Technology Report 2022

Tech Companies Eat Disruption for Breakfast

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Acknowledgments

Contents

Disruption in the DNA

Buffeted by external factors, technology remains resilient and critically important.

By David Crawford

Welcome to Bain's third annual Global Technology Report.

A lot can happen in a year. Traditionally in tech, value is determined by innovation and revenue growth. This year, macroeconomic and geopolitical factors have played an outsized role. When we wrote our last report, technology stocks were still on a meteoric rise. Today the sector has been hit hard *(see Figure 1)*.

Still, CIOs and CTOs are increasing their technology spending *(see Figure 2)*. Of course, there may be budget pressure in the future, but over the long term, to them—and to us—tech is not so much a cost as an investment that spurs productivity.

Turbulence and disruption are in this sector's DNA, and often give rise to fresh advances. However rocky the next year may be, technology will continue to play a central role in the global economy, helping to shape how companies create sustained value.

David Crawford
Leader of Bain's Global Technology Practice

Technology Report 2022

Figure 1: High-growth companies have been hit hardest by the recent market shift

Public market valuation multiple
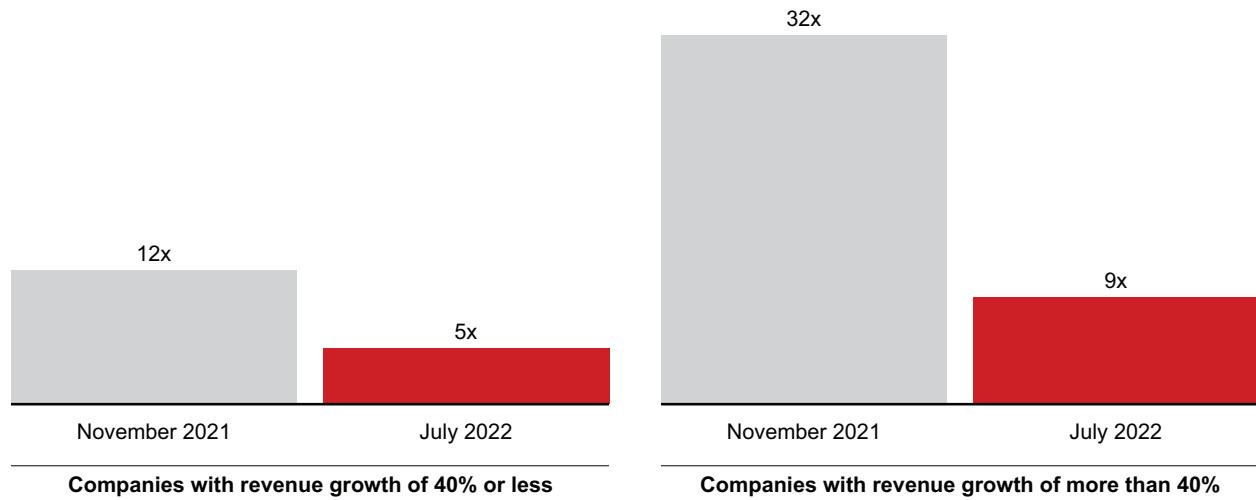
Notes: Public market valuation multiple is calculated by dividing total enterprise value by next-12-month revenue for Internet services and infrastructure companies and software companies with more than $50 million in revenue over the last 12 months; revenue growth based on July 2022 last 12 months/ next 12 months; excludes companies with incomplete data
Sources: S&P Capital IQ; Bain analysis

Figure 2: Despite the drop, companies expect to continue investing in IT

Percentage who expect IT budget to increase or stay the same
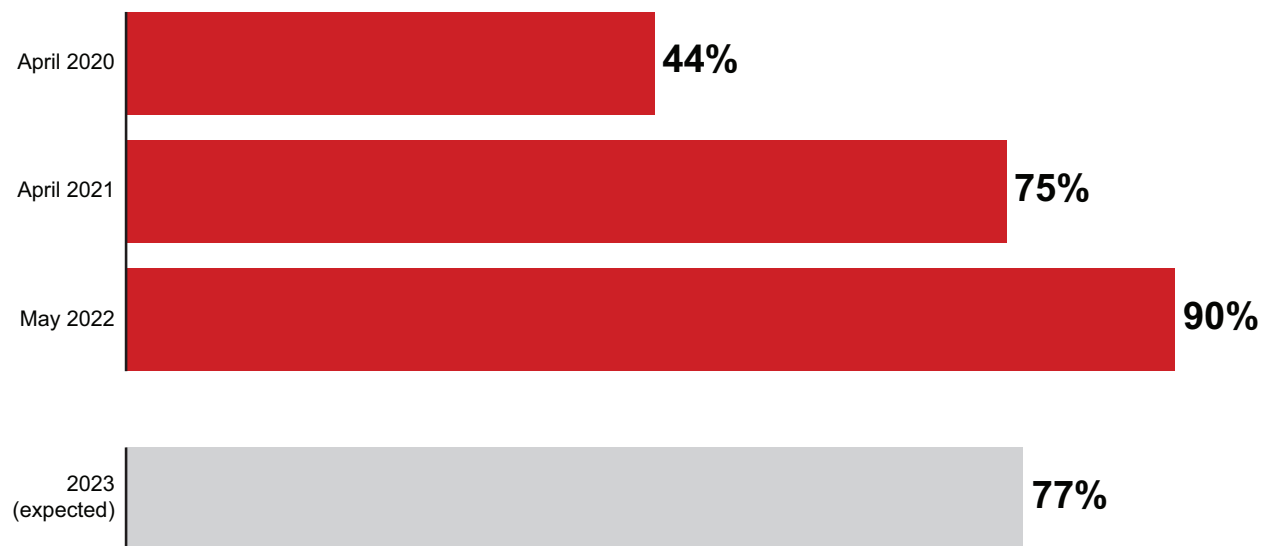
Note: 2023 forecast was made in July 2022
Source: Bain surveys (n=210, April 25, 2020; n=188, April 26, 2021; n=179, May 20, 2022; n=187, July 19, 2022)
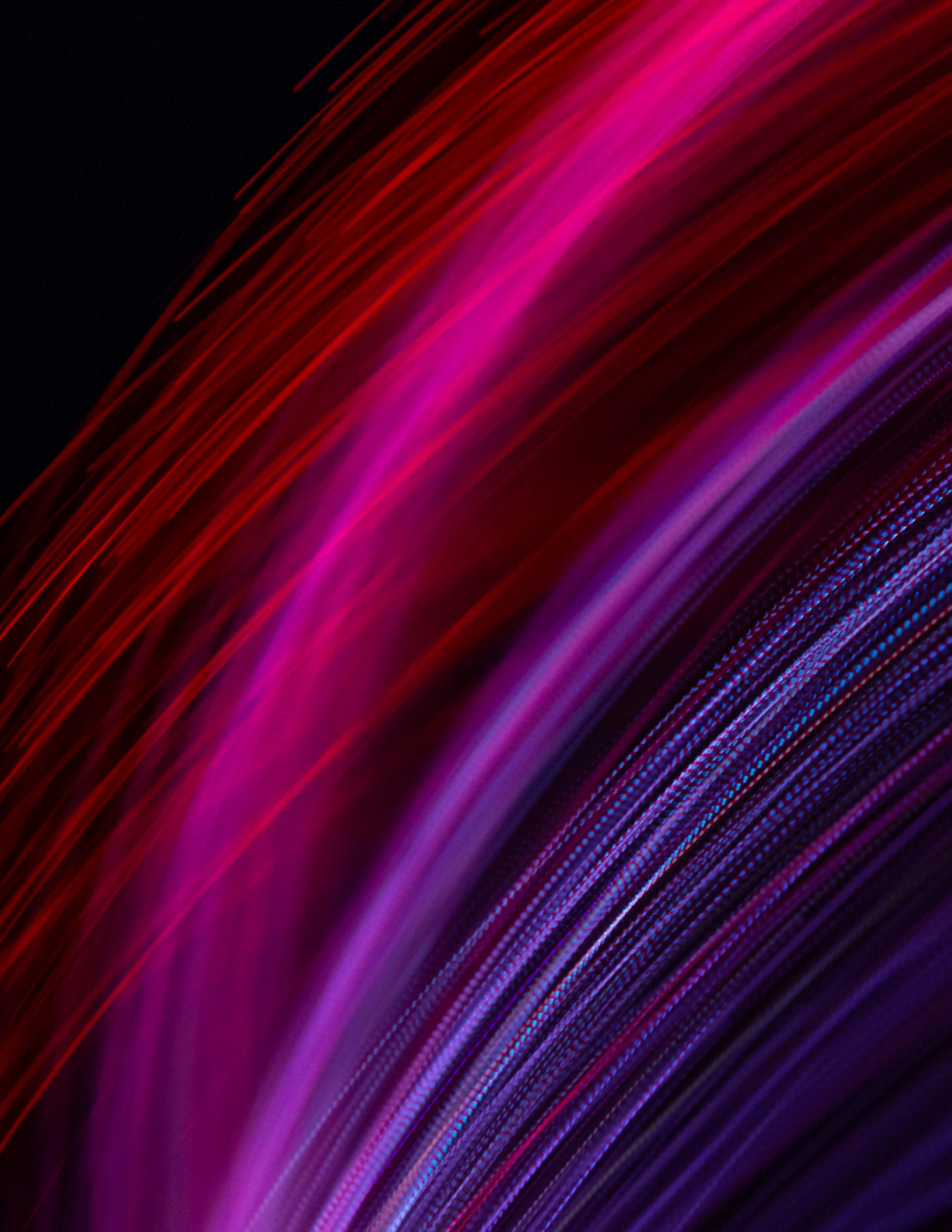
Value Evolution

