back office applications are not customer-facing. Back office software applications are designed to handle tasks such as financial management, human resources tasks, supply chain management, and other back-end processes, aiming to improve business efficiency and performance.

Human capital management (HCM) is a subset of back office software focused specifically on managing the workforce. It constitutes functionality such as payroll, time and attendance tracking, employee performance management, talent acquisition tools, and many others. On the other hand, Enterprise Resource Planning (ERP) software is used to support departments such as finance, procurement, and manufacturing. ERP systems provide a centralized platform for data management.

We estimate a combined total addressable market (TAM) for back-office software using a bottom-up methodology of $188bn, $81bn from Human Capital Management and $107bn from financials/ERP. We predict this number will continue to grow at a CAGR of 7.5% to $270bn ($114bn HCM and $116bn financials/ERP). We detail below our own bottom up build as well as IDC's estimate.

HCM market sizing

BofA bottom up HCM addressable market estimate

We calculate the TAM for the HCM market using a price x quantity methodology. We first start with the number of companies in the US, segmented by size, according to US census data. Then, we assume that the number of companies worldwide is 3x the amount of the number of companies in the US. From here, we estimate the average number of HCM seats per company, segmented by size, and multiply that by the number of companies worldwide. This gives us an estimate of the total number of employees that are using HCM seats for each company size.

Then, we multiply total employees by the annual cost per HCM seat for each company size to calculate the segmented HCM TAMs by company size. Annual cost per seat figures are based on a combination of online list prices and BofA estimates based on covered HCM company disclosures. Finally, we sum these figures together to calculate the total TAM. Using this method, we get to a TAM of $81bn in 2023. Calculations for the 2028 TAM calculation are the same with added assumptions for the number of companies worldwide and annual cost per HCM seat in 2028. We estimate 2028 TAM to be $114bn.

Exhibit 119: Calculation for Human Capital Management (HCM) TAM

We estimate a HCM TAM of $81.4bn in 2028.

TAM assumptions/data points
Companies sizes taken from the US Census Bureau
HR and Payroll technology vendors generally charge on a PEPM basis (per employee per month)
Pricing assumptions:
SMB: Online list prices: Rippling ($8/mo); Intuit: ($2-12/mo)
Mid-market: BofA estimates: Paylocity ($18/mo); Paycom: ($16/mo)
Large companies: BofA estimate: Workday ($10/mo)
# of companies assumes a 3% CAGR
PEPM growth assumption of 3% per year (conservative vs. an +11.5% y/y Payroll and HCM market CAGR)

TAM Calculation	Very small businesses (< 20)	Small Businesses (20 - 500)	Mid-market (500 - 2,500)	Large Enterprise (>2,500)	Global 2000	Total/ Average
# companies (US)	5,740,721	683,475	17,271	4,494	1,000	
Assume 3x US for international total	17,222,163	2,050,425	51,813	13,482	2,000	19,339,883
x Average number of employees within cohort	10	260	1,500	7,500	10,000	
Total employees	172,221,630	533,110,500	77,719,500	101,115,000	20,000,000	904,166,630
x Annual Cost	$75	$75	$180	$120	$120	
TAM $mn) - 2023	$12,917	$39,983	$13,990	$12,134	$2,400	$81,423
# companies (global)	19,965,207	2,377,005	60,065	15,629	2,000	
x Average number of employees within cohort	10	260	1,500	7,500	10,000	
Total employees	199,652,071	618,021,181	90,098,201	117,219,998	20,000,000	1,044,991,452
x PEPM 2028 (assuming +3% CAGR)	$91	$91	$219	$146	$146	
TAM ($mn) - 2028	$18,218	$56,394	$19,731	$17,114	$2,920	$114,377
5 year CAGR						7.0%

Source: BofA Global Research estimates, company report

BofA GLOBAL RESEARCH

Financial market sizing

Bottom up financials TAM estimate

We also calculate the financial total addressable market using a price x quantity methodology. We first start with the number of companies in the US, segmented by size. Then, we assume that the number of companies worldwide is 3x the amount of the number of companies in the US. We then apply the average number of employees per category against the estimate percentage of employees in finance. We estimate this number is roughly 5% to 10%, depending on company size. This gives us an estimate of the total number of employees that are using financial applications seats for each company size.

From here, we multiply total employees by the annual cost per financial application seat, for each company size, to calculate the segmented financial application TAMs by company size. We sourced the seat costs using list price from various financial application providers, including Microsoft Dynamics, Oracle NetSuite and SAP. Finally, we sum these figures together to calculate the total TAM. Using this method, we get to a TAM of $101.6bn in 2023. Calculations for the 2028 TAM calculation are the same with added assumptions for the number of companies worldwide and annual cost per financial application seat in 2028. We estimate 2028 TAM to be $149.3bn.

Exhibit 120: P*Q calculation for financial applications TAM

We estimate a financials TAM of $149.3bn in 2028.

TAM assumptions/data points						
Companies sizes taken from the US Census Bureau						
List price estimates (without add-on modules):						
Microsoft Dynamics (Finance) pricing: $180/user/month						
NetSuite pricing: $100/user/month						
SAP pricing: $108/user/month for Professional tier						
Assume price increases at a +5% CAGR (conservative vs. an +10% industry CAGR)						
TAM Calculation						
	Very small businesses (< 20)	Small Businesses (20 - 500)	Mid-market (500 - 2,500)	Large Enterprise (>2,500)	Global 2000	Total/ Average
# companies (US)	5,740,721	683,475	17,271	4,494	1,000	
Assume 3x US for international total	17,222,163	2,050,425	51,813	13,482	2,000	19,339,883
x Average number of financials seats	1	25	150	800	1050	
Total employees	17,222,163	51,260,625	7,771,950	10,785,600	2,100,000	89,140,338
x Annual Cost	$360	$1,200	$1,188	$1,800	$2,500	
TAM $mn) - 2023	$6,200	$61,513	$9,233	$19,414	$5,250	$101,610
# companies (global)	19,965,207	2,377,005	60,065	15,629	2,000	
x Average number of employees within cohort	1	25	150	800	1,050	
Total employees	19,965,207	59,425,114	9,009,820	12,503,466	2,100,000	103,003,607
x PEPM 2028 (assuming +5% CAGR)	$459	$1,532	$1,516	$2,297	$3,191	
TAM ($mn) - 2028	$9,173	$91,012	$13,661	$28,724	$6,700	$149,271
5-year CAGR						8.0%

Source: BofA Global Research estimates, company report

BofA GLOBAL RESEARCH

For detailed market share data from IDC, please see the full report, Back Office Moving to the Front of Innovation Curve

Worker Voice, AI & the SMB shaping HCM

The dynamic nature of workforce management, coupled with technological advancements continues to drive innovation in HCM solutions. In this section, we explore several emerging themes and their implications for the future of HCM software. Many of the topics we touch on below are informed by our conversations with industry contacts such as system integrator partners, company management teams, and customers. We provide a discussion of the top three secular trends shaping the HCM industry below, for additional themes, see the full report, Back Office Moving to the Front of Innovation Curve

Vendor consolidation – the big keep getting bigger

The convergence of payroll and HCM software/vendors is a key trend in the world of HR technology. This convergence reflects a growing preference by HR professionals for a fully integrated HR function with payroll for more seamless workflow management that often overlays both functions. Traditionally, payroll systems focused solely on the employee salary processing, tax deductions, and compliance with regulatory requirements. On the other hand, HCM systems encompass a wider range of HR functionality, including recruitment, onboarding, performance management, learning, employee feedback, and more.

The convergence of these two functions brings several advantages: 1) it allows for a more seamless flow of data between the two systems and reduces the chance of error, 2) provides a more holistic view of the workforce for strategic planning purposes, and 3) better pricing and potential discounting via bundled offerings. One key nuance in our view is that the payroll vendors have continued to add HCM capabilities over time. For example, 60% of Paylocity's recurring revenue is derived from HCM modules and add-ons it sells, despite the company's original founding as a payroll company.

However, the largest HCM providers such as Workday, Oracle, and SAP do not offer full-service payroll and rather need to be integrated with a payroll provider. Common payroll partners for Oracle, SAP, or Workday deployments include ADP or Ceridian. This highlights the more mission critical and specialized nature of a payroll system. Feedback from partners in the payroll ecosystem suggests that enterprises prefer a vendor with a focused, trusted offering as opposed to a suite. The perception is that a payroll system offered by a suite vendor is viewed as not good enough. We see this trend apparent in the market share data we presented above in exhibit 8.

Lastly, our proprietary channel work through coverage of Workday suggests enterprise customers of HCM technology are increasingly consolidating systems for cost advantages. Large enterprise vendors provide discounts to firms who opt for more applications in a suite. The cost advantage also stems from the avoidance of expensive integration costs. For example the typical consulting services implementation service engagement can run 3 to 6 months for cloud vendor and 6 to 12 months for an on premise vendor. We provide commentary from recent system integrator partners in the HCM/payroll ecosystems below.

- "Some of these are replacement deals of single solutions, so definitely seeing some consolidation to Workday when possible, especially when it means cost savings." **– GSI**

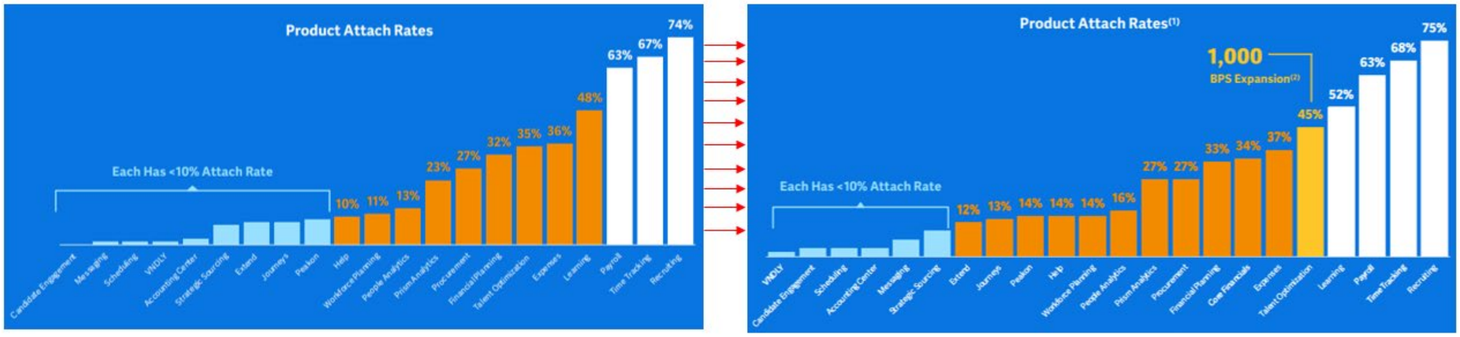
- "The second thing here is the talk of a potential recession, where companies want to make sure they're spending in a optimized way, so we are seeing more discussion around how to consolidate software solutions." **– SI, North America**

- "How can we move all these different tools we've acquired into or purchased over time into Workday? This is a question we're working with a lot of customers on." **– SI, North America**

- "So far we are into 2023, a lot more of our conversations are centered around consolidation." **– SI, North America**

Exhibit 121: Workday Product Attach Rates

Pictured on the left are 2022 attach rates. We see that the attach rates for modules have increased in 2023, suggesting continued vendor consolidation among the large vendors



Source: Workday

BofA GLOBAL RESEARCH

AI brings added automation to back office workflow

Mundane tasks such as resume screening, candidate sourcing, employee onboarding, are increasingly being done via AI and machine learning. These features can provide tangible time (and cost) savings for HR professionals. AI and machine learning algorithms are also being used to help predict employee turnover, identify skill gaps, and personalize learning and development plans.

Workday introduced many new AI features in its Rising conference in October 2023, such as predictive planning in the FP&A function (financial planning and analytics), generative job descriptions for recruiting, knowledge base article generation (HCM and FINS), and statement of work (SOW) generation for procurement in FINS, among many other generative AI enhancements. Workday also launched its Workday AI Marketplace for customers to find and deploy AI/ML apps built within the Workday ecosystem. The company also launched the Workday AI Gateway for Workday Extend to enable developers to build custom apps using Workday AI.

Exhibit 122: AI initiatives at Workday

Workday outlines key focus areas with respect to AI

Source: Workday

BofA GLOBAL RESEARCH

Making every dollar count – PEO versus HCM software

Many smaller firms use HR delivery services known as PEO (Professional Employer Organization). This is when a firm outsources HR functions rather than processing them internally, which involves a co-employment arrangement with the PEO vendor. The firm maintains responsibility over regular businesses decisions such as products choices and hiring, and the PEO vendor becomes responsible for processing payrolls, withholding taxes, administering more competitive group rates for benefit, etc.

Exhibit 123: Advantages and disadvantages for using a PEO
A PEO comes with both advantages and disadvantages

Advantages	Disadvantages
PEOs sometimes have better benefits packages, or similar coverage at lower prices, which benefits both the business and its employees.	There's less flexibility in selecting benefits since businesses and employees must choose from the providers the PEO uses.
Using a PEO gives a business more time and energy to focus on other operations and priorities.	Partnering with a PEO is an added cost for a business. This can be calculated in different ways, such as a percentage of the business's overall payroll or the number of employees.
PEOs often have compliance experts on staff who can help businesses monitor their status and potential risks.	The company's workplace culture may suffer due to an external agency taking over tasks normally done by internal staff.

Source: Paylocity.com

BofA GLOBAL RESEARCH

Our conversations with customers and HR consultants suggest PEO plans can cost anywhere from $50 to $150 per month. We compare this number directly to our calculated Per Employee Per Month cost for SMB to midmarket solutions such as Paycom or Paylocity with $16 to $18 per employee per month costs. While this is significantly lower, there typically is a payroll administrator who is running the software and supporting the HR function, which is on average an additional $62,000+ per year in cost in the US (according to salary.com). We see below that the total cost of ownership (TCO) is generally cheaper for PEO plans at small firms.