Don't Count Out Growth Equity Investors

This class of tech investors has been battered by the market downturn, but their approach has permanently changed the financing of fast-growth innovation.

By Christian Buecker, Greg Fiore, Dunigan O'Keeffe, and Sean Tanaka

At a Glance

▸ In recent years, tech innovators backed by growth equity investors have grown rapidly to valuations of $1 billion or more.

▸ The underlying technological and business model innovation that made this possible remain sound.

▸ But the market shock of 2022 has clear ramifications—and offers new opportunities—to stars, fallen angels, and savvy tech incumbents.

In the last decade, technology companies like Airbnb, Snowflake, Stripe, and Crowdstrike led a wave of disruption that reordered established industries and invented whole new ones. Along the way, they created astonishing value. In June, the number of private billion-dollar start-ups exceeded 1,100, according to data from CB Insights, a more than tripling in five years of these once-rare unicorns. As a group, they reached a value of roughly $4 trillion to $5 trillion before the recent market correction, according to CB Insights and Crunchbase.

This explosion has been backed by a new wave of growth equity investors. While many traditional venture capitalists narrowed their focus to early-stage companies that have not yet achieved product

market fit, the funding of a new class of investors pioneering a different model of investment grew significantly *(see Figure 1)*. These growth equity investors deploy large amounts of capital—often exceeding $100 million in a single funding round—to help relatively mature companies pursue breakthrough innovation and scale at an unprecedented pace. They often double down in later fund-raising rounds, positioning themselves as long-term investors by holding their stakes through the initial public offering (IPO) and beyond. As a result, newly minted growth specialist funds, hedge funds, refocused VC firms, and other growth equity investors have become the financial partner of choice for many fast-growth companies.

Thanks to this new model, in recent years capital ceased to be a limiting factor for a private company's quick scaling. Some 30% of companies that went public in 2020 had raised more than $100 million before their IPO, compared with 7% in 2015. This made it possible for Space X (valued at approximately $125 billion) and Shein (at approximately $100 billion) to grow to huge valuations while still private and helped Uber's IPO reach $70 billion-plus and Kuaishou Technology's debut in the range of $150 billion to $160 billion. Once public, growth-backed software companies continued to perform. Among software companies, growth equity-backed tech companies account for only 8% of revenue, but 19% of growth, 14% of sales and marketing spending, and 13% of research and development spending.

Growth equity's first big test came in 2022. By May, as interest rates hit high-growth stocks and the IPO markets, the cumulative market capitalization of the fastest-growing software-as-a-service (SaaS)

Figure 1: In technology, growth equity has increased faster than all other investment segments

Investment in technology, by investment segment ($B)