Exhibit 124: PEO TCO versus HR software TCO
PEOs are generally cheaper than a small company administering its own HR software

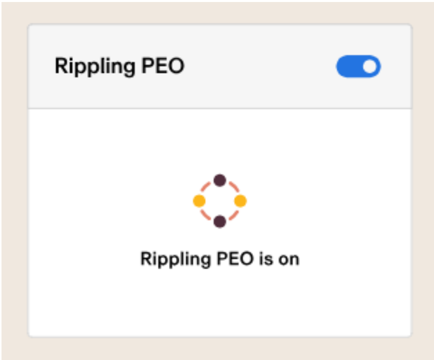
HR software	Seats	Per month cost per employee	Annual cost
HR administrator	1	$5,167	$62,004
Employees	20	$16	$3,840
TCO			$65,844
PEO	**Seats**	**Per month cost per employee**	**Cost**
Employees	20	$100	$24,000
TCO			$24,000

Source: BofA Global Research estimates, company report

BofA GLOBAL RESEARCH

While we see above that the TCO with a PEO plan is cheaper for smaller firms, the increasing consumerization of HR software may curb this trend over time. For example, Paycom's Beti offering allows employees to do their own payroll, thus eliminating the need for a payroll or HR professional. At the same time, newer companies such as Rippling are making it easier for firms to enroll in PEO-style plans electronically. In its software offering, employees can opt for PEO provided payroll on the employee portal with the switch of a button.

Exhibit 125: Rippling PEO setting
Newer HR software vendors make it seamless to switch from PEO to in-house



Source: Rippling.com

BofA GLOBAL RESEARCH

Process digitization is shaping financials

While a slower moving market in terms of adoption and renewal cycles when compared to the HCM market, we point to several key themes that are set to shape the financials software application market over the coming years. This section will explore some of the pivotal themes, adoption cycles underway, and their implications for the trajectory of ERP software applications in the near future. Many of the topics we touch on below are informed by our conversations with industry contacts such as system integrator partners, company management teams, and customers. We provide a discussion of the top three secular trends shaping the HCM industry below, for additional themes, see the full report, Back Office Moving to the Front of Innovation Curve

Slow move to the cloud: 10 to 12 year cycles are the norm

The transition to cloud-based core financials software has been characterized by a deliberate and measured pace in many industries. The benefits of cloud core financials/ERP, such as scalability, accessibility, and reduced IT infrastructure costs are widely acknowledged. However, concerns about data security, legacy system integration, and integration complexity have contributed to a cautious approach. Additionally, some organizations, especially those with highly specialized or customized on-premise systems (manufacturing companies, for example), face challenges in finding suitable cloud alternatives.

However, as cloud technology matures and security requirements continue to change, an increasing number of companies will gradually move to cloud-based financial/ERP solutions. We expect the transition from on-premise financial solutions to accelerate over time as we approach end of life dates associated with legacy systems (SAP will end support of Business Suite 7 in 2027, for example). Discussions with integrators and software firms in the ERP ecosystem suggest that the average upgrade cycle for a core financials system is 10 to 12 years. We highlight feedback from the ERP SI ecosystem on this topic below.

- “Big companies who have been around for a long time know and plan for these cycles, when things aren’t growing too fast, it actually gives them time to get rid of their tech debt, ERP changes are disruptive to business, and if business is good, it is a bad time for a new ERP implementation. This is why so many CFOs have pushed off ERP changes over the past five plus years.” **– Global SI**

- “From my perspective, about two-thirds to 75% of ERPs that are supposedly in the cloud are actually simple lift and shifted.” **– Global SI**

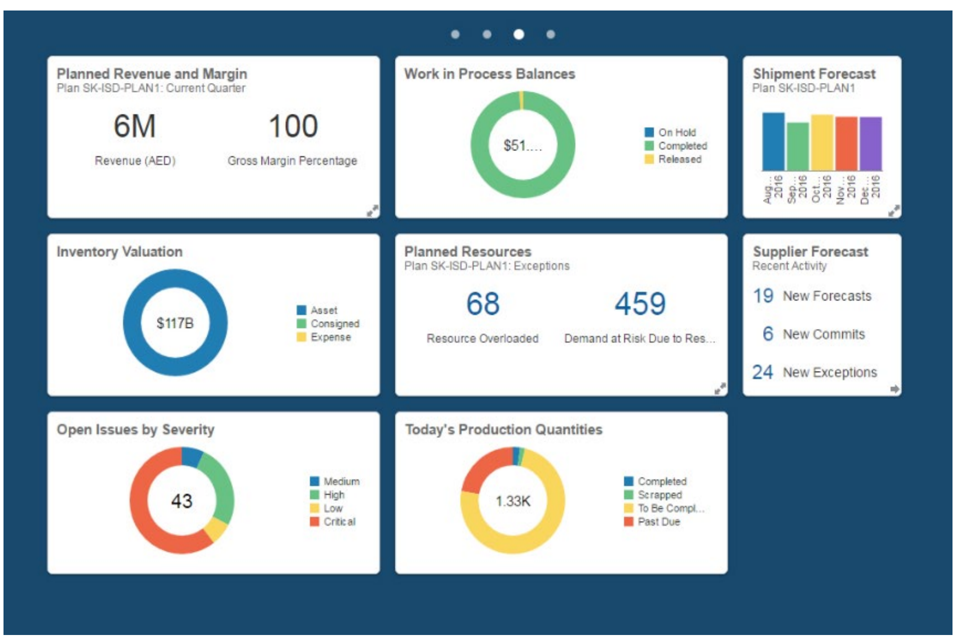
- “Technical debt is not enough of a reason to change ERP systems…it is usually a forcing function like a divestiture, a take-private, or some other event that brings in budget or motivation to change [ERP].” **– Global SI**

- "If they want to get off the data center then they lift and shift it, then gradually moving the functionality to the cloud. These are long, painful multi-year journeys." **– Global SI**
- "The move of an ERP system to the cloud requires re-implementation of many systems…that comes with a lot of risk." **– Global SI**
- "SaaS offerings are not as fully featured at the moment – but this is primarily because on premise applications have been there for 10-15+ years and have lots of customizations on top of them. This is another gating factor to the cloud transition for ERP." **– Global SI**
- "SaaS is of course more one-size fits all and you have to re-wire everything from your on-premise application." **– Global SI**
- "It takes longer to get organizations to take longer to switch their FINS application, they need to look at their entire financial footprint." **– Global SI**
- "These ERP refreshes are 10-year cycles, maybe even 12. Oracle and SAP are not going to give that share up easily either." **– Global SI**

Financials are not one size fits all – industry apps are key

To counter a primary concern for what holds CFO/companies back from moving their core financial systems to the cloud from on-premises, vertical functionality is likely required. Specialized functionality tailored for financial/ERP systems can be used to meet the unique needs and regulatory requirements of industries such as manufacturing, healthcare, or financial services. By providing industry-specific features, ERP vendors can offer solutions that are more ready out of the box and complaint with their target sectors. This not only streamlines implementation and reduces customization efforts (as touched on above), but also demonstrated an understanding of the specific challenges and nuances faced by certain industries which is key in the selling cycle. We think the ability for financials/ERP vendors to offer vertical-specific functionality will give them an edge in converting their on-premises users to the cloud.

Exhibit 126: Oracle Manufacturing Cloud dashboard overview
The Manufacturing Cloud dashboard offers a high level overview of KPIs important for businesses with manufacturing operations



Source: Oracle

Exhibit 126: Oracle Manufacturing Cloud dashboard overview
The Manufacturing Cloud dashboard offers a high level overview of KPIs important for businesses with manufacturing operations

BofA GLOBAL RESEARCH

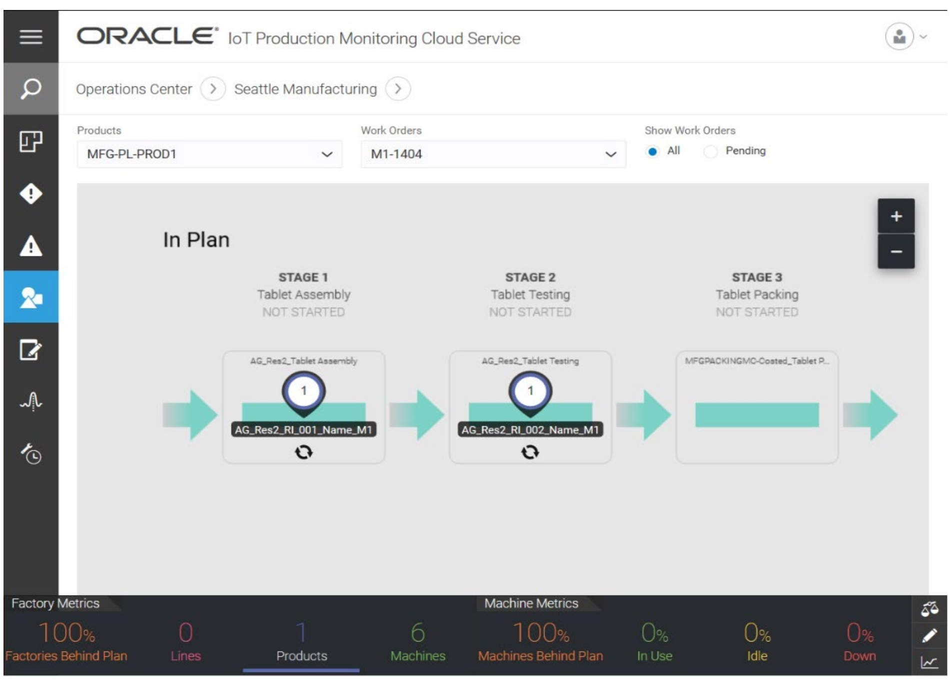
We highlight feedback from the SI ecosystem on this topic below.

- "The early adopters of these companies, whether they were Oracle or SAP, were dominant in the on-premise world. E-business, PeopleSoft, Siebel, JD Edwards, and such. Many of these were strong offerings for companies with physical operations and assets. SAP has an especially high footprint with these companies too. Services companies were and are the first adopters to SaaS, often HCM or Finance/Procurement were the first candidates. Manufacturing and supply chain applications tend to remain on premise." **– Global SI**

- "Certain industries that are stronger and more ready for Workday Financials. They are working to grow their capabilities. But for example, in non-inventory and non-manufacturing companies, that's where we've seen the biggest wins for Workday since they cover that functionality better." **– Global SI**

- "Vertical functionality is very important. SaaS is technology that should work out of the box. Making the transition to cloud ERP is especially difficult because all of the old on-premise software has 10+ years of custom integrations built on top of them that are specific to each company. Recreating that functionality so that every new customer has that out of the box will help lower the switching costs a lot, hence vertical-specific functionality is important. It helps bridge the pain of switching between the two." **– Global SI**

Exhibit 127: Oracle Production Monitoring module
Oracle offers various modules across its suite which are purpose-built to solve for specific use cases



Source: Oracle

BofA GLOBAL RESEARCH

Procurement provides automation, visibility & compliance

Procurement applications automate the order to cash payables cycle. These systems better enable compliance with approved vendors and pricing across departments of large organizations, and automate these process through an integrated suite which spans purchase order, invoicing and payables. The adoption of procurement software has been driven by broad digital transformation mandates.

Exhibit 128: Coupa's Business Spend Management (BSM) platform
Coupa's BSM platform includes many functions, including its flagship Procurement & Invoicing functionality

Source: Coupa

BofA GLOBAL RESEARCH

There are numerous benefits associated with using a modern procurement solution, including 1) procurement automation that tracks inventory and automatically sends out orders, 2) accurate cost tracking considering taxes, shipping, and other non-primary expenses, 3) relationship management with suppliers in terms of contracts, pricing, and payments, and 4) a centralized platform for all purchasing activities, from requisition to payment, providing real-time visibility into spending, supplier performance, and compliance. Furthermore, the centralized platform allows for advanced features like AI-driven analytics and predictive modeling to inform better decision making.

Companies addressing the Procurement market include Coupa (private), ScoutRFP (owned by Workday), and Ivalua (private). We highlight feedback from the ERP SI ecosystem on this topic below.

- "Most customers typically start with the Procure and Invoicing modules. Some also attach the sourcing application and Expense. Most clients moving to Coupa are either replacing a previous procurement platform, or only using procurement modules from an ERP system, such as materials management, which is a difficult process." **– Regional SI, North America**
- "Coupa's three value drivers are 1) the immediate ROI from the Coupa Advantage due to supplier discounting as well as the quick implementations (14-16 weeks), 2) ability to downsize the Accounts Payable department, and 3) the unified platform

which is extremely easy to use. Customers typically start with the Procure, Invoice, and Pay modules, with some customers attaching Expense." **– Regional SI, North America**

Procurement TAM

Exhibit 129: Procurement Applications Software Market
IDC estimates the procurement applications software market will reach $12.2bn in 2027

($mn)	2022	2023	2024	2025	2026	2027	2022 - 2027 CAGR
Americas	4265.5	4648.8	5162.3	5667.8	6257.5	6916.2	10.1%
APJ	1035.7	1096.3	1199.2	1322.5	1461.0	1601.3	9.1%
EMEA	2543.7	2673.9	2923.2	3173.1	3432.0	3691.5	7.7%
Total	**7845.0**	**8419.0**	**9284.7**	**10163.4**	**11150.4**	**12209.0**	**9.2%**

Source: IDC's Worldwide Semiannual Software Tracker, May 2023

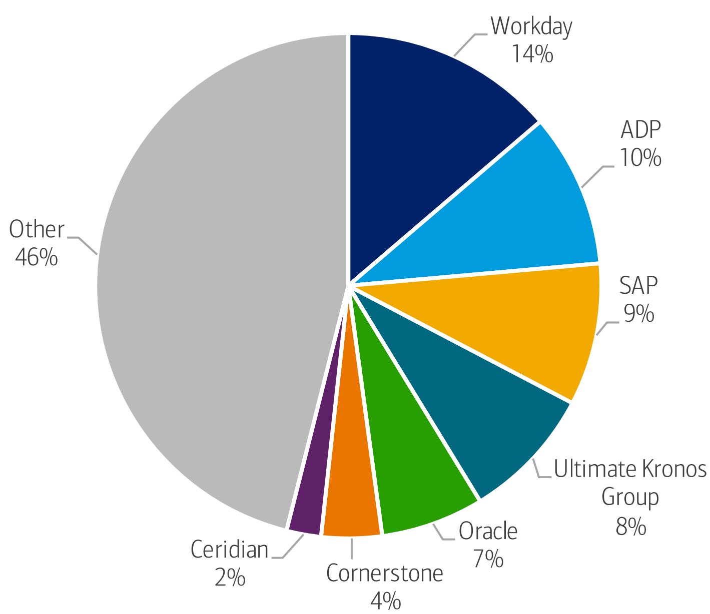
BofA GLOBAL RESEARCH

Competitive landscape

We summarize market share and Gartner Magic Quadrant analyses for HCM and financials below. For vendor profiles, see the full report, Back Office Moving to the Front of Innovation Curve.