Growth equity's share grew to 27% in 2021 from 19% in 2017

Venture   Growth equity   Buyout   Public
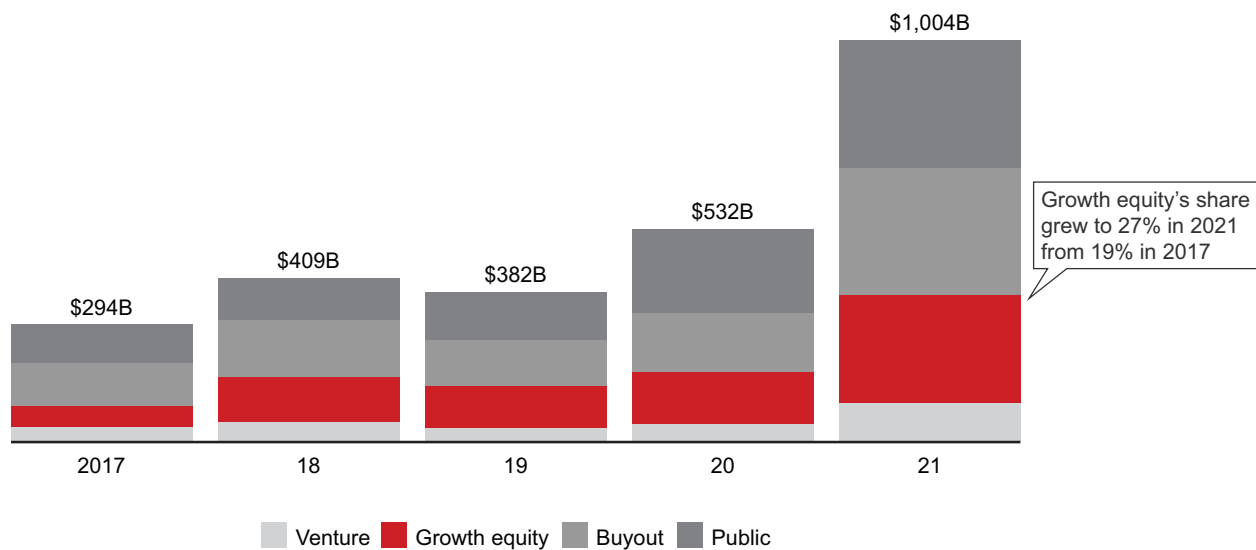
Notes: Growth equity investments include growth, expansion, and late-stage venture capital deals; 2022 data as of May 26
Sources: S&P Capital IQ; Pitchbook; Dealogic

stocks had fallen almost 70%, according to Meritech. Tech IPO volume in the first half of 2022 fell 80% from the same period a year earlier. The number of late-stage financing rounds collapsed. High-profile investors began to speak of black swans and tough times ahead. Companies that once couldn't hire fast enough started letting people go. Today, both Kuaishou and Uber trade well below their offering price.

Was this the growth equity bubble bursting?

That's an understandable question given the 2022 crash in valuations for high-growth assets, but growth equity has fundamentally altered tech investing over the last decade, and there is a strong argument that the underlying changes that led to the creation of the asset class remain sound—as technical innovation will continue to create opportunities for fast-scaling companies.

Technological innovation

Innovative technology will continue to help build and scale disruptive businesses. Cloud computing puts highly scalable data centers and advanced capabilities at the fingertips of fledgling companies. Cloud-native companies like Snowflake, Databricks, and GitLab catapulted to success with tools for cloud data analytics, artificial intelligence, and DevOps. Their technology's modularity, the way applications communicate via API-based architectures, has built an ecosystem of complementary solutions that collectively compete against the monoliths. And the next generation is waiting in the wings—nascent technologies like the Internet of Things, quantum computing, artificial intelligence, virtual reality, autonomy, new space, and web3. Not all will succeed, but the ones that do will become the next generation of growth equity-backed leaders—using massive amount of capital to scale rapidly into massive markets.

Innovative technology will continue to help build and scale disruptive businesses.

Business model innovation

Business model innovation has changed how technology is bought and sold. SaaS customers no longer have to install and operate technology purchases themselves. Thanks to open-source, freemium, and product-led growth models, today's frontline users can both try and buy technology. Other business model innovations have lowered the barriers to entry in industries previously considered immune to tech disruption, including financial services, healthcare, and even space, in the process creating a well-understood playbook and an ecosystem of executives and investors experienced in running and investing based on it.

This flywheel of disruption is accelerating as innovations combine to create more innovation, a concept called recombinatory innovation. Think of how GPS, cell phones, and digital maps together created real-time navigation. Even in a world where geopolitical tensions increasingly affect the technology industry, innovation today remains a global market, nurturing a rich worldwide competition of ideas.

Steps to take now

While the new model of innovation has already spread strong roots, the market shock of 2022 will have ramifications. Once-rising stars will have to focus sooner on unit economics and a path to profitability. Fallen angels that haven't lived up to expectations would benefit from thinking like a private equity investor: What costs, products, or customer segments would they cut? What assets would they sell in order to concentrate on the core?

Incumbent tech leaders have a unique opportunity to fundamentally rethink corporate innovation patterns, and, after doing their homework, aggressively pursue mergers and acquisitions (M&A), partnerships with innovators, and talent acquisition. Three steps are paramount.

1. **Develop the skills to sense disruption.** No industry or company is safe from disruption. Invest in customer relationships and deeply understand their needs. Ensure your customer and competitive intelligence is up to the task of monitoring the landscape and informing your strategy. Assess where you can partner and integrate with the next generation of companies, including the use of corporate venture capital as a means to better understand, partner with, and cultivate the ecosystem.

2. **Commit to major investments.** Most companies will need to become tech-native. That may require new organizational structures, talent, culture, and budgeting. Rationalize your innovation bets by focusing resources where you can win and cutting subscale, half-hearted efforts. Reevaluate your M&A strategy for an environment in which buying the winners will remain difficult due to growth equity-backed valuations and founders who see selling to a big corporation as less attractive.

3. **Get good at scaling.** An incumbent may never be as innovative as a founder able to raise $100 million, but it does have valuable assets a disrupter may lack: business ecosystems, customers, and often a strong core business. Established companies that figure out how to unlock untapped potential in those assets and scale them can borrow a page from the unicorns and set themselves on a whole new growth trajectory.

Savvy incumbents can compete with growth equity-backed success stories. Google Cloud's sustained investment and innovation in analytics has enabled BigQuery to go toe-to-toe with Snowflake, for example. And Dynatrace incubated Ruxit, a cloud-native observability tool under the Compuware banner that is now its core product, helping it compete with growth equity-backed Datadog.

Whether as direct competitors, complementary partners, or acquirers, companies are smart to operate on the principle that growth equity-backed business innovation is here to stay.

Value Evolution

How to Compete and Win in the Multicloud World

After a crash in valuations, multicloud infrastructure software vendors (ISVs) and "hyperscaler" cloud service providers battle for the cloud software market, each bringing unique strengths.

By Matthew Crupi, Mark Brinda, Morgan Maxwell, and Bill Radzevych

At a Glance

▶ The multicloud software market has grown tremendously in recent years, but not all companies can survive.

▶ Three factors will determine an ISV's likelihood to succeed in a given market: whether customers will pay for premium functionality, whether they want to avoid locking into walled gardens, and whether hyperscalers' benefits of scale provide a unique advantage.

After the valuations of multicloud infrastructure software vendors shot into the stratosphere over the past three years only to start crashing down to earth in late 2021, investors and enterprise customers are left wondering, who will survive and thrive?

It's one of the most consequential questions in technology right now, because it has significant bearing on who will win the cloud software market: multicloud infrastructure software vendors (ISVs), hyperscaler cloud service providers, or on-premise originators (see definitions of these three groups in "Cloud Software Competitors" on page 13.)

Multicloud ISVs' rapid growth in value indicated an expectation of transformative market penetration and massive revenue growth over the next few years. Indeed, revenue growth of top multicloud

ISVs has exceeded that of both hyperscalers and on-premise originators, increasing by a median of 44% from 2019 to 2020 and 50% from 2020 to 2021 *(see Figure 1)*. Their market valuations increased by a median of 157% from 2019 to 2020 and 25% from 2020 to 2021. Some ISVs enjoyed valuations 50 times higher than their annual revenue, more than triple the average software multiple.

It wasn't sustainable. As macroeconomic challenges dragged down the stock market overall, multicloud ISV valuations declined even more steeply, even as their revenue growth often exceeded expectations. In time, it will become clear whether this is an overcorrection or a reset that better reflects intrinsic value. However that plays out, it's increasingly clear that the competition between multicloud ISVs and hyperscalers will determine the future of the cloud software market. As investors and enterprises evaluate their cloud strategies, here's our guide to what will determine the winners.

Three swing factors

The strength of a multicloud ISV's advantage in a segment hinges on three characteristics.

- Customers' willingness to pay a premium for best-of-breed solutions. Multicloud ISVs have an opening to differentiate themselves in parts of the cloud stack located further from hyperscalers' core offerings. Customers already choose ISVs when they need best-in-class technology, and for certain key purchase criteria *(see Figure 2)*.

Figure 1: Infrastructure software vendors grew quickly and were highly valued through 2021, but they've been hit hard this year

Median revenue growth among top ISVs, on-premise originators, and hyperscalers

Median change in market capitalization among top ISVs and on-premise originators

ISV   On-premise   Hyperscaler
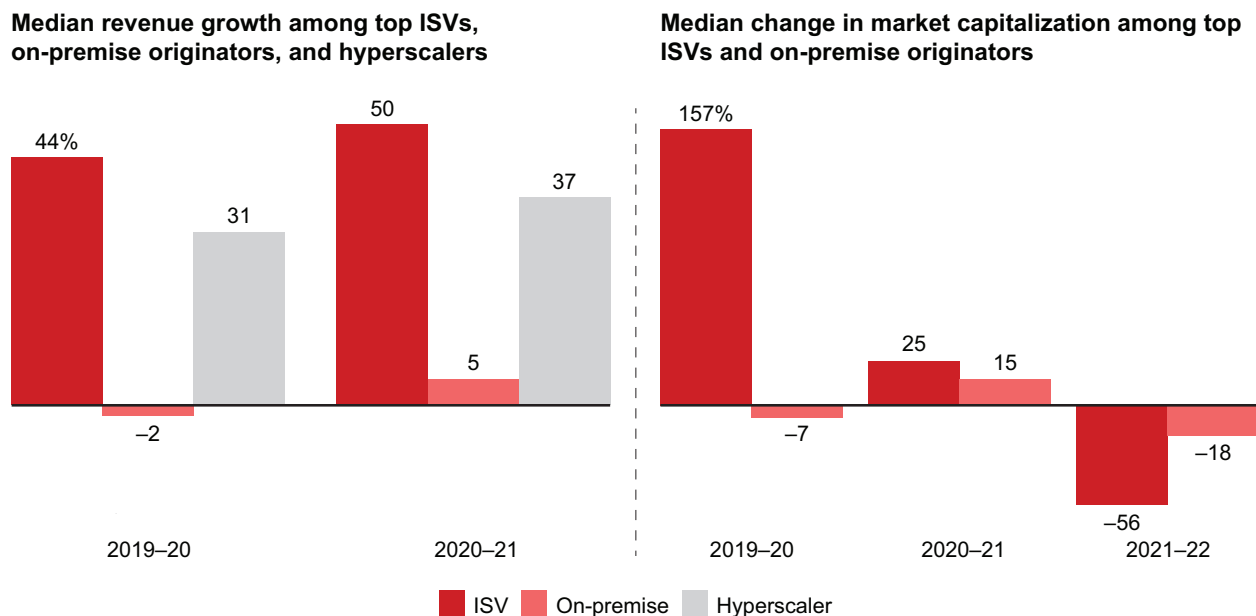
Notes: Market cap as of 12/31/19, 12/31/20, 12/31/21, and 5/12/22; for private companies, valuations based on latest publicly announced funding round; hyperscalers aren't included in market cap analysis
Sources: S&P Capital IQ; Pitchbook; Barclays analyst reports; Bain & Company

Figure 2: Customers choose ISVs for high-quality technology, and hyperscalers for reliability, integration with existing IT, and cost

Percentage of new customers who cite this reason for choosing hyperscalers or infrastructure software vendors
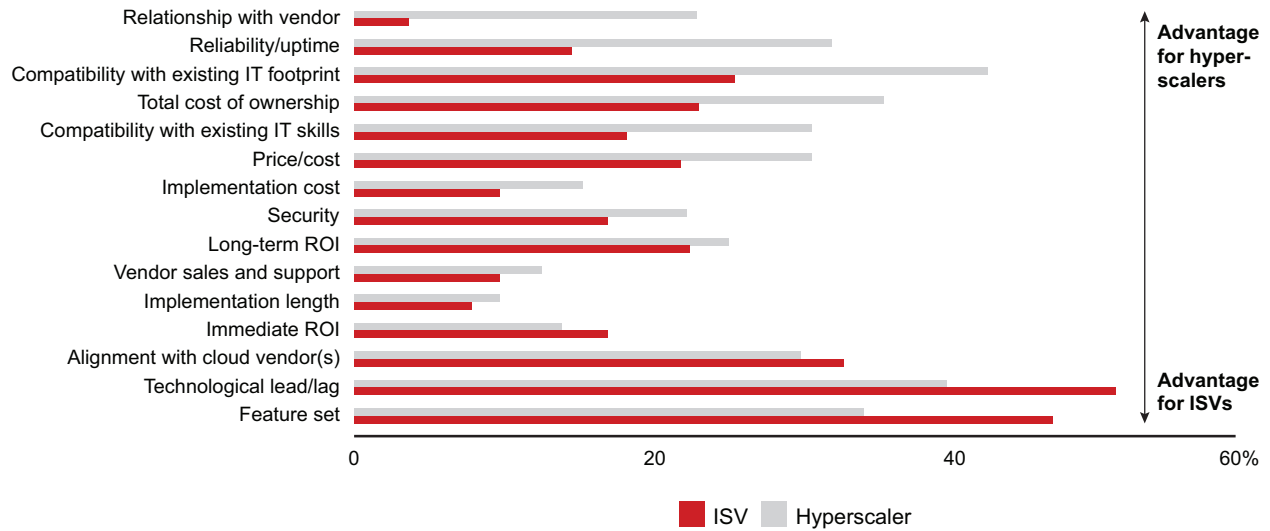
Note: Survey consists of respondents who reported plans to adopt a new hyperscaler or ISV in 2021 for database/data warehouse, container platform, infrastructure software, or analytics/ business intelligence/ big data solutions
Source: ETR TSIS survey, January 2021

- Strong customer preference for cloud infrastructure flexibility. Multicloud ISV solutions that work consistently across computing environments are well suited to buyers that want to avoid vendor lock-in and simplify their multicloud or hybrid environments.