HCM vendors

Exhibit 130: Human Capital Management Applications Software Market Share
Workday, ADP, and SAP are the largest HCM application providers by market share

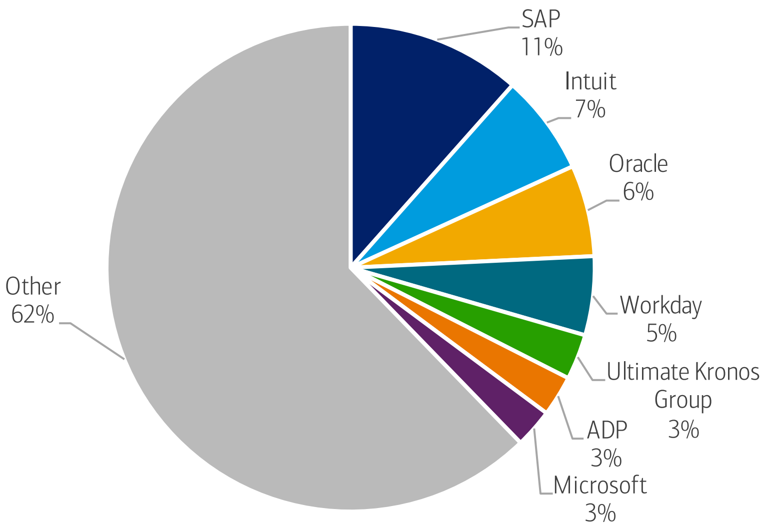


Source: IDC, Worldwide Human Capital Management and Payroll Applications Software Market Shares, 2022: Growth Remained Steady, June 2023, #US49130523

BofA GLOBAL RESEARCh

Financial and ERP vendors

Exhibit 131: Enterprise Resource Planning Software Market Share
SAP, Intuit, and Oracle are the top three ERP vendors by market share



Source: IDC, Worldwide Enterprise Resource Management Software Market Shares, 2022: The Digital Era Is Shifting Market Shares, August 2023, #US50269623

BofA GLOBAL RESEARCH

Exhibit 132: Magic Quadrant for Cloud ERP for Services-Centric Enterprises
Workday and Oracle rank the highest in this category

Source: Gartner

BofA GLOBAL RESEARCH

Exhibit 133: Magic Quadrant for Cloud ERP for Product-Centric Enterprises
Oracle (Fusion Cloud ERP) once again ranks the highest in this category

Source: Gartner

BofA GLOBAL RESEARCH

Exhibit 134: Stocks mentioned
Prices and ratings for stocks mentioned in the report

BofA Ticker	Bloomberg ticker	Company name	Price	Rating
EGHT	EGHT US	8x8	US$ 3.61	C-1-9
ADBE	ADBE US	Adobe	US$ 567.05	B-1-9
ALRM	ALRM US	Alarm	US$ 61.8	B-1-9
AMPL	AMPL US	Amplitude, Inc.	US$ 11.81	C-1-9
ADSK	ADSK US	Autodesk	US$ 228.92	B-2-9
AVDX	AVDX US	AvidXchange, Inc.	US$ 11.47	C-3-9
BSY	BSY US	Bentley Systems	US$ 46.95	B-2-7
BIGC	BIGC US	Bigcommerce	US$ 8.45	C-2-9
BILL	BILL US	BILL	US$ 74.08	C-1-9
BLKB	BLKB US	Blackbaud, Inc.	US$ 83.45	B-3-7
BL	BL US	BlackLine, Inc.	US$ 55.98	C-3-9
AI	AI US	C3.ai	US$ 27.89	C-3-9
CCCS	CCCS US	CCC Intelligent Sol	US$ 10.67	B-1-9
CFLT	CFLT US	Confluent	US$ 21.71	C-3-9
DDOG	DDOG US	Datadog Inc	US$ 113.02	C-2-9
LAW	LAW US	Disco	US$ 7.27	C-3-9
DOCU	DOCU US	DocuSign	US$ 54.97	C-2-9
DBX	DBX US	Dropbox	US$ 28.6	B-1-9
DT	DT US	Dynatrace	US$ 51.66	C-1-9
ESTC	ESTC US	Elastic	US$ 103.34	C-1-9
ENFN	ENFN US	Enfusion, Inc.	US$ 9.19	C-3-9
EVBG	EVBG US	Everbridge	US$ 21.75	C-3-9
FIVN	FIVN US	Five9	US$ 74	C-3-9
FRSH	FRSH US	Freshworks	US$ 21.47	C-2-9
GTLB	GTLB US	GitLab	US$ 57.58	C-1-9
GLBE	GLBE US	Global-e Online Ltd.	US$ 37.05	C-1-9
GWRE	GWRE US	Guidewire Software	US$ 104.89	B-3-9
HCP	HCP US	HashiCorp	US$ 21.77	C-2-9
HUBS	HUBS US	HubSpot	US$ 530.25	C-1-9
INFA	INFA US	Informatica Inc.	US$ 26.38	B-1-9
INTA	INTA US	Intapp Inc.	US$ 36.45	C-1-9
INTU	INTU US	Intuit	US$ 586.82	B-1-7
JAMF	JAMF US	Jamf	US$ 17.58	C-2-9
FROG	FROG US	JFrog	US$ 31.45	C-1-9
LSPD	LSPD US	Lightspeed	US$ 18.66	C-2-9
YLSPD	LSPD CN	Lightspeed	C$ 24.91	C-2-9
MLNK	MLNK US	MeridianLink	US$ 22.75	B-1-9
MSFT	MSFT US	Microsoft	US$ 367.94	B-1-7
MDB	MDB US	MongoDB	US$ 362.41	C-1-9
NCNO	NCNO US	nCino	US$ 33.36	C-1-9
NCSYF	NICE IT	NICE Ltd.	ILS 709.7	C-1-9
NICE	NICE US	NICE Ltd.	US$ 194.25	B-1-9
ORCL	ORCL US	Oracle	US$ 102.59	B-2-7
PD	PD US	PagerDuty	US$ 21.5	C-1-9
PAYC	PAYC US	Paycom	US$ 196.5	C-2-7
PCTY	PCTY US	Paylocity	US$ 160.13	C-2-9
PWSC	PWSC US	PowerSchool	US$ 23.02	C-1-9
RNG	RNG US	RingCentral	US$ 31.06	C-1-9
CRM	CRM US	Salesforce.com	US$ 251.24	B-1-9
NOW	NOW US	ServiceNow	US$ 671.87	B-1-9
SHOP	SHOP US	Shopify, Inc.	US$ 73.42	C-2-9
SNOW	SNOW US	Snowflake	US$ 183.72	C-2-9
TWLO	TWLO US	Twilio	US$ 68.49	C-3-9
PATH	PATH US	UiPath	US$ 22.57	C-1-9
U	U US	Unity	US$ 37.05	C-1-9
VEEV	VEEV US	Veeva Systems, Inc.	US$ 186.11	B-2-9
VERX	VERX US	Vertex	US$ 25.53	C-3-9
WEAV	WEAV US	Weave	US$ 11.22	C-1-9
WDAY	WDAY US	Workday	US$ 267.08	B-1-9
ZETA	ZETA US	Zeta Global	US$ 8.04	C-1-9
ZM	ZM US	Zoom	US$ 66.9	C-2-9
ZI	ZI US	ZoomInfo	US$ 16.82	C-2-9

Exhibit 134: Stocks mentioned
Prices and ratings for stocks mentioned in the report

BofA Ticker	Bloomberg ticker	Company name	Price	Rating
WDAY	WDAY US	Workday	US$ 267.08	B-1-9
ZETA	ZETA US	Zeta Global	US$ 8.04	C-1-9
ZM	ZM US	Zoom	US$ 66.9	C-2-9
ZI	ZI US	ZoomInfo	US$ 16.82	C-2-9

Source: BofA Global Research

BofA GLOBAL RESEARCH

Price objective basis & risk

8x8 (EGHT)

Our price objective is based on our discounted cash flow (DCF) analysis. We assume a WACC of 11% and terminal cash flow multiple of 15x, which implies our $6 PO. Our $6 PO implies a C24 EV/Revenue multiple of 1.4x, which is a discount to EGHT's historic average, a discount to pre pandemic multiple and a discount to the communication peer group multiple of 2.3x. We believe a discount multiple to the peer group is justified based on lower growth profile, more SMB/mid-market exposure, and a need for turnaround efforts to accelerate growth and improve sales efficiency.

Downside risks to our price objective are failure to scale up market, lower-than-expected operational efficiencies as the company moves up market, higher-than-expected competitive pressure from larger vendors, and slower UCaaS migration at larger enterprises.

Upside risks to our price objective are faster acceleration in revenue, overall better execution, and improved sales efficiency.

Adobe (ADBE)

Our PO of $700 is based on an EV/FCF multiple of 31x our C25E free cash flow estimate. This represents 1.5x our 3-year mid-teens FCF CAGR, a premium to the large-cap GARP (growth at reasonable price) software group average of 1.3x. We view the premium as justified given Adobe's AI leadership position and durability of both top- and bottom-line growth.

Risks to our PO are 1) competition from point solutions and platform vendors, 2) application spending cyclicality, and 3) future acquisitions, which could weigh on margin expansion.

Alarm.com (ALRM)

Our PO of $75 is based on a 4.3x EV/24e revenue multiple (0.9x on an EV/24e Rev/Growth basis), a discount on EV/Rev, but a premium on EV/Rev/Growth versus <20% growth software peers, on average, at 5.1x EV/24e revenue (0.4x EV/Rev/G). We think a premium EV/Rev/Growth multiple is warranted by revenue visibility, positive secular forces and profitability.

Downside risks to our price objective are SaaS multiple compression, lower growth during housing market growth, continued COVID impact, greater than expected headwind from Vivint licensing legal dispute, internet company competition, ADT shifting away from Alarm.com, hardware supply, high customer concentration, change in economics with Vivint, Vivint's lawsuit against Alarm.com, ability to expand the business internationally, ability to grow beyond professionally-monitored security, fierce competition in the smart home market and dependency on security dealers

Amplitude, Inc. (AMPL)

Our $14 PO is based on 6.0x EV/C24E revenue, representing a growth adjusted multiple of 0.8x our 7% growth rate. The multiple is slightly lower than the previous multiple to account for a higher cash balance.The multiple we use is a premium to infrastructure software peers on a growth adjusted basis at 0.4x (6.4x EV/C24E revenues), warranted, in our view, due to their position as a category leader and long-term growth profile balanced against execution risks.

Risk to our PO are1) competition, 2) premium valuation is a top risk for Amplitude's stock, 3) execution in go to market (G2M) and R&D, 4) not profitable in the near term, and 5) enterprise software spend can be highly cyclical.

Autodesk (ADSK)
Our $235 PO is based on an EV/EBITDA multiple of 22x our CY24 EBITDA estimate. The 22x multiple is slightly below the design software peer group average of 24x. We believe a slight discount multiple is warranted by a cloudier short-term outlook, partially offset by ADSK's durable business model and favorable margin profile.

Downside risks to our PO are increased competition leading to higher churn, greater than expected headwinds to FCF in association with Autodesk's billing transition, spending reductions in the company's end markets arising from an economic slowdown and lower than expected net subscriber additions.

Upside risks to our PO are better than expected economic activity, greater than projected net subscriber additions and NR3, lower than expected impact of billing transition on FCF and better than expected execution leading to heightened operating margin expansion.

AvidXchange, Inc. (AVDX)
Our PO of $10 is based on an EV/rev multiple of 3.7x our C25 revenue estimate, which represents an EV/rev/growth multiple of 0.2x our C25e revenue growth of 16% y/y, in line with the small cap group, trading at 0.2x.

Risks to our PO are as follows: 1) AvidXchange operates in a highly cyclical business given exposure to small and mid-sized businesses, 2) AvidXchange needs to drive awareness of the new AP automation software category as it currently competes with manual check writing and legacy ERP providers, and 3) AvidXchange competes with established platform vendors and point solutions.

Bentley Systems (BSY)
Our PO of $57 is based on an EV/FCF multiple of 46x our C24 free cash flow estimate, a premium to the SaaS group (40x), which we believe is warranted given strong secular growth drivers and defensive exposure, as well as its high visibility revenue and attractive margin profile.
Downside risks: 1) Premium valuation presents risk of pullback in the event of changes to market sentiment stemming from global macro uncertainty, or potentially disappointing quarterly revenue, 2) prolonged COVID headwinds resulting in slower economic activity and decreased company budgets, 3) ability to drive upsell and cross sell through the installed base, 4) increased competition from Autodesk and vertical-specific vendors resulting in elevated churn, 5) execution issues within growth initiatives such as China and Digital Twins.

BigCommerce Holdings, Inc. (BIGC)
Our $11 PO is based on 2.7x EV/C24E revenue or 0.3x EV/R/G. The multiple we use to calculate our PO is a discount to its horizontal SaaS peers at 6.6x (0.5x EV/R/G), which we believe is warranted given BigCommerce is disrupting a large, growing, and attractive digital commerce TAM, balanced against execution risks on its recent pivot to focus primarily on the upmarket.

Risks to our PO are: 1) competition, 2) pandemic driven supply chain bottlenecks, 3) tough pandemic comps, 4) cyclical spending pressures, 5) SMB exposure, and 6) execution risk.

BILL (BILL)
Our PO of $80 is based on an EV/revenue multiple of 5.5x our CY25 revenue estimate. This represents an EV/Rev/Growth multiple of 0.3x based on our C25e core revenue growth rate of 23%, in line with the mid cap peer group trading at 0.3x 17%.

Downside risks are: 1) Higher degree of cyclical exposure, given the focus on SMB and variable transaction and float revenue, which, in a recessionary environment, could see declined transaction volume and lower interest rates, 2) Premium valuation presents risk of pullback in the event of changes to market sentiment stemming from global macro uncertainty, or potentially disappointing quarterly revenue, 3) Need to drive brand/product awareness to drive growth - there is relatively low awareness of the BILL brand and BILL is most often competing with status quo (manual/human efforts). Execution on demand generation, with both customers and partners, is critical for BILL to continue growing at its recent growth trend (revenue growth of 67% in FY19).

Blackbaud, Inc. (BLKB)
Our $70 PO represents 3.8x EV/C24E based on our revenue estimate, representing a growth adjusted multiple of 0.63x our 6% growth rate. The multiple we use is a discount to the small cap SaaS peer group at 4.3x for slower growth outlook.

Downside risks to our price objective are: 1) relatively low nonprofit IT spending growth, 2) risk that acquisitions do not generate long term margin expansion from potentially lacking execution on cross selling or cost saving initiatives and 3) exposure to applications spending, which is discretionary and highly cyclical.

Upside risks are: 1) accelerating revenue growth from sales productivity selling broader suite of products, 2) better than expected development and sales productivity as the company gains traction selling an integrated product offering and 3) multiple expansion from improving macroeconomic environment and rotation into small/mid cap growth stocks.

BlackLine, Inc. (BL)
Our $52 PO is 5.1x EV/C24E revenue, representing a growth adjusted multiple of 0.47x our 11% growth rate. The multiple we use is discount to the horizontal SaaS group average (6.0x EV/CY24E revs), warranted for decelerating billings growth and compressing NRR trends, balanced against its category leadership in accounting automation.

Risks to our PO are: 1) Pace of enterprise finance department digital transformations accelerates, 2) competition decreases, 3) better than expected margin expansion, 4) net revenue retention expands faster than expected, and 5) adoption of SaaS Financials platforms slow, increasing the need for multi-ERP visibility tools.

C3.ai (AI)
Our PO of $18 is based on an EV/rev multiple of 3.8x our C25E revenue. On a growth-adjusted basis, this is 0.3x our +15% y/y C24E growth rate. Our 0.3x multiple is in line with the small cap peer group trading at 0.3x. We carry an underperform rating for 1) a more pronounced impact from macro uncertainty on the business, 2) continued lack of visibility in the business model given the lumpiness/low customer count, and 3) near-term uncertainty associated with sales execution challenges.

Risks to our price objective are: 1) Premium valuation presents risk of pullback in the event of changes to market sentiment stemming from global macro uncertainty, or potentially disappointing quarterly revenue, 2) Larger deal sizes create lumpy quarterly revenue growth which can present challenges to forecasting quarterly backlog (or remaining performance obligation), total contract value (TCV), and revenue, and 3) Enterprise application spending has proven to be highly cyclical, given the more discretionary nature of applications projects which could present a higher degree of risk for a bookings deceleration for C3.ai and other application vendors, in the event of an economic slowdown.

CCC Intelligent Solutions (CCCS)
Our $14 PO is based on an EV/revenue multiple of 9.5x our CY24e revenue estimate. The 9.5x multiple represents an EV/revenue/growth multiple of 1.1x, which is above the less than 10% growth and vertical software peers at 0.5x and 0.6x, respectively. We attribute the premium to CCCS' level of profitability, high visibility revenue stream, less dependence on new customer acquisition for growth and expected post-COVID tailwind. Relative to insuretech, we believe CCC's margin profile, FCF generation and depth of proprietary data support a premium valuation. The same holds true relative to <10% growers where there is a wide range of profitability, competitive forces and differentiation. Within the vertical SaaS group we find a strong correlation between EBITDA margin, FCF and valuation.

Downside risk to our PO include increased competition leading to higher churn, increased pricing pressure from a highly fragmented market, increased sales lead time reducing new customer acquisition, continued chip shortage could result in fewer new vehicle sales and lead to fewer insured vehicles on the road and economic conditions and gasoline prices may impact number of miles driven which is correlated with number of accidents.

Confluent (CFLT)
Our PO of $24 is based on an EV/Revenue multiple of 5.5x our C25 revenue estimate. The 5.5x multiple represents an EV/Revenue/Growth multiple of 0.2x based on our C25e revenue growth rate of 26%, at a discount to the midcap group trading at 0.3x C25e growth averaging 17% for lower margin profile.

Downside risks: 1) Confluent shares trade at a premium to the software group on an EV/revenue basis. This premium presents the risk of a pullback, which could occur in the event of changes to market sentiment stemming from global macro uncertainty or potentially disappointing quarterly revenue growth. 2) It has high exposure to cyclical trends of application software spend. Enterprise application software has proven to be highly cyclical, during an economic slowdown when firms are faced with shrinking IT budgets, application upgrades, migrations, or new installations are often deferred, which could present a high degree of risk for bookings deceleration. 3) Confluent competes in a market with deep pocketed vendors, such as the top three cloud hyperscaler (AWS, Azure, and GCP), which may decide to invest more aggressively against the emerging data-in-motion/event stream processing opportunity.

Upside risks: 1) Confluent Cloud operates in a consumption model (versus typical SaaS subscription). In the event of changes to market sentiment on macro abating and IT spend returning to normal, consumption and revenue growth could quickly reaccelerate which could drive multiple expansion

CS Disco, Inc. (LAW)
The $6 PO is based on 1.6x our C24E revenue for good quarterly execution and better-than-expected expanding EBITDA margins. Our multiple represents an EV/revs/growth multiple of 0.2x, a discount to horizontal peers at 6.1x and 0.4x, warranted given higher execution risks and an unpredictable revenue stream.

Risks to our PO are: 1) revenue growth is much better and more predictable than expected, 2) a visible path to profitability is much faster than expected, 3) Disco becomes the industry standard, lowering competitive threats, 4) execution is much better than expected, 5) demand and spend for legal-tech proves very resilient in a recessionary/inflationary environment.

Datadog Inc (DDOG)

Our new $120 PO is based on an EV/revenue multiple of 16.3x (was 14.9x) to our CY24E revenue estimate of $2.4bn. We raise our multiple to account for our increased confidence in Datadog's potential to drive upside to consensus estimates and infrastructure group multiple expansion. The 16.3x multiple represents an EV/revenue/growth multiple of 0.9x, which is above infrastructure peers at 7.1x/0.6x (was 6.5x/0.4x prior).

Upside risks to our PO: 1) better-than-expected revenue growth, 2) faster-than-expected AI tailwinds, 3) better-than-expected expanding free cash flow margins, 4) expanding NRR, and 5) stronger-than-expected competitive differentiation.

Downside risks to our PO: 1) valuation risk, 2) competition, 3) deteriorating NRR, 4) execution, and 5) enterprise software spend can be cyclical.

DocuSign (DOCU)

Our PO of $60 is based on an EV/FCF multiple of 13x our CY25 FCF estimate. This multiple represents a discount to mid cap peers at an average of 24x. We view a discount as warranted for DocuSign given a slower revenue and FCF growth profile.

Downside risks to our PO are 1) increased competition from Adobe, 2) slower-than-expected adoption of eSignature in key end markets, 3) declines in sales productivity ratio as measured by S&M spend divided by incremental subscription revenue.

Dropbox (DBX)

Our $34 PO is based on a weighted bull/base/bear case DCF analysis assigned 25%/50%/25% weights respectively. Our $34 PO represents a 2024E P/FCF multiple of 12.2x, compared to the less than 10% software growers peer group average of 25.3x. We believe the 12.2x multiple is justified given DBX's revenue visibility and favorable margin profile, but acknowledge a discount to the low growth software group is warranted given DBX's limited growth levers and intensifying competitive environment.

Downside risks to our PO: 1) increased competition leading to greater than expected pricing pressure 2) greater than expected user churn, and 3) slower than expected paying user growth.

Dynatrace (DT)

Our $60 PO is based on 48.9x EV/C24E FCF, a premium to infrastructure software peers at 41.3x, which we think is warranted given our strong revenue forecast and good execution in F2Q24.

For comparison purposes, our $60 PO implies 10.8x EV/C24E revenue compared to its infrastructure peers at 7.5x.

Downside risks: macroeconomic downturn, increase in competition, ability to hire direct sales reps at a healthy clip, ability to expand into adjacent markets, and ability to sustain high R&D innovation.

Elastic NV (ESTC)

Our $108 PO is based on 8.0x EV/C24E revenue, which represents an EV/revenue/growth adjusted multiple of 0.5x, comparable to its infrastructure software peers at 7x/0.5x, warranted for its potential growth profile, differentiation, and positioning in the attractive AI opportunity, and balanced against a contracting net revenue retention (NRR) metric.

Risks to our PO are: 1) competition, 2) relatively unproven profitability, 3) M&A could weigh on margins and execution, 4) application spending is highly cyclical, 5) increasing SaaS demand could weigh on gross margins, and 6) conversion ratio to paid subscriptions could decrease.

Enfusion, Inc. (ENFN)

Our $8 PO is based on a 4.9x EV/C24E revenue multiple, representing a growth adjusted multiple of 0.3x (i.e., EV/R/G) which is lower than its vertical software peers at 0.5x (or 7.1x EV/revenue). We believe a discount EV/R/G multiple is warranted given Enfusion's relatively good growth profile balanced against execution risks given sensitivity to market volatility.

Upside risks to our PO: 1) revenue growth proves accelerates above 20%+, 2) customer retention proves healthy, 3) ability to drive strong new customer acquisition in a tough macro environment, 4) big new logo and conversion deals, and 5) company delivers a Rule of 40 (revenue growth + adjusted EBITDA profile) over the medium-term.

Downside risks to our PO: 1) revenue growth proves decelerates and stays below 10%, 2) customer churn increases, 3) new customer acquisition proves difficult in an improving macro environment, and 4) company struggles to get back a rule of 25 profile (revenue growth + adjusted EBITDA) over the medium-term.

Everbridge (EVBG)

Our $22 PO is based on 2.7x EV/C24E multiple, which translates to a 0.5x EV/revenue/growth adjusted multiple, a discount to its horizontal software peers at 7.6x/0.6x, warranted given business model transition risk, and growth forecast reset.

Downside risks are 1) lower-than-expected revenue growth/market share gains resulting from new competition arising due to low barriers to entry in EMNS market, 2) lower-than-expected revenue growth due to price erosion from low usage of product, 3) pullback to the stock's multiple more than expected due to slowdown in macro sentiment or disappointing results given that EVBG is an earlier-stage company with higher degree of execution risk.

Upside risks are 1) faster- and better-than-expected CEO transition, 2) earnings upside, 3) large customer experience management (CEM) wins, 4) guidance revisions higher, and 5) better-than-expected organic revenue/billings growth.

Five9 (FIVN)

Our PO of $61 is based on a CY24e EV/Sales multiple of 4.3x, a discount with 20-30% growth software group. We believe this is justified based on our view that contact center as a service (CCaaS) is an attractive market with mid-20% projected annual growth and Five9's leading solution. However, with competitive intensity increasing, we see risk to long term revenue growth projections limiting near term multiple expansion.

Downside risks to our PO are any slowdown in the enterprise sales ramp and productivity, failure to execute new large deals, slower than expected EBITDA and FCF margin expansion, and heightened competition in the contact center market. Upside risks are improving success upmarket with larger enterprises, partnerships with or acquisition by larger platform vendors, better than expected contact center demand.

Freshworks, Inc. (FRSH)

Our PO of $23 is based on an EV/Rev multiple of 9.0x our C24E revenue, a premium to the mid-cap software group, trading at 5.8x for faster growth and stronger margin/FCF progression.

Risks to our PO: 1) Freshworks shares trade at a premium to the software group, presenting the risk of a pullback in the event of changes to market sentiment stemming from global macro uncertainty or potentially disappointing quarterly revenue, 2) relatively high churn could challenge profitability as small and mid-sized businesses have higher attrition, and 3) Freshworks competes in highly competitive markets, which includes large and established vendors.

GitLab Inc. (GTLB)

Our $74 PO is based on an EV/revenue multiple of 15.5x to our FY25E (C24E) revenue estimate. The multiple implies an EV/revenue/growth multiple of 0.58x, which is above infrastructure peers at 7.3x/0.57x. We believe the premium multiple to peers is warranted given its faster growth, NRR in the high 120s, and upside potential.

Risks to our PO: 1) valuation risk, 2) competition, 3) deteriorating NRR, 4) extended timeline to profitability, 5) execution, and 6) enterprise software spend can be cyclical.

Global-e Online Ltd. (GLBE)

Our $48 PO is based on a 27.1x EV/gross profit applied to our C24E GAAP gross profit. The 27.1x multiple translates to an EV/gross profit/growth adjusted multiple of 0.8x, a premium to peers at 0.6x, which we believe is warranted given Global-e's potential to display 35%+ GMV and revenue growth trends in 2023, and the potential for sustained upward estimate revisions. On an EV/revenue basis, the $48 PO implies 11x C23E revs, or 0.3x EV/R/G, compared to peers at 6.5x/0.5x.

Risks to our PO: 1) transactional revenue model tied to GMV, 2) tough comps out of the pandemic, 3) pandemic driven supply chain bottlenecks, 4) failure to renew Shopify partnership, 5) competition, 6) regulatory risk, and 7) customer concentration risk.

Guidewire Software, Inc. (GWRE)

Our $80 PO is based on an EV/sales multiple of 6.0x our C24 revenue estimate (0.6x growth adjusted), a premium to the SMID cap software group at roughly 0.4x EV/CY23rev/G based on GWRE's position as a market leader and long-term secular tailwinds, offset by near-term headwinds with potential to pressure growth and margins. Upside risks to our PO are 1) quarterly license revenue upside from stronger new customer wins or cross selling of the new analytics offering, 2) margin upside from earlier than expected roll out of new features under development, 3) revenue/margin upside from better than expected execution integrating and upselling acquired offerings (Cyence, FirstBeat, Eagle Eye), and 4) pickup in economic activity leading to appreciation of the stock's multiple and increasing the premium to peers. Downside risks to our PO are 1) pullback to the stock's multiple more than expected due to slowdown in macro sentiment or disappointing quarterly license growth, 2) negative margin leverage more than expected due to accelerated adoption of cloud based systems pressuring overall gross margins, and 3) variable pricing model facing downward pressure more than expected given increasing commoditized market for insurance and possible discounting required for larger customers.