- Relatively limited benefit from scale. ISVs are more likely to succeed when this key advantage of hyperscalers' platforms isn't critical.

The future of ISVs

These three swing factors help clarify when ISVs are better positioned to win, when they'll face fierce competition from hyperscalers, and when hyperscalers have the advantage.

- ISVs are in a good position to win when best-in-class technology and cloud infrastructure flexibility are paramount. Examples include cybersecurity and app monitoring. In cybersecurity, despite hyperscalers' moves to bolster their offerings (such as Google Cloud Platform's $5.4 billion Mandiant acquisition), multicloud ISVs will be formidable competition, well positioned on all three swing factors. Cloudflare, for example, has upped the game for web performance and security with its differentiated software architecture and innovation. The combination has powered the company beyond investor analysts' revenue growth expectations, more than tripling its total addressable market estimate from $32 billion in 2018 just before its 2019 IPO to over $100 billion.

Cloud Software Competitors

Three major categories of organizations are building out the cloud's infrastructure, middleware, and management software markets.

- **On-premise originators.** On-premise natives providing infrastructure and analytics, including hardware, software, and middleware layers of the technology stack. Examples with on-premise roots include VMware, a virtualization company that has moved from on-premise to multicloud, and Teradata, which now offers software subscriptions in the cloud in place of an on-premise, hardware-centric product portfolio.

- **Multicloud infrastructure software vendors (ISVs).** Cloud-native, hybrid-native (combining on-premise systems with cloud), or open-source software-as-a-service (SaaS) companies offering solutions that integrate with the hyperscalers' cloud infrastructure. Examples include Datadog, Snowflake, and Twilio.

- **Hyperscalers.** The largest cloud service providers that have built a growing portfolio of services running on top of their own platforms. Examples include Amazon Web Services, Microsoft Azure, and Google Cloud. These services either compete with or complement solutions from the multicloud ISVs.

- ISVs and hyperscalers will engage in fierce competition when best-in-breed technology may be beneficial but not necessary. Examples include data warehousing and database management. In data warehousing, we believe multicloud ISVs can continue carving out leading positions in the market, but doing so will require overcoming strong hyperscaler presence and investment, as well as managing the complex relationship between ISVs and hyperscalers in those market segments where they both compete and partner. Snowflake has enjoyed a spectacular rise, including the largest software IPO at that point in history. Similarly, Databricks has demonstrated exceptional strength, reaching $800 million in annual recurring revenue in 2021, 80% more than in 2020.

- Hyperscalers could capture the majority of profit pools when they have a distinct technological edge, a significant lead in the market, or an overwhelming advantage from scale. This may include areas within artificial intelligence (AI) and machine learning (ML), such as AI developer frameworks or vision and natural language processing. Hyperscalers get differentiated benefit of scale from training AI/ML solutions on large data sets and across multiple tools. In this segment, customers are already voting with their dollars, spending around 60% of their AI/ML budgets on hyperscalers' tools, compared with 25% on multicloud ISV solutions, according to a 2022 Bain survey. We still expect to see ISVs winning in areas of AI further from the hyperscaler core, however, including cases involving proprietary data or domain-specific functionality.

Implications for ISVs, hyperscalers, and on-premise originators

As the cloud services industry matures, multicloud ISVs should play a larger role in the market, but hyperscalers will maintain a strong competitive position, and on-premise originators have an opportunity to carve out their own valuable niche.

On-premise originators have two important strengths to draw upon: a large installed base of customers and well-known brand names. Rather than trying to beat hyperscalers, we expect more on-premise originators to form partnerships and invest in making their leading software offerings work seamlessly on top of hyperscalers' platforms.

Critical questions for on-premise originators to consider as they crystallize their strategies:

- What's the source of our competitive differentiation from hyperscalers and multicloud ISVs today? What will it be in the future?

- How can we partner with hyperscalers to keep customers from seeking a new solution?

Successful multicloud ISVs will disproportionately invest in products located further from the hyperscaler core that have hybrid or multicloud requirements and limited benefits from scale. By maintaining a focus on customer needs and delivering best-in-class solutions, they can continue to win. One wild card to watch is regulation. If regulators require more standardization and interoperability, that's likely to benefit multicloud ISVs.

Critical questions for multicloud ISV leadership teams:

- Do hyperscalers view our markets as must-win battlegrounds or as distant adjacency bets?

- In markets with attractive swing factors, how can we create maximum value?

The most effective hyperscalers will assess their portfolio of services to determine where their scale delivers a needle-moving competitive advantage and where best-of-breed players have the edge. As their service offerings expand from hundreds today to potentially thousands in the future, hyperscalers will need to effectively manage that complexity while remaining an easy-to-use one-stop shop for customers.

Critical questions for hyperscalers:

- Which priority areas of our core business should we invest in to ensure we stay ahead of the competition?

- In which limited number of critical adjacent software markets should we invest? How will these further differentiate us from other hyperscalers?

Web3 Could Rewrite the Rules of User Identity

A reimagined form of digital identity could disrupt some of today's largest tech platforms.

By Thomas Olsen, Gene Rapoport, Parker DeRensis, and Nihar Naik

At a Glance

▸ One of the emerging battlegrounds that will define future profit pools in web3 is the concept of identity.

▸ Many say web3 provides the opportunity to democratize the online experience, enable users to reclaim control of their data, and open the door to mass customization.

▸ Web3's use of wallets and other identity platforms could upend the traditional approach to online identity and asset storage.

Web3, the name for a group of technologies that make up the third generation of the Internet, has rapidly developed over the last several years. The ecosystem now boasts thousands of companies and more than $80 billion of start-up funding from venture capital, hedge funds, private equity, and other investors. Major companies across industries—JPMorgan, Nike, Google, and Disney among them—have begun to think about how web3 will influence their business and what benefits this new tech could unlock.

Though web3 is still nascent and some promised effects are likely overhyped, the technology could be transformative if even a fraction of the full potential is reached. The financial services

industry has experimented the most, creating applications including tokenized assets, payment systems, and settlement infrastructure. But as web3 matures, the core applications will sit squarely within the technology sector.

One of the emerging battlegrounds that will define future profit pools in web3 is the concept of identity. Identity is central to what many see as web3's greatest opportunity: the chance to democratize the online experience, enable users to reclaim control of their data, and open the door to mass customization of each user's experience. Web3's approach to identity will have important implications for many other technologies, such as artificial intelligence and machine learning, that will be needed to manage the proliferation and complexity of data required to serve and track customers. This potential can be realized only if effective, user-friendly ways are created to share only the right data in the right contexts.

As companies compete to shape the future of identity online, digital web3 wallets are expected to play a large role.

As companies compete to shape the future of identity online, digital web3 wallets are expected to play a large role. These wallets act as unified bank accounts and digital passports that have the potential to change how users connect with applications by offering universal sign-in capabilities. What used to be a website-specific log-in may soon just require choosing "connect wallet." Many of web3's proponents hope that this new approach will enable users to directly own and control more of their data and digital goods.

Web3 key concepts

Given how new web3 is, we'll start with some of the basics about this collection of technologies seeking to create a more decentralized and composable Internet.

The foundational building blocks of web3 are blockchains, smart contracts, and tokens (fungible and nonfungible). Blockchains are open and interconnected community-owned databases and computing platforms. With the invention of Ethereum in 2014, blockchains became decentralized computing resources capable of executing lines of code, called smart contracts, when certain criteria are met. Finally, tokens, whether fungible, digitally native money or nonfungible—meaning unique to a specific asset—allow for the digital representation of value. Taken together, these building blocks inform web3's approach to open, decentralized, and public infrastructure. This approach unlocks the power of composability and allows for "compounding software development," just like open source software does. From these building blocks come many core web3 applications, including decentralized applications, DeFi (decentralized finance), open digital wallets, tokens, decentralized autonomous organizations (DAOs), and open metaverses *(see Figure 1)*.

Figure 1: Web3 comprises a combination of new concepts and tools

Infrastructure and building blocks

Blockchains

Open and interconnected community-owned databases and computing platforms

Smart contracts

Programs enabling automation and execution of software on a decentralized computing platform

Cryptocurrencies
(digitally native money)

Means to transfer value natively within digital ecosystem

NFTs
(nonfungible tokens)

Blockchain-based, tokenized records that guarantee the unique identification of a digital asset

Applications of that infrastructure

Decentralized apps

Applications built on open networks enabling financial, social, and other activities

DeFi
(decentralized finance)

Financial platforms that run entirely on code using smart contracts on a blockchain

(Open) Digital wallets

Online "passport" that combines aspects of identity, access, and ownership for the user

DAOs
(decentralized autonomous organizations)

Member-owned communities with a shared bank account

Tokenization of real world assets

Digital, universal representation of assets such as property, gold, and art

Open metaverse

Digital space where users can live, interact, and explore

Sources: Bain & Company; Andreessen Horowitz

While web3 and the metaverse are distinct concepts with a wide range of related technologies, web3 principles can be embedded in metaverse design *(see Figure 2)*. Familiar web3 products include decentralized exchanges like Uniswap, digital dollars like Circle's USDC, and OpenSea's nonfungible token (NFT) market. Games like Roblox or platforms like Meta's Horizon Worlds are well-known virtual worlds. Where the two concepts overlap sit "open metaverses," like The Sandbox or Otherside, that are built on web3 concepts, distinguishing them from metaverses that aren't always web3-enabled and may be closed or based on more traditional infrastructure. Identity plays a critical role wherever a metaverse is at least partly open. Consistent personhood and asset transferability limit friction for the users; if a virtual skin exists in one place, you'll want to be able to use it in another metaverse.

Growth of web3

What started in Internet forums and white papers has turned into a full-fledged ecosystem over the last decade. Bain's web3 and digital asset database tracks more than 4,000 firms that cumulatively raised over $80 billion through June 2022 in the many segments of web3 *(see Figure 3)*.

While the web3 investment landscape has undoubtedly changed over the last several months due to market volatility, momentum continues across industries, with many companies publicly acknowledging new efforts, such as Meta, Visa, Fidelity, Google, Mercado Libre, and Breitling.

Figure 2: Web3 and the metaverse are distinct concepts characterized by a range of related technologies, though web3 principles can be embedded in metaverse design

Blockchains

Smart contracts

(Open) Digital wallets

Tokens

Digitally native money

Decentralized apps

Web3
(Ethereum, Uniswap, OpenSea, etc.)

Closed metaverses and virtual worlds
(Fortnite, Roblox, Minecraft, etc.)

Web3-enabled metaverses and virtual worlds
(The Sandbox, etc.)

Internal database

Back-end software

User profiles

Digital assets

Apps

App store
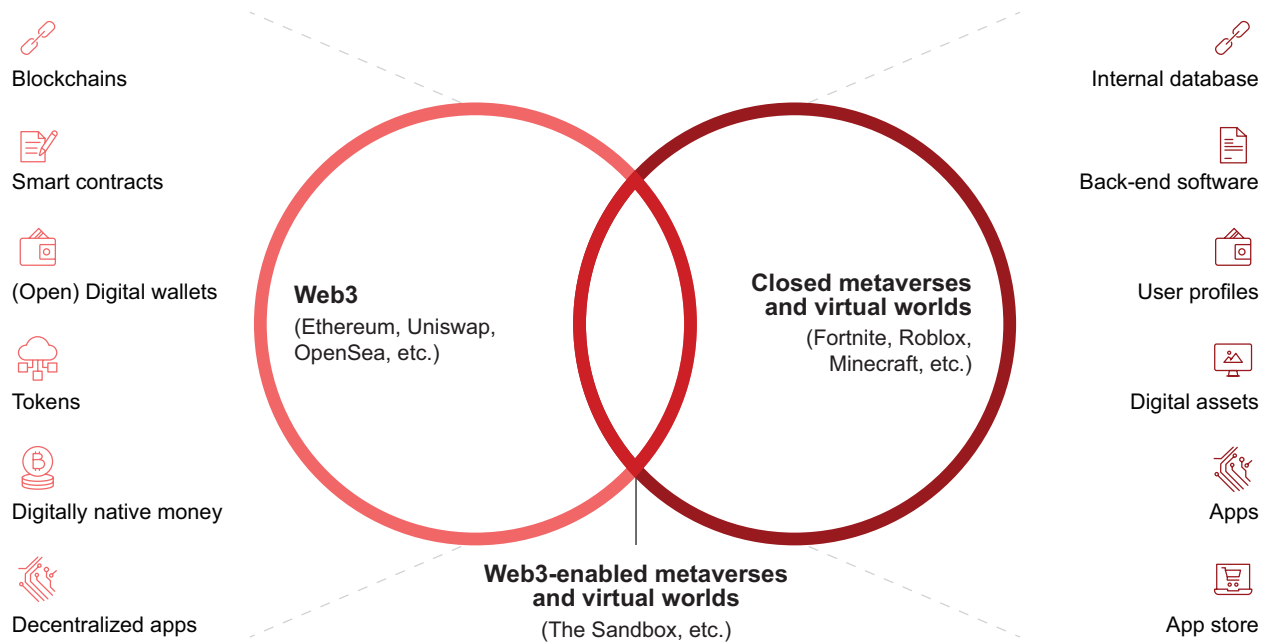
Source: Bain & Company

Figure 3a: Financial market infrastructure providers have attracted the biggest share of web3 company funding to date