HashiCorp (HCP)

Our PO of $24 is based on EV/sales of 4.6x our CY25e Sales, or 0.2x our C25 revenue growth rate of 20%, a discount to the mid-cap peers at 0.3x (13% growth) for lower profitability and heightened near term macro/execution risk.

Upside risk to our PO is that HashiCorp shares trade in line with the software group. In the event of changes to market sentiment on macro abating and IT spend returning to normal, shares could rerate.

Downside risks to our PO are: 1) It has high exposure to cyclical trends of application software spend. Enterprise application software has proven to be highly cyclical. During an economic slowdown, when firms are faced with shrinking IT budgets, application upgrades, migrations, or new installations are often deferred, which could present a high degree of risk for bookings deceleration. 2) HashiCorp competes against deep-pocketed platform vendors, such as the major cloud providers as well as point solutions, and thus the absence of ongoing feature and capability enhancement may slow share gains.

HubSpot (HUBS)
Our PO of $600 is based on an EV/revenue multiple of 10.0x our CY25 revenue estimate. The 10.0 multiple represents an EV/Rev/Growth multiple of 0.5x based on our C25E revenue growth rate of +22% y/y, in line with the large cap group on a growth-adjusted basis, at 0.5x EV/Rev/G (+16% y/y growth).

Risks to our PO are: 1) higher customer attrition rate (low teens) may limit future growth, particularly as the company grows and the dollar attrition amount grows, 2) HubSpot shares trade at a premium to where the software stocks have historically traded, presenting the risk of a pullback, which could occur in the event of changes to market sentiment stemming from the global macro uncertainty, or potentially disappointing quarterly revenue growth, 3) we believe that HubSpot's business has a high degree of exposure to the macro economic cycle, given the company's focus on selling applications into the SMB market segment. Applications projects are discretionary and can be delayed in the event of a shrinking IT budget, unlike projects involving more mission critical infrastructure or security technologies. Also, SMB mortality increases during cyclical downturns, which could affect HubSpot's renewal rate.

Informatica Inc. (INFA)
Our $33 PO is based on a SOTP valuation analysis. On a consolidated basis, the SOTP implies a 6.8x EV/C24E revenue multiple. For our SOTP, we use a 9.8x EV/C24E subscription revenue multiple, that translates to an EV/R/G of 0.65x, a premium to infrastructure peers at 7.3x/0.6x, warranted for 35%+ growth vs. 16% peers. We use a 2.0x EV/C23E multiple for the rest of the revenue, as its legacy maintenance revenue stream is not a strategic growth vector. This compares to 5.5x for legacy software peers.

Risks to our PO are: 1) competition, 2) transition takes time, 3) execution, 4) shifts in cloud and self-managed could affect recognized revenue, 5) pricing changes that elevate churn, and 6) macro related risks.

Intapp Inc. (INTA)
Our $50 PO is based on our SOTP (sum of the parts) valuation analysis: 9.8x EV/C24E SaaS revenues, above vertical software peers at 7.0x for faster cloud growth (35%+ vs mid-teens peers). The rest of revenues is at a 6.0x multiple, comparable to legacy on-premise vertical peers at 6x, given on-premise is not a focus vector. Our PO implies a 8.3x EV/C24E consolidated revenue multiple.

Downside risks to our PO are: 1) TAM penetration, 2) execution, 3) competition, 4) not currently profitable, and 5) enterprise application spending is highly cyclical.

Intuit (INTU)
Our PO of $650 is based on 27x our C25E FCF. It implies 1.4x on a growth-adjusted basis (assuming a normalized 17% CAGR for FCF), a premium to the large cap GARP software peer group average of 1.3x to reflect a more durable growth profile.

Risks to our price objective are a deepening of the macroeconomic slowdown, leading to increased pressure on the SMB business, potential government intervention requiring the tax-filing process be free for all users, increased complications in the tax code driving users to professionals for tax filing, increased focus from competitors in the SMB accounting and payroll space.

Jamf (JAMF)

$22 PO is based on an EV/sales multiple of 5.0x our C24E revenue estimate, representing a premium to the small cap SaaS group at 4.8x, given our expectations for Jamf to sustain high-teens percent or higher recurring revenue growth over the next two to three years (versus the small cap SaaS group expected to grow in the mid teens) driven by ongoing share gains in the $18 billion estimated addressable market for Apple device management software.

Downside risks are: 1) Systems management market is more mature relative to other software markets with a somewhat lacking innovation cycle driving growth, which could cap growth in the near/long term, 2) Need to drive awareness of Jamf brand to continue driving replacement deals in order to sustain growth which could be challenging given larger priorities are underway (cloud IaaS, cloud apps, digital transformation, etc.), and 3) Highly competitive market in device management, with offerings from platform vendors that sell broader suites that can manage multiple devices/infrastructure - the absence of ongoing feature enhancements for product differentiation could present the risk of slowing share gains or even share losses to platform vendors, which could curb growth.

JFrog Ltd (FROG)

Our $36 PO is based on 7.9x EV/C24E revenue or an EV/R/G of 0.3x, which compares to its infrastructure peers at 0.4x EV/R/G (6.4x revenue), warranted given a similar growth profile vs the peer average (i.e., low-20s vs mid teens), but compressing NRR.

Downside risks to our PO include: macroeconomic downturn, prolonged COVID headwinds, increase in competition, ability to upsell installed base, ability to convert free users to paid subscriptions, ability to expand into adjacent markets, and ability to sustain high R&D innovation.

Lightspeed Commerce Inc. (LSPD / YLSPD)

Our $20 USD PO / $26 CAD PO is based on 5.0x EV/C24E gross profit, or an EV/GP/G of 0.24x, which is a discount to its horizontal software peers at 7.6x/0.5x. We believe a discount multiple is warranted given the risks the company is facing due to recessionary pressure, inflationary pressure, and/ waning consumer demand, along with competition risk, and execution risk around its One Lightspeed strategy.

Risks to an investment in LSPD are 1) macro-sensitivity of the company's customer-base, 2) competition, 3) execution risk while integrating acquisitions, 4) payments adoption, and 5) path to profitability.

MeridianLink, Inc. (MLNK)

The $24 PO is based on 20x EV/C24E EBITDA, lower than its Rule-of-40+ vertical peers of 31x, given one of its end markets, mortgage originations, is under pressure due to the current high interest rate environment.

Risks to our PO are: 1) transactional model tied to loan volumes, 2) rising interest rates affecting refinancings, 3) consumer sentiment decreases, 4) pricing pressures from competitors, and 5) relatively high debt leverage ratio.

Microsoft Corporation (MSFT)

Our PO of $430 is based on an EV/FCF multiple of 38x our C25E free cash flow estimate. The growth-adjusted multiple trades at a premium to the large cap GARP group, which we view as warranted given our view of Microsoft as a leading AI play in software.

Downside risks to our price objective: 1) Microsoft could see some near term gross margin pressure as the Azure business grows as a percentage of overall revenue. While Microsoft's on premise offerings offer a high margin profile, growth in these lines of business is decelerating. 2) Enterprise application spending has proven to be highly cyclical, given the more discretionary nature of applications projects. During an economic slowdown, when firms are faced with shrinking IT budgets, projects involving application upgrades, migrations or new installations are often deferred. This could present a higher degree of risk for a bookings deceleration for Microsoft and other application vendors, in the event of an economic slowdown.

MongoDB Inc (MDB)
Our PO of $480 represents EV/sales of 15x our CY25e, or 0.6x our C25 revenue growth rate of 26%, in line with the large-cap peers at 0.6x (16% growth). We believe MongoDB has a long expected runway for growth as the company consolidates the $108 billion market for the database market.

Downside risks to our PO are: 1) MongoDB trades at a significant premium to its software large-cap peer group on an EV/Sales basis. In the event of changes to market sentiment stemming from global macro uncertainty, or potentially disappointing quarterly revenue results, there could be risk of a potential pullback. 2) The company recognizes a large majority of its revenue based on actual consumption which implies more revenue volatility than a traditional subscription model. 3) MongoDB serves in a highly competitive market, which consists of deep-pocketed next-gen NoSQL database, public cloud vendors and legacy database vendors. An inability to execute on a product roadmap for added capabilities could result in slowing share gains or even share losses.

nCino, Inc. (NCNO)
Our PO of $34 is based on an EV/sales multiple of 7.0x our C24E revenue estimate (0.4x growth adjusted), in line with the SMID cap software group trading at 0.4x C24E. We believe nCino will drive ongoing share gains in the $18 billion addressable market for financial applications.

Downside risks are 1) instability in nCino's end market, 2) inability to achieve long term targets profitability - the company targets a future long term (4 to 6 years) operating margin of approximately 35% and, 3) enterprise application spending has proven to be highly cyclical - in the event of an economic slowdown, nCino could see deferred projects which could present a higher degree of risk for a bookings deceleration.

NICE Ltd. (NICE / NCSYF)
Our PO of US$285 / ILS 1034 is based on a 6.9x multiple of our C24e EV/Revenue. Our target multiple is a premium to the UCaaS peer group trading at 2.7x, which we believe is justified based on competitive positioning, market share gains, margin and FCF generation. As Cloud increases as a percentage of total revenue, this should be supportive for the multiple.

Upside risks to our PO are 1) higher-than-expected cloud revenue growth, 2) higher-than-expected Contact Center market growth, and 3) a faster displacement of legacy on-premise solutions.

Downside risks to our PO are 1) investor sentiment and sensitivity to the premium valuation levels, 2) lower-than-expected cloud revenue growth, 3) slower-than-expected displacement of legacy on-premise solutions, 4) cash flow deterioration.

Oracle Corporation (ORCL)
Our $122 PO is based on 18x our C25E EPS estimate of $6.60 and is a premium to where the S&P500 is trading. We believe the premium is justified given possible revenue

acceleration, sustainability of EPS growth in the long term, diversity of the company's product offering, sticky customer base, and margin profile.

Risks to our price objective are a severe downturn in enterprise software spending, currency headwinds, issues with the integration of past acquisitions, database competition from IBM, Amazon, and Microsoft, apps competition from SAP, Microsoft and others, and the development of viable open source database and middleware alternatives.

PagerDuty (PD)
Our $30 PO is based on an EV/revenue multiple of 5.8x to our CY24E revenue estimate of $475bn. The 5.8x multiple is below infrastructure peers at 7.6x, which we believe is warranted given its growth acceleration potential, large TAM and platform differentiation, balanced against execution risks. On an EV/R/G basis, the 5.8x multiple translates to 0.52x, which is below the peer group at 0.60x.

Risks to our PO: 1) decelerating growth metrics such as revenue, billings and RPO, 2) increased competition driving pricing pressure, 3) compressing NRR trends, 4) execution around its core growth strategy and international expansion, and 5) enterprise software spend can be cyclical.

Paycom (PAYC)
Our $210 PO is based on 34x EV/C24E FCF. The 34x EV/C24E FCF multiple is a slight discount to payroll and HR peers which include Workday and Paylocity at 37x EV/C24E FCF to account for recent execution issues and uncertainty surrounding what a sustainable long term growth trajectory looks like.

Downside risks to our PO are: 1) multiple compression in the event of disappointing quarterly results, 2) meaningful SMB exposure, which is a market segment more prone to churn given it has a higher rate of business closures and/or failures, and 3) interest rate sensitivity.

Paylocity (PCTY)
Paylocity shares trade at a slight discount to its HR and payroll vendor peers (32x EV/C24E FCF). Our $180 PO is based on 34x EV/C24E FCF and represents a slight premium to the peer group given a faster growth and and margin expansion trajectory than most peers.

Downside risks to our PO are: 1) multiple compression in the event of disappointing quarterly results, 2) meaningful SMB exposure, which is a market segment more prone to churn given it has a higher rate of business closures and/or failures, and 3) interest rate sensitivity.

PowerSchool Holdings, Inc. (PWSC)
Our $30 PO is based on 25.3x EV/C24E EBITDA, applied to our $260mn estimate. The 25.3x multiple we use is a discount to its vertical software peers that are currently trading at a 28.0x average, warranted for slower revenue growth (10% organic vs. 11%), balanced against less end-market demand risk and PowerSchool's category leadership in its target K-12 end-market.

Risks to our PO are: 1) M&A risk, increasing acquisition/integration/execution risks in the future, 2) high penetration rates, 3) school and district budget constraints, 4) international expansion could take time, 5) new regulations negatively affecting sales/adoption cycles, 6) increasing competition, and 7) ed-tech software spending can be cyclical

RingCentral (RNG)

Our $55 PO is based on 2.8x CY24e EV/revs. Our target multiple is a premium to the communication peer group at 2.5x but in line on EV/Rev/Growth. We believe that a premium is also supported by RNG's margin upside, positive FCF, and market share gains. The company has the largest scale among cloud-based pure-play vendors and the potential for market disruption.

Downside risks to our PO are 1) benefits of the Avaya and other partnerships taking longer than expected, 2) changes in strategic direction, 3) failure to scale upmarket, 4) higher-than-anticipated customer support and acquisition costs as the company scales up market, 5) macro economy negatively affecting the company's SMB-centric customer base, and 6) competition including Microsoft and Zoom Phone.

Salesforce.com (CRM)
Our PO of $300 is based on an EV/FCF multiple of 22x our C25 FCF estimate, representing a growth adjusted multiple of 0.7x. This is a discount to the large cap software group at 1.3x, which we believe is justified for margin expansion.

Downside risks are: 1) Competition from point solutions and platform vendors presents the risk of slowing share gains/share losses if the company fails to continue delivering ongoing roadmap of new features/new modules, 2) Salesforce's history of acquisitions could present a higher degree of execution risk given the need to continuously integrate the technologies and the installed bases of offerings of technology that are not organically built, and 3) enterprise application spending has proven to be highly cyclical, given the more discretionary nature of applications projects - during an economic slowdown, projects involving application upgrades, migrations or new installations are often deferred which could present a higher degree of risk for a bookings deceleration.

ServiceNow (NOW)
Our price objective of $750 is based on 36x our C25E FCF estimate, representing an EV/FCF/Growth multiple of 1.5x. The multiple compares to the GARP group trading at 31x EV/C25E FCF (1.3x growth-adjusted).