Total disclosed funding received by companies in database, by primary segment ($B)

$10B	$7B	$8B	$48B	$14B
Blockchains and platforms	Core infra-structure	Developer tools and web3 infrastructure	Web3 financial market infrastructure	User applications and systems

Number of companies	383	153	835	1,851	1,150
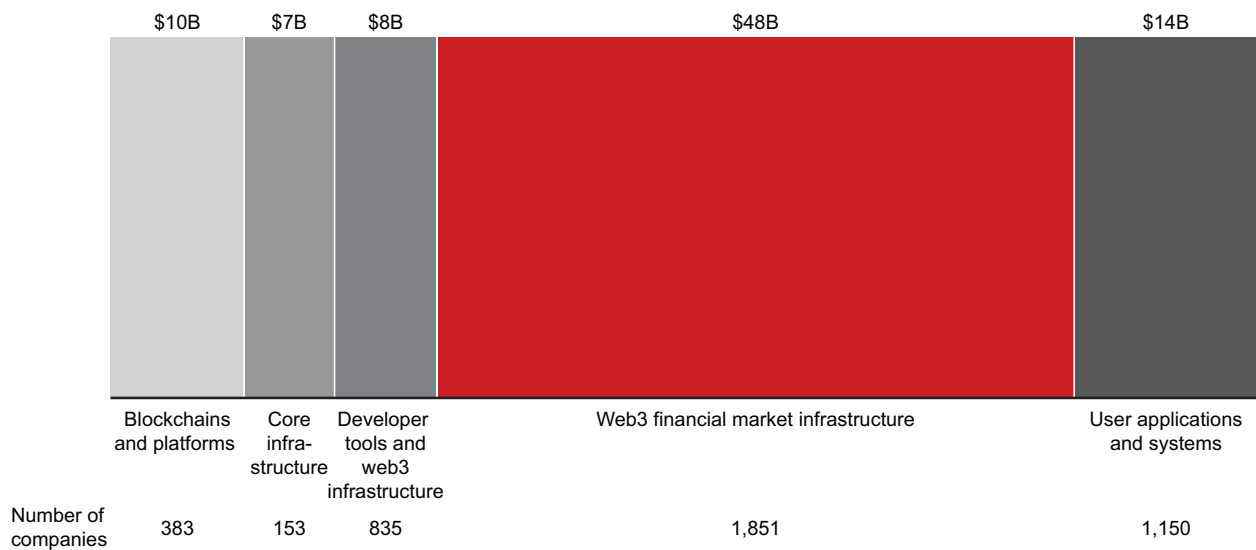
Notes: Funding as of June 2022; equity investments only; based on public disclosures
Sources: Crunchbase; The Block; Bain Crypto Database

Figure 3b: Blockchains and platforms have attracted about $10 billion of web3 company funding

Total disclosed funding received by companies in database, by subsegment

	$10B	$7B	$8B	$48B	$14B

Cross-chain bridges
Cryptocurrency
Service chains
General purpose protocols (Ethereum virtual machine)
Enterprise chains
Cross-chain protocols
Special purpose chains
Scaling and sidechains
General purpose protocols (non-EVM)

	Blockchains and platforms	Core infra-structure	Developer tools and web3 infrastructure	Web3 financial market infrastructure	User applications and systems
Number of companies	**383**	153	835	1,851	1,150
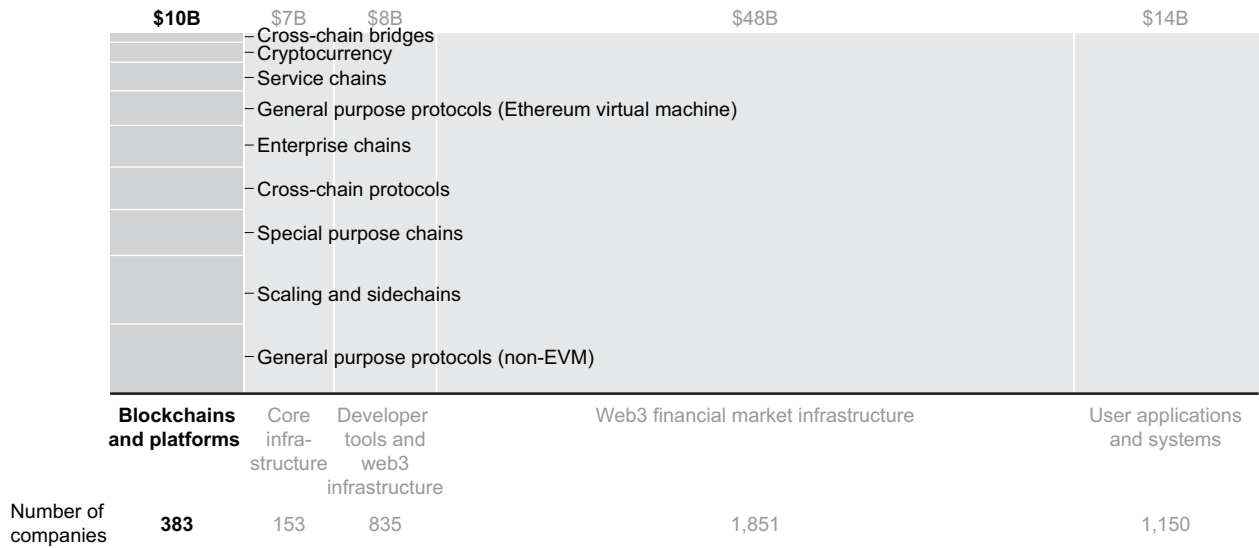
Sources: Crunchbase; The Block; Bain Crypto Database

Figure 3c: Core infrastructure has attracted about $7 billion of web3 company funding

Total disclosed funding received by companies in database, by subsegment

	$10B	**$7B**	$8B	$48B	$14B

Staking infrastructure
Mining service support and tools
Node infrastructure
Mining companies