Downside risks are: 1) ServiceNow shares currently trade at a premium versus its large cap software peer group, and we recognize the risk of a potential pullback in the event of changes to market sentiment or a disappointing bookings quarter, 2) an inability to maintain key product advantages may slow share gains and large established competitors in the space may pose threats to ServiceNow's goal of continuing to capture market share by competing on price, 3) application spending is highly cyclical, which could present a higher degree of risk for a bookings deceleration for ServiceNow and other application vendors in the event of an economic slowdown.

Shopify, Inc. (SHOP)
Our $85 PO is based on an EV/sales multiple of 10.6x our C25 sales estimates, or 0.5x on a growth adjusted basis. in line with the large cap software group.

Upside risks are: A larger contribution to monthly recurring revenue stemming from traction of the premium Shopify Plus business.

Downside risks are: A lower customer renewal rate (75-80%) compared to the broader cloud applications market, averaging in the high eighties given the focus on the SMB market segment. Higher attrition may limit growth as the dollar attrition amount increases. High exposure to the macroeconomic cycle in both the applications subscription and payments businesses, driven by consumer discretionary spend.

Snowflake (SNOW)
Our PO of $220 is based on EV/sales of 16x our CY25e, implying 0.5x our C25E revenue growth rate of 31%, in line with the large-cap peers at 0.5x.

Upside risks to our PO: Snowflake recognizes revenue based on actual consumption (versus subscription ratably in arrears). In the event of changes to market sentiment on macro abating and IT spend returning to normal, consumption and revenue growth could quickly reaccelerate which could drive multiple expansion.

Downside risks to our PO: 1) Snowflake trades at a significant premium to its software large-cap peer group. In the event of changes to market sentiment stemming from global macro uncertainty, or potentially disappointing quarterly revenue results, there could be risk of a potential pullback, 2) The company's consumption model implies more revenue volatility than a traditional subscription model, 3) Snowflake serves in a highly competitive market, which consists of deep-pocketed next-gen DBMS vendors, public cloud vendors and legacy DBMS. An inability to execute on a product roadmap for added capabilities could result in slowing share gains or even share losses.

Twilio (TWLO)
Our $55 PO is based on 1.7x EV/C24eRev (EV/Rev/G multiple of 0.3x). Our multiple is a discount to the communication software comp group trading at 2.5x. We believe a discount is justified based on TWLO's lower expected usage, potential margin pressure, and intensifying competition.

Upside risks to our PO are 1) faster-than-expected reacceleration of organic revenue growth, 2) macro recovery driving better-than-expected usage rates, and 3) higher-than-expected revenue mix of software versus core messaging, voice and email.

Downside risks to our PO are 1) increased competition from larger platform vendors, 2) possible price pressure, 3) deterioration in the macro economy, 4) decrease in ability to monetize the platform via developers, 5) deterioration in gross margins, 6) missteps causing growth to dip below management's targets, 7) major network and product issues.

UiPath (PATH)
Our $26 PO is based on 7.0x C25E revenue (0.3x growth-adjusted on our C25E ARR growth rate of 22%), a premium to the midcap peer group trading at 4.7x C25E revenue (0.4x growth-adjusted on a 17% growth rate).

Downside risks are: 1) Premium valuation presents risk of pullback in the event of changes to market sentiment stemming from global macro uncertainty, or potentially disappointing quarterly revenue given UiPath shares trade at a significant premium to the software group, 2) Application spending is highly cyclical, thus during an economic slowdown, when firms are faced with shrinking IT budgets, projects involving application upgrades, migrations or new installations are often deferred which could present a higher degree of risk for a bookings deceleration for UiPath and other application vendors, and 3) UiPath faces competition from point solutions and platform vendors - the absence of ongoing feature enhancements and new module development could present the risk of slowing share gains or even share losses to application platform vendors investing in machine learning and automated workflow offerings and/or other RPA vendors.

Unity (U)
Our $46 PO is based on a 8.8x 2024E EV/Revenue multiple (0.4x growth adjusted). Our growth adjusted multiple is a discount to the design software peer group. We believe a discount multiple is warranted based on lower revenue visibility and profitability, partially offset by Unity's entrenched competitive position and various levers for growth.

Downside risks to our PO are slower than expected recovery in Unity's monetization tool, increased competition, greater than expected churn rate, and greater than expected pull back in ad spend and mobile gaming usage.

Veeva Systems, Inc. (VEEV)
Our PO of $200 is based on an EV/FCF multiple of 24x our C25E FCF estimate (1.2x growth adjusted), a discount to the GARP software group trading at 1.3x for macro headwinds.

Downside risks to our PO are: 1) changes in market sentiment due to global macro uncertainty, which could impact the stock's premium valuation/multiple, 2) overall growth slows faster than expected from slowing sales in the core market, and 3) billings deceleration in the event of an economic slowdown.

Vertex, Inc. (VERX)
Our PO of $23 is based on an EV/sales multiple of 5.7x our C25 revenue estimate, representing a growth adjusted multiple of 0.5x, a slight premium to small cap software peer group at 0.3x EV/sales/growth, given our expectations for mid teens percentage subscription revenue growth over the longer term and limited margin expansion in the near-term.

Upside risks are 1) targets an underpenetrated market in the enterprise segment, 2) integrations with large ERP and back-office software providers, and 3) low churn given its target customers.

Downside risks are 1) growth is largely dependent on the rate of expansion and adoption in the large enterprise segment and adoption of Vertex's tax automation suite could be seen as a lower priority project which could result in slowing rate of expansion and growth, 2) near term margin pressure from lacking cloud datacenter scale, with cloud gross margin of 66% in FY19, low relative to other SaaS business at this scale (mid 80s) - an inability to drive meaningful scale in the cloud business could weigh on margin over the near and long term, and 3) fairly intense competitive environment from Big 4 accounting firms with outsourced tax services - an inability to maintain key product advantages (such as depth of integration with key large enterprise ERP vendors and broad global tax content database) could present the risk of slowing share gains or share losses which could curb growth.

Weave (WEAV)
Our PO of $14 represents 4.7x EV/Rev on our 2024 forecast or 0.3x EV/Rev/Growth. This is a discount to the vertical software peer group at 6.8x EV/Rev and 0.5x EV/Rev/Growth. We believe a discount is warranted based on the company's relative newness in the public market and smaller size.

Risks to our price objective are: 1) slower than projected customer growth, 2) margin pressure, and 3) market share loss.

Workday Inc. (WDAY)
Our PO of $300 is based on a C25E EV/FCF multiple of 32x. On a growth-adjusted basis, this is 1.3x our estimated our estimated 3-yr FCF CAGR of 20%. Our 1.3x multiple is in line with the large cap software GARP group at 1.3x (growing +21% y/y).

Downside risks are as as follows: 1) Large deal size could be impacted by a worsening macro environment (deal delays). 2) Workday has been gaining share in the HCM market since the company's founding in 2005. There is risk that overall growth slows faster than expected from slowing sales in the HCM market, absent increased progress selling Financials and add-on products. 3) Enterprise application spending has proven to be highly cyclical, given the more discretionary nature of applications projects. We believe that this profile presents a higher degree of risk for a billings deceleration for Workday and other application vendors, in the event of an economic slowdown.

Zeta Global (ZETA)
Our $14 PO is 3.6x EV/C24E revenue, representing a growth adjusted multiple of 0.2x. The 3.6x multiple we use is a premium to its advertising / marketing-tech peers at 1.9x, warranted given steady revenue growth, coupled with faster EBITDA growth and strong recent execution.

Risks to our price objective: Zeta's proprietary customer data set is disrupted and end customers shift their budgets to other data source vendors and platforms, execution risk in scaling Zeta's business efficiently and customer concentration risk.

Zoom Video Communications (ZM)
Our $90 PO is based on free cash flow multiple of 14.0x and represents a free cash flow yield of 7.1%. The 14.0x multiple is a discount to the less than 20% growth software peer group trading at 32.5x. This discount is warranted based on ZM's weaker visibility with regards to future growth trajectory and an increasingly competitive xCaaS environment.

Upside risks to our price objective are stabilization of the non-enterprise user base, successful penetration of enterprise phone and contact center and acquisition.

Downside risks are greater-than-expected attrition of non-enterprise users, failed M&A, a prolonged economic downturn and heightened competitive pressure.

ZoomInfo (ZI)
Our $20 PO is based on 7.1x EV/C24E revenue, representing a growth adjusted multiple of 4.5x our 1.6% growth rate. The multiple we use is a premium to horizontal SaaS peers at 5.8x EV/revenue (0.4x EV/R/G) which we believe is justified given its ability to generate meaningful free cash flow (i.e., 35%+ margin) compared to peers at roughly 20%. Our $20 PO implies an EV/C24E FCF multiple of 22.2x, which is a discount to horizontal software peers at 28.2x.

Upside risks to our price objective are stabilization of the non-enterprise user base, successful penetration of enterprise phone and contact center and acquisition. Downside risks are greater than expected attrition of non-enterprise users, failed M&A, a prolonged economic downturn and heightened competitive pressure.

Analyst Certification

We, Alkesh Shah, Adam Bergere, Brad Sills, Koji Ikeda, CFA and Michael J. Funk, hereby certify that the views each of us has expressed in this research report accurately reflect each of our respective personal views about the subject securities and issuers. We also certify that no part of our respective compensation was, is, or will be, directly or indirectly, related to the specific recommendations or view expressed in this research report.

US - Enterprise Software Coverage Cluster

Investment rating	Company	BofA Ticker	Bloomberg symbol	Analyst
BUY				
	8x8	EGHT	EGHT US	Michael J. Funk
	Adobe	ADBE	ADBE US	Brad Sills
	Alarm.com	ALRM	ALRM US	Michael J. Funk
	Amplitude, Inc.	AMPL	AMPL US	Koji Ikeda, CFA
	BILL	BILL	BILL US	Brad Sills
	CCC Intelligent Solutions	CCCS	CCCS US	Michael J. Funk
	Dropbox	DBX	DBX US	Michael J. Funk
	Dynatrace	DT	DT US	Koji Ikeda, CFA
	Elastic NV	ESTC	ESTC US	Koji Ikeda, CFA
	GitLab Inc.	GTLB	GTLB US	Koji Ikeda, CFA
	Global-e Online Ltd.	GLBE	GLBE US	Koji Ikeda, CFA
	HubSpot	HUBS	HUBS US	Brad Sills
	Informatica Inc.	INFA	INFA US	Koji Ikeda, CFA
	Intapp Inc.	INTA	INTA US	Koji Ikeda, CFA
	Intuit	INTU	INTU US	Brad Sills
	JFrog Ltd	FROG	FROG US	Koji Ikeda, CFA
	MeridianLink, Inc.	MLNK	MLNK US	Koji Ikeda, CFA
	Microsoft Corporation	MSFT	MSFT US	Brad Sills
	MongoDB Inc	MDB	MDB US	Brad Sills
	nCino, Inc.	NCNO	NCNO US	Adam Bergere
	NICE Ltd.	NICE	NICE US	Michael J. Funk
	NICE Ltd.	NCSYF	NICE IT	Michael J. Funk
	PagerDuty	PD	PD US	Koji Ikeda, CFA
	PowerSchool Holdings, Inc.	PWSC	PWSC US	Koji Ikeda, CFA
	RingCentral	RNG	RNG US	Michael J. Funk
	Salesforce.com	CRM	CRM US	Brad Sills
	ServiceNow	NOW	NOW US	Brad Sills
	UiPath	PATH	PATH US	Brad Sills
	Unity	U	U US	Michael J. Funk
	Weave	WEAV	WEAV US	Michael J. Funk
	Workday Inc.	WDAY	WDAY US	Brad Sills
	Zeta Global	ZETA	ZETA US	Koji Ikeda, CFA
NEUTRAL				
	Autodesk	ADSK	ADSK US	Michael J. Funk
	Bentley Systems	BSY	BSY US	Michael J. Funk
	BigCommerce Holdings, Inc.	BIGC	BIGC US	Koji Ikeda, CFA
	Coveo	YCVO	CVO CN	Koji Ikeda, CFA
	Datadog Inc	DDOG	DDOG US	Koji Ikeda, CFA
	DocuSign	DOCU	DOCU US	Brad Sills
	Freshworks, Inc.	FRSH	FRSH US	Adam Bergere
	HashiCorp	HCP	HCP US	Brad Sills
	Jamf	JAMF	JAMF US	Koji Ikeda, CFA
	Lightspeed Commerce Inc.	LSPD	LSPD US	Koji Ikeda, CFA
	Lightspeed Commerce Inc.	YLSPD	LSPD CN	Koji Ikeda, CFA
	Oracle Corporation	ORCL	ORCL US	Brad Sills
	Paycom	PAYC	PAYC US	Adam Bergere
	Paylocity	PCTY	PCTY US	Adam Bergere
	Shopify, Inc.	SHOP	SHOP US	Brad Sills
	Snowflake	SNOW	SNOW US	Brad Sills
	Veeva Systems, Inc.	VEEV	VEEV US	Brad Sills
	Zoom Video Communications	ZM	ZM US	Michael J. Funk
	ZoomInfo	ZI	ZI US	Koji Ikeda, CFA
UNDERPERFORM				
	AvidXchange, Inc.	AVDX	AVDX US	Brad Sills
	Blackbaud, Inc.	BLKB	BLKB US	Koji Ikeda, CFA
	BlackLine, Inc.	BL	BL US	Koji Ikeda, CFA
	C3.ai	AI	AI US	Brad Sills
	Confluent	CFLT	CFLT US	Brad Sills
	CS Disco, Inc.	LAW	LAW US	Koji Ikeda, CFA
	Enfusion, Inc.	ENFN	ENFN US	Koji Ikeda, CFA
	Everbridge	EVBG	EVBG US	Koji Ikeda, CFA
	Five9	FIVN	FIVN US	Michael J. Funk
	Guidewire Software, Inc.	GWRE	GWRE US	Michael J. Funk

US - Enterprise Software Coverage Cluster

Investment rating	Company	BofA Ticker	Bloomberg symbol	Analyst
	Twilio	TWLO	TWLO US	Michael J. Funk
	Vertex, Inc.	VERX	VERX US	Brad Sills
RSTR				
	Splunk	SPLK	SPLK US	Brad Sills

Disclosures

Important Disclosures

Equity Investment Rating Distribution: Technology Group (as of 31 Dec 2023)

Coverage Universe	Count	Percent	Inv. Banking Relationships [R1]	Count	Percent
Buy	215	53.09%	Buy	111	51.63%
Hold	97	23.95%	Hold	45	46.39%
Sell	93	22.96%	Sell	24	25.81%

Equity Investment Rating Distribution: Telecommunications Group (as of 31 Dec 2023)

Coverage Universe	Count	Percent	Inv. Banking Relationships [R1]	Count	Percent
Buy	57	51.82%	Buy	43	75.44%
Hold	27	24.55%	Hold	17	62.96%
Sell	26	23.64%	Sell	12	46.15%

Equity Investment Rating Distribution: Global Group (as of 31 Dec 2023)

Coverage Universe	Count	Percent	Inv. Banking Relationships [R1]	Count	Percent
Buy	1895	53.62%	Buy	1083	57.15%
Hold	832	23.54%	Hold	454	54.57%
Sell	807	22.84%	Sell	383	47.46%

[R1] Issuers that were investment banking clients of BofA Securities or one of its affiliates within the past 12 months. For purposes of this Investment Rating Distribution, the coverage universe includes only stocks. A stock rated Neutral is included as a Hold, and a stock rated Underperform is included as a Sell.

FUNDAMENTAL EQUITY OPINION KEY: Opinions include a Volatility Risk Rating, an Investment Rating and an Income Rating. VOLATILITY RISK RATINGS, indicators of potential price fluctuation, are: A - Low, B - Medium and C - High. INVESTMENT RATINGS reflect the analyst's assessment of both a stock's absolute total return potential as well as its attractiveness for investment relative to other stocks within its Coverage Cluster (defined below). Our investment ratings are: 1 - Buy stocks are expected to have a total return of at least 10% and are the most attractive stocks in the coverage cluster; 2 - Neutral stocks are expected to remain flat or increase in value and are less attractive than Buy rated stocks and 3 - Underperform stocks are the least attractive stocks in a coverage cluster. An investment rating of 6 (No Rating) indicates that a stock is no longer trading on the basis of fundamentals. Analysts assign investment ratings considering, among other things, the 0-12 month total return expectation for a stock and the firm's guidelines for ratings dispersions (shown in the table below). The current price objective for a stock should be referenced to better understand the total return expectation at any given time. The price objective reflects the analyst's view of the potential price appreciation (depreciation).

Investment rating	Total return expectation (within 12-month period of date of initial rating)	Ratings dispersion guidelines for coverage cluster[R2]
Buy	≥ 10%	≤ 70%
Neutral	≥ 0%	≤ 30%
Underperform	N/A	≥ 20%

[R2]Ratings dispersions may vary from time to time where BofA Global Research believes it better reflects the investment prospects of stocks in a Coverage Cluster.

INCOME RATINGS, indicators of potential cash dividends, are: 7 - same/higher (dividend considered to be secure), 8 - same/lower (dividend not considered to be secure) and 9 - pays no cash dividend. *Coverage Cluster* is comprised of stocks covered by a single analyst or two or more analysts sharing a common industry, sector, region or other classification(s). A stock's coverage cluster is included in the most recent BofA Global Research report referencing the stock.

Price Charts for the securities referenced in this research report are available on the Price Charts website, or call 1-800-MERRILL to have them mailed.

BofAS or one of its affiliates acts as a market maker for the equity securities recommended in the report: 8x8, Adobe, Alarm, Amplitude, Inc., Autodesk, AvidXchange, Inc., Bentley Systems, Bigcommerce, BILL, Blackbaud, Inc., BlackLine, Inc., C3.ai, CCC Intelligent Sol, Confluent, Datadog Inc, Disco, DocuSign, Dropbox, Dynatrace, Elastic, Enfusion, Inc., Everbridge, Five9, Freshworks, GitLab, Global-e Online Ltd., Guidewire Software, HashiCorp, HubSpot, Informatica Inc., Intapp Inc., Intuit, Jamf, JFrog, Lightspeed, MeridianLink, Microsoft, MongoDB, nCino, NICE Ltd., Oracle, PagerDuty, Paycom, Paylocity, PowerSchool, RingCentral, Salesforce.com, ServiceNow, Shopify, Inc., Snowflake, Twilio, UiPath, Unity, Veeva Systems, Inc., Vertex, Weave, Workday, Zeta Global, Zoom, ZoomInfo.

BofAS or an affiliate was a manager of a public offering of securities of this issuer within the last 12 months: CCC Intelligent Sol, Dynatrace, Intapp Inc., Intuit, PagerDuty, PowerSchool, RingCentral.

The issuer is or was, within the last 12 months, an investment banking client of BofAS and/or one or more of its affiliates: 8x8, Inc., Adobe, Autodesk, Blackbaud, Inc., CCC Intelligent Sol, DocuSign, Dropbox, Dynatrace, Enfusion, Inc., GitLab Inc., Intapp Inc., Intuit, MeridianLink, Inc., Microsoft Corp, nCino, NICE Ltd., Oracle, PagerDuty, PowerSchool, RingCentral, Salesforce.com, Snowflake Inc, Unity, Workday, Zeta Global, ZoomInfo.

BofAS or an affiliate has received compensation from the issuer for non-investment banking services or products within the past 12 months: 8x8, Inc., Adobe, Alarm, Autodesk, AvidXchange, Inc., Bentley Systems, Bigcommerce, BILL, Blackbaud, Inc., BlackLine, Inc., C3.ai, CCC Intelligent Sol, Confluent, CS Disco, Inc, DocuSign, Dropbox, Dynatrace, Enfusion, Inc., Everbridge, Five9 Inc, Freshworks, Inc., GitLab Inc., Guidewire Software,, HashiCorp, IHubSpot, Inc., Informatica Inc., Intapp Inc., Intuit, Jamf, Lightspeed, MeridianLink, Inc., Microsoft Corp, MongoDB, nCino, Oracle, PagerDuty, Paycom Software, Paylocity, PowerSchool, RingCentral, Salesforce.com, ServiceNow, Inc., Shopify, Inc., Snowflake Inc, Twilio Inc., UiPath, Unity, Veeva Systems, Inc., Workday, Zeta Global, Zoom Video, ZoomInfo.

The issuer is or was, within the last 12 months, a non-securities business client of BofAS and/or one or more of its affiliates: 8x8, Inc., Adobe, Alarm, Amplitude, Inc., Autodesk, AvidXchange, Inc., Bentley Systems, Bigcommerce, BILL, Blackbaud, Inc., BlackLine, Inc., C3.ai, CCC Intelligent Sol, Confluent, CS Disco, Inc, DocuSign, Dropbox, Dynatrace, Enfusion, Inc., Everbridge, Five9 Inc, Freshworks, Inc., GitLab Inc., Guidewire Software,, HashiCorp, IHubSpot, Inc., Informatica Inc., Intapp Inc., Intuit, Jamf, Lightspeed, MeridianLink, Inc., Microsoft Corp, MongoDB, nCino, Oracle, PagerDuty, Paycom Software, Paylocity, PowerSchool, RingCentral, Salesforce.com, ServiceNow, Inc., Shopify, Inc., Snowflake Inc, Twilio Inc., UiPath, Unity, Veeva Systems, Inc., Workday, Zeta Global, Zoom Video, ZoomInfo.
An officer, director or employee of BofAS or one of its affiliates is an officer or director of this issuer: Salesforce.com.
BofAS or an affiliate has received compensation for investment banking services from this issuer within the past 12 months: 8x8, Inc., Adobe, Autodesk, Blackbaud, Inc., CCC Intelligent Sol, Dropbox, Dynatrace, Enfusion, Inc., Intapp Inc., Intuit, MeridianLink, Inc., Microsoft Corp, Oracle, PagerDuty, PowerSchool, RingCentral, Salesforce.com, Snowflake Inc, Unity, Zeta Global, ZoomInfo.
BofAS or an affiliate expects to receive or intends to seek compensation for investment banking services from this issuer or an affiliate of the issuer within the next three months: Adobe, Blackbaud, Inc., CCC Intelligent Sol, DocuSign, Dynatrace, GitLab Inc., Intuit, Microsoft Corp, nCino, NICE Ltd., Oracle, RingCentral, Salesforce.com, Workday, Zeta Global.
BofAS together with its affiliates beneficially owns one percent or more of the common stock of this issuer. If this report was issued on or after the 9th day of the month, it reflects the ownership position on the last day of the previous month. Reports issued before the 9th day of a month reflect the ownership position at the end of the second month preceding the date of the report: Adobe, Autodesk, BlackLine, Inc., Confluent, Dropbox, Guidewire Software,, Intuit, JFrog, Microsoft Corp, MongoDB, PagerDuty, Salesforce.com, ServiceNow, Inc., Workday.
BofAS or one of its affiliates is willing to sell to, or buy from, clients the common equity of the issuer on a principal basis: 8x8, Adobe, Alarm, Amplitude, Inc., Autodesk, AvidXchange, Inc., Bentley Systems, Bigcommerce, BILL, Blackbaud, Inc., BlackLine, Inc., C3.ai, CCC Intelligent Sol, Confluent, Datadog Inc, Disco, DocuSign, Dropbox, Dynatrace, Elastic, Enfusion, Inc., Everbridge, Five9, Freshworks, GitLab, Global-e Online Ltd., Guidewire Software, HashiCorp, HubSpot, Informatica Inc., Intapp Inc., Intuit, Jamf, JFrog, Lightspeed, MeridianLink, Microsoft, MongoDB, nCino, NICE Ltd., Oracle, PagerDuty, Paycom, Paylocity, PowerSchool, RingCentral, Salesforce.com, ServiceNow, Shopify, Inc., Snowflake, Twilio, UiPath, Unity, Veeva Systems, Inc., Vertex, Weave, Workday, Zeta Global, Zoom, ZoomInfo.
The issuer is or was, within the last 12 months, a securities business client (non-investment banking) of BofAS and/or one or more of its affiliates: 8x8, Inc., Adobe, Autodesk, AvidXchange, Inc., Bentley Systems, BILL, Blackbaud, Inc., BlackLine, Inc., C3.ai, CCC Intelligent Sol, Confluent, DocuSign, Dropbox, Dynatrace, Five9 Inc, Freshworks, Inc., GitLab Inc., Guidewire Software,, IHubSpot, Inc., Informatica Inc., Intuit, Jamf, MeridianLink, Inc., Microsoft Corp, MongoDB, Oracle, PagerDuty, Paycom Software, Paylocity, RingCentral, Salesforce.com, ServiceNow, Inc., Shopify, Inc., Snowflake Inc, Twilio Inc., UiPath, Unity, Veeva Systems, Inc., Workday, Zeta Global, Zoom Video, ZoomInfo.
Due to the nature of strategic analysis, the issuers or securities recommended or discussed in this report are not continuously followed. Accordingly, investors must regard this report as providing stand-alone analysis and should not expect continuing analysis or additional reports relating to such issuers and/or securities.
BofA Global Research personnel (including the analyst(s) responsible for this report) receive compensation based upon, among other factors, the overall profitability of Bank of America Corporation, including profits derived from investment banking. The analyst(s) responsible for this report may also receive compensation based upon, among other factors, the overall profitability of the Bank's sales and trading businesses relating to the class of securities or financial instruments for which such analyst is responsible.

Other Important Disclosures

From time to time research analysts conduct site visits of covered issuers. BofA Global Research policies prohibit research analysts from accepting payment or reimbursement for travel expenses from the issuer for such visits.
Prices are indicative and for information purposes only. Except as otherwise stated in the report, for any recommendation in relation to an equity security, the price referenced is the publicly traded price of the security as of close of business on the day prior to the date of the report or, if the report is published during intraday trading, the price referenced is indicative of the traded price as of the date and time of the report and in relation to a debt security (including equity preferred and CDS), prices are indicative as of the date and time of the report and are from various sources including BofA Securities trading desks.
The date and time of completion of the production of any recommendation in this report shall be the date and time of dissemination of this report as recorded in the report timestamp.

Recipients who are not institutional investors or market professionals should seek the advice of their independent financial advisor before considering information in this report in connection with any investment decision, or for a necessary explanation of its contents.
Officers of BofAS or one or more of its affiliates (other than research analysts) may have a financial interest in securities of the issuer(s) or in related investments.
Refer to BofA Global Research policies relating to conflicts of interest.
"BofA Securities" includes BofA Securities, Inc. ("BofAS") and its affiliates. Investors should contact their BofA Securities representative or Merrill Global Wealth Management financial advisor if they have questions concerning this report or concerning the appropriateness of any investment idea described herein for such investor. "BofA Securities" is a global brand for BofA Global Research.
Information relating to Non-US affiliates of BofA Securities and Distribution of Affiliate Research Reports:
BofAS and/or Merrill Lynch, Pierce, Fenner & Smith Incorporated ("MLPF&S") may in the future distribute, information of the following non-US affiliates in the US (short name: legal name, regulator): Merrill Lynch (South Africa): Merrill Lynch South Africa (Pty) Ltd., regulated by The Financial Service Board; MLI (UK): Merrill Lynch International, regulated by the Financial Conduct Authority (FCA) and the Prudential Regulation Authority (PRA); BofASE (France): BofA Securities Europe SA is authorized by the Autorité de Contrôle Prudentiel et de Résolution (ACPR) and regulated by the ACPR and the Autorité des Marchés Financiers (AMF). BofA Securities Europe SA ("BofASE") with registered address at 51, rue La Boétie, 75008 Paris is registered under no 842 602 690 RCS Paris. In accordance with the provisions of French Code Monétaire et Financier (Monetary and Financial Code), BofASE is an établissement de crédit et d'investissement (credit and investment institution) that is authorised and supervised by the European Central Bank and the Autorité de Contrôle Prudentiel et de Résolution (ACPR) and regulated by the ACPR and the Autorité des Marchés Financiers. BofASE's share capital can be found at www.bofaml.com/BofASEdisclaimer; BofA Europe (Milan): Bank of America Europe Designated Activity Company, Milan Branch, regulated by the Bank of Italy, the European Central Bank (ECB) and the Central Bank of Ireland (CBI); BofA Europe (Frankfurt): Bank of America Europe Designated Activity Company, Frankfurt Branch regulated by BaFin, the ECB and the CBI; BofA Europe (Madrid): Bank of America Europe Designated Activity Company, Sucursal en España, regulated by the Bank of Spain, the ECB and the CBI; Merrill Lynch (Australia): Merrill Lynch Equities (Australia) Limited, regulated by the Australian Securities and Investments Commission; Merrill Lynch (Hong Kong): Merrill Lynch (Asia Pacific) Limited, regulated by the Hong Kong Securities and Futures Commission (HKSFC); Merrill Lynch (Singapore): Merrill Lynch (Singapore) Pte Ltd, regulated by the Monetary Authority of Singapore (MAS); Merrill Lynch (Canada): Merrill Lynch Canada Inc, regulated by the Canadian Investment Regulatory Organization; Merrill Lynch (Mexico): Merrill Lynch Mexico, SA de CV, Casa de Bolsa, regulated by the Comisión Nacional Bancaria y de Valores; Merrill Lynch (Argentina): Merrill Lynch Argentina SA, regulated by Comisión Nacional de Valores; BofAS Japan: BofA Securities Japan Co., Ltd., regulated by the Financial Services Agency; Merrill Lynch (Seoul): Merrill Lynch International, LLC Seoul Branch, regulated by the Financial Supervisory Service; Merrill Lynch (Taiwan): Merrill Lynch Securities (Taiwan) Ltd., regulated by the Securities and Futures Bureau; BofAS India: BofA Securities India Limited, regulated by the Securities and Exchange Board of India (SEBI); Merrill Lynch (Israel): Merrill Lynch Israel Limited, regulated by Israel Securities Authority; Merrill Lynch (DIFC): Merrill Lynch International (DIFC Branch), regulated by the Dubai Financial Services Authority (DFSA); Merrill Lynch (Brazil): Merrill Lynch S.A. Corretora de Títulos e Valores Mobiliários, regulated by Comissão de Valores Mobiliários; Merrill Lynch KSA Company: Merrill Lynch Kingdom of Saudi Arabia Company, regulated by the Capital Market Authority.
This information: has been approved for publication and is distributed in the United Kingdom (UK) to professional clients and eligible counterparties (as each is defined in the rules of the FCA and the PRA) by MLI (UK), which is authorized by the PRA and regulated by the FCA and the PRA - details about the extent of our regulation by the FCA and PRA are available from us on request; has been approved for publication and is distributed in the European Economic Area (EEA) by BofASE (France), which is authorized by the ACPR and regulated by the ACPR and the AMF; has been considered and distributed in Japan by BofAS Japan, a registered securities dealer under the Financial Instruments and Exchange Act in Japan, or its permitted affiliates; is issued and distributed in Hong Kong by Merrill Lynch (Hong Kong) which is regulated by HKSFC; is issued and distributed in Taiwan by Merrill Lynch (Taiwan); is issued and distributed in India by BofAS India; and is issued and distributed in Singapore to institutional investors and/or accredited investors (each as defined under the Financial Advisers Regulations) by Merrill Lynch (Singapore) (Company Registration No 198602883D). Merrill Lynch (Singapore) is regulated by MAS. Merrill Lynch Equities (Australia) Limited (ABN 65 006 276 795), AFS License 235132 (MLEA) distributes this information in Australia only to 'Wholesale' clients as defined by s.761G of the Corporations Act 2001. With the exception of Bank of America N.A., Australia Branch, neither MLEA nor any of its affiliates involved in preparing this information is an Authorised Deposit-Taking Institution under the Banking Act 1959 nor regulated by the Australian Prudential Regulation Authority. No approval is required for publication or distribution of this information in Brazil and its local distribution is by Merrill Lynch (Brazil) in accordance with applicable regulations. Merrill Lynch (DIFC) is

authorized and regulated by the DFSA. Information prepared and issued by Merrill Lynch (DIFC) is done so in accordance with the requirements of the DFSA conduct of business rules. BofA Europe (Frankfurt) distributes this information in Germany and is regulated by BaFin, the ECB and the CBI. BofA Securities entities, including BofA Europe and BofASE (France), may outsource/delegate the marketing and/or provision of certain research services or aspects of research services to other branches or members of the BofA Securities group. You may be contacted by a different BofA Securities entity acting for and on behalf of your service provider where permitted by applicable law. This does not change your service provider. Please refer to the Electronic Communications Disclaimers for further information.

This information has been prepared and issued by BofAS and/or one or more of its non-US affiliates. The author(s) of this information may not be licensed to carry on regulated activities in your jurisdiction and, if not licensed, do not hold themselves out as being able to do so. BofAS and/or MLPF&S is the distributor of this information in the US and accepts full responsibility for information distributed to BofAS and/or MLPF&S clients in the US by its non-US affiliates. Any US person receiving this information and wishing to effect any transaction in any security discussed herein should do so through BofAS and/or MLPF&S and not such foreign affiliates. Hong Kong recipients of this information should contact Merrill Lynch (Asia Pacific) Limited in respect of any matters relating to dealing in securities or provision of specific advice on securities or any other matters arising from, or in connection with, this information. Singapore recipients of this information should contact Merrill Lynch (Singapore) Pte Ltd in respect of any matters arising from, or in connection with, this information. For clients that are not accredited investors, expert investors or institutional investors Merrill Lynch (Singapore) Pte Ltd accepts full responsibility for the contents of this information distributed to such clients in Singapore.

General Investment Related Disclosures:

Taiwan Readers: Neither the information nor any opinion expressed herein constitutes an offer or a solicitation of an offer to transact in any securities or other financial instrument. No part of this report may be used or reproduced or quoted in any manner whatsoever in Taiwan by the press or any other person without the express written consent of BofA Securities.

This document provides general information only, and has been prepared for, and is intended for general distribution to, BofA Securities clients. Neither the information nor any opinion expressed constitutes an offer or an invitation to make an offer, to buy or sell any securities or other financial instrument or any derivative related to such securities or instruments (e.g., options, futures, warrants, and contracts for differences). This document is not intended to provide personal investment advice and it does not take into account the specific investment objectives, financial situation and the particular needs of, and is not directed to, any specific person(s). This document and its content do not constitute, and should not be considered to constitute, investment advice for purposes of ERISA, the US tax code, the Investment Advisers Act or otherwise. Investors should seek financial advice regarding the appropriateness of investing in financial instruments and implementing investment strategies discussed or recommended in this document and should understand that statements regarding future prospects may not be realized. Any decision to purchase or subscribe for securities in any offering must be based solely on existing public information on such security or the information in the prospectus or other offering document issued in connection with such offering, and not on this document.

Securities and other financial instruments referred to herein, or recommended, offered or sold by BofA Securities, are not insured by the Federal Deposit Insurance Corporation and are not deposits or other obligations of any insured depository institution (including, Bank of America, N.A.). Investments in general and, derivatives, in particular, involve numerous risks, including, among others, market risk, counterparty default risk and liquidity risk. No security, financial instrument or derivative is suitable for all investors. Digital assets are extremely speculative, volatile and are largely unregulated. In some cases, securities and other financial instruments may be difficult to value or sell and reliable information about the value or risks related to the security or financial instrument may be difficult to obtain. Investors should note that income from such securities and other financial instruments, if any, may fluctuate and that price or value of such securities and instruments may rise or fall and, in some cases, investors may lose their entire principal investment. Past performance is not necessarily a guide to future performance. Levels and basis for taxation may change.

Digital assets, including cryptocurrencies and digital tokens, are a new technological innovation and are extremely speculative assets. Digital assets are volatile, have variable liquidity and may be subject to manipulation or fraud. Digital asset markets are relatively nascent and are not regulated in a manner similar to U.S. securities markets. Digital assets do not have a standardized exchange, like a stock market. Any future regulatory developments could limit or affect the viability of digital assets.

This report may contain a short-term trading idea or recommendation, which highlights a specific near-term catalyst or event impacting the issuer or the market that is anticipated to have a short-term price impact on the equity securities of the issuer. Short-term trading ideas and recommendations are different from and do not affect a stock's fundamental equity rating, which reflects both a longer term total return expectation and attractiveness for investment relative to other stocks within its Coverage Cluster. Short-term trading ideas and recommendations may be more or less positive than a stock's fundamental equity rating.

BofA Securities is aware that the implementation of the ideas expressed in this report may depend upon an investor's ability to "short" securities or other financial instruments and that such action may be limited by regulations prohibiting or restricting "shortselling" in many jurisdictions. Investors are urged to seek advice regarding the applicability of such regulations prior to executing any short idea contained in this report.

Foreign currency rates of exchange may adversely affect the value, price or income of any security or financial instrument mentioned herein. Investors in such securities and instruments, including ADRs, effectively assume currency risk.

BofAS or one of its affiliates is a regular issuer of traded financial instruments linked to securities that may have been recommended in this report. BofAS or one of its affiliates may, at any time, hold a trading position (long or short) in the securities and financial instruments discussed in this report.

BofA Securities, through business units other than BofA Global Research, may have issued and may in the future issue trading ideas or recommendations that are inconsistent with, and reach different conclusions from, the information presented herein. Such ideas or recommendations may reflect different time frames, assumptions, views and analytical methods of the persons who prepared them, and BofA Securities is under no obligation to ensure that such other trading ideas or recommendations are brought to the attention of any recipient of this information.

In the event that the recipient received this information pursuant to a contract between the recipient and BofAS for the provision of research services for a separate fee, and in connection therewith BofAS may be deemed to be acting as an investment adviser, such status relates, if at all, solely to the person with whom BofAS has contracted directly and does not extend beyond the delivery of this report (unless otherwise agreed specifically in writing by BofAS). If such recipient uses the services of BofAS in connection with the sale or purchase of a security referred to herein, BofAS may act as principal for its own account or as agent for another person. BofAS is and continues to act solely as a broker-dealer in connection with the execution of any transactions, including transactions in any securities referred to herein.

BofA ESGMeter Methodology:

ESGMeter is a proprietary metric based on quantitative analysis and fundamental analyst inputs that reflects our assessment of a company's Environmental, Social and Governance-related attributes. The ESGMeter is intended to indicate a company's likelihood of experiencing stronger financial stability (higher return on equity and lower earnings and price volatility) over the next three years relative to peer group. There are three ESGMeter levels - Low, Medium, and High - which indicate whether a company has attributes most likely to translate into superior financial stability (in the case of a High level) or weaker financial stability (in the case of a Low level) over the next three years relative to its peer group. A Medium level suggests that a company exhibits ESG characteristics that are likely associated with financial stability results in line with its peer group over the next three years. Full details of our methodology, financial stability definition and disclaimers are available at BofA ESGMeter methodology. ESGMeter is not indicative of a company's future stock price performance and is not an investment recommendation or rating. ESGMeter is independent of the BofA Global Research fundamental equity analyst's investment rating, volatility risk rating, income rating or price objective for that company.

Copyright and General Information:

Materials prepared by BofA Global Research personnel are based on public information. Facts and views presented in this material have not been reviewed by, and may not reflect information known to, professionals in other business areas of BofA Securities, including investment banking personnel. BofA Securities has established information barriers between BofA Global Research and certain business groups. As a result, BofA Securities does not disclose certain client relationships with, or compensation received from, such issuers. To the extent this material discusses any legal proceeding or issues, it has not been prepared as nor is it intended to express any legal conclusion, opinion or advice. Investors should consult their own legal advisers as to issues of law relating to the subject matter of this material. BofA Global Research personnel's knowledge of legal proceedings in which any BofA Securities entity and/or its directors, officers and employees may be plaintiffs, defendants, co-defendants or co-plaintiffs with or involving issuers mentioned in this material is based on public information. Facts and views presented in this material that relate to any such proceedings have not been reviewed by, discussed with, and may not reflect information known to, professionals in other business areas of BofA Securities in connection with the legal proceedings or matters relevant to such proceedings.

This information has been prepared independently of any issuer of securities mentioned herein and not in connection with any proposed offering of securities or as agent of any issuer of any securities. None of BofAS any of its affiliates or their research analysts has any authority whatsoever to make any representation or warranty on behalf of the issuer(s). BofA Global Research policy prohibits research personnel from disclosing a recommendation, investment rating, or investment thesis for review by an issuer prior to the publication of a research report containing such rating, recommendation or investment thesis.

Any information relating to the tax status of financial instruments discussed herein is not intended to provide tax advice or to be used by anyone to provide tax advice. Investors are urged to seek tax advice based on their particular circumstances from an independent tax professional.

The information herein (other than disclosure information relating to BofA Securities and its affiliates) was obtained from various sources and we do not guarantee its accuracy. This information may contain links to third-party websites. BofA Securities is not responsible for the content of any third-party website or any linked content contained in a third-party website. Content contained on such third-party websites is not part of this information and is not incorporated by reference. The inclusion of a link does not imply any endorsement by or any affiliation with BofA Securities. Access to any third-party website is at your own risk, and you should always review the terms and privacy policies at third-party websites before submitting any personal information to them. BofA Securities is not responsible for such terms and privacy policies and expressly disclaims any liability for them.

All opinions, projections and estimates constitute the judgment of the author as of the date of publication and are subject to change without notice. Prices also are subject to change without notice. BofA Securities is under no obligation to update this information and BofA Securities ability to publish information on the subject issuer(s) in the future is subject to applicable quiet periods. You should therefore assume that BofA Securities will not update any fact, circumstance or opinion contained herein.

Subject to the quiet period applicable under laws of the various jurisdictions in which we distribute research reports and other legal and BofA Securities policy-related restrictions on the publication of research reports, fundamental equity reports are produced on a regular basis as necessary to keep the investment recommendation current.

Certain outstanding reports or investment opinions relating to securities, financial instruments and/or issuers may no longer be current. Always refer to the most recent research report relating to an issuer prior to making an investment decision.

In some cases, an issuer may be classified as Restricted or may be Under Review or Extended Review. In each case, investors should consider any investment opinion relating to such issuer (or its security and/or financial instruments) to be suspended or withdrawn and should not rely on the analyses and investment opinion(s) pertaining to such issuer (or its securities and/or financial instruments) nor should the analyses or opinion(s) be considered a solicitation of any kind. Sales persons and financial advisors affiliated with BofAS or any of its affiliates may not solicit purchases of securities or financial instruments that are Restricted or Under Review and may only solicit securities under Extended Review in accordance with firm policies.

Neither BofA Securities nor any officer or employee of BofA Securities accepts any liability whatsoever for any direct, indirect or consequential damages or losses arising from any use of this information.