	Blockchains and platforms	**Core infra-structure**	Developer tools and web3 infrastructure	Web3 financial market infrastructure	User applications and systems
Number of companies	383	**153**	835	1,851	1,150

Sources: Crunchbase; The Block; Bain Crypto Database

Figure 3d: Developer tools and web 3 infrastructure have attracted about $8 billion of all web3 company funding

Total disclosed funding received by companies in database, by subsegment

	$10B	$7B	**$8B**	$48B	$14B

Other
Nonfungible token infrastructure
Developing, testing, and releasing kits
Auditing and security
Identity kits
Social infrastructure and tools
Data analytics
Blockchain as a service
Minting tools
Tokenization infrastructure
Data management and storage
General infrastructure

	Blockchains and platforms	Core infra-structure	**Developer tools and web3 infrastructure**	Web3 financial market infrastructure	User applications and systems
Number of companies	383	153	**835**	1,851	1,150

Sources: Crunchbase; The Block; Bain Crypto Database

Figure 3e: Financial market infrastructure has attracted about $48 billion of web3 company funding

Total disclosed funding received by companies in database, by subsegment

	$10B	$7B	$8B	**$48B**	$14B

Other
Decentralized finance exchange
Compliance
Market making
Banking
Custody
Other DeFi
Payments and payment infrastructure
Wallets
Institutional brokers
Lending/credit
Retail brokers
Exchange

	Blockchains and platforms	Core infra-structure	Developer tools and web3 infrastructure	**Web3 financial market infrastructure**	User applications and systems
Number of companies	383	153	835	**1,851**	1,150
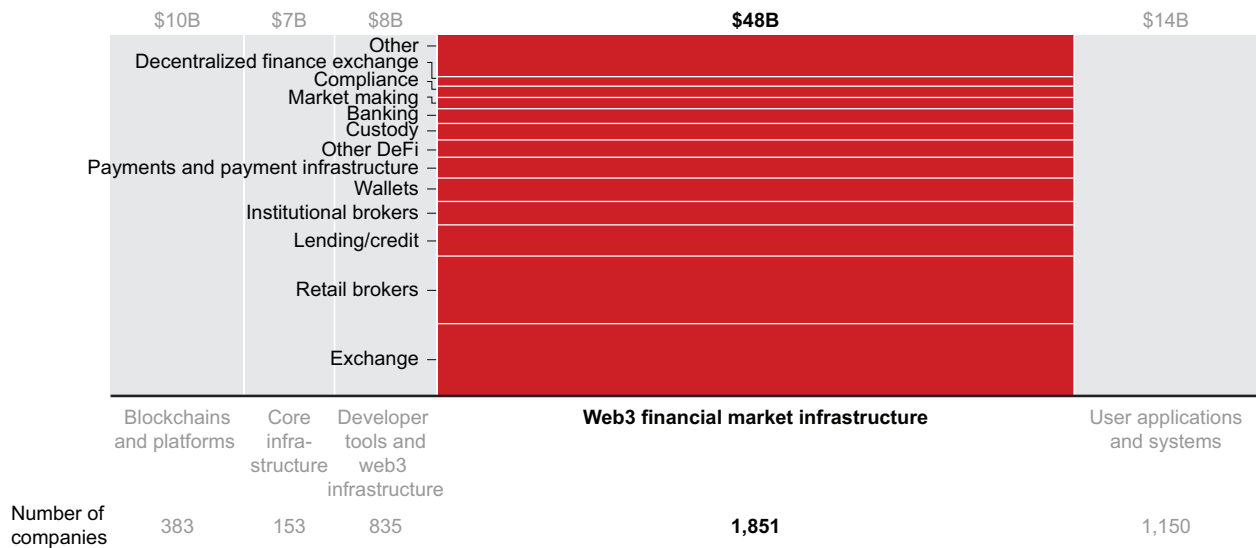
Sources: Crunchbase; The Block; Bain Crypto Database

Figure 3f: User applications and systems have attracted about $14 billion of web3 company funding

Total disclosed funding received by companies in database, by subsegment
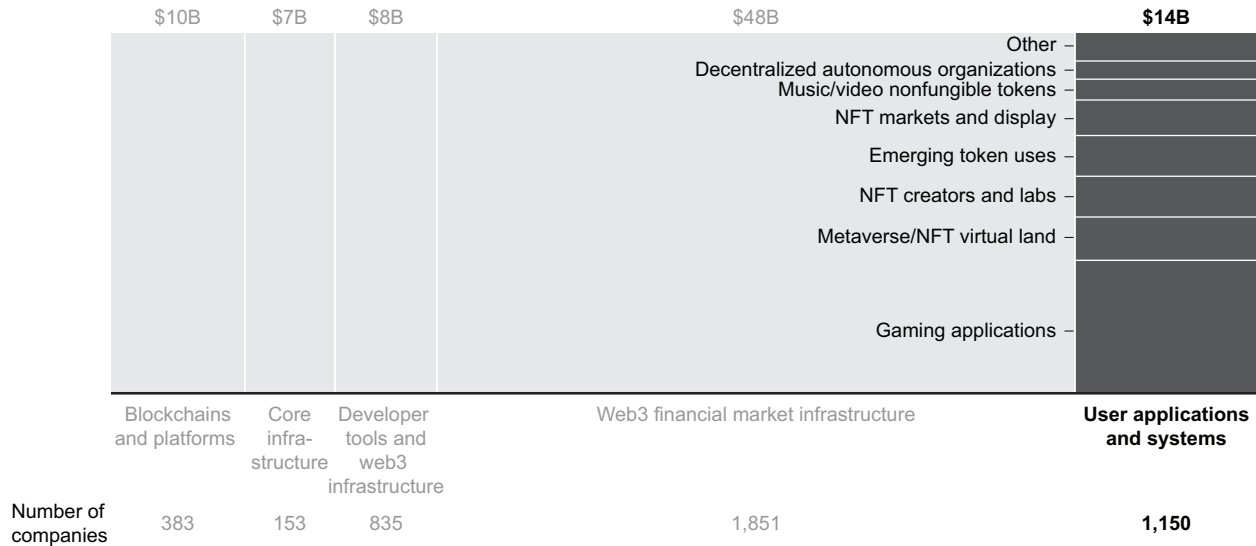
Sources: Crunchbase; The Block; Bain Crypto Database

The wallet and web3 identity

For some of the world's leading technology firms, web3's use of wallets and other identity platforms could potentially upend the traditional approach to online identity and asset storage. A wallet is a ledger account on the blockchain. User interface layers like popular wallet apps read the current ledger of your assets, but don't always store them uniquely on a specific platform; that is, the assets aren't held in custody by the platform.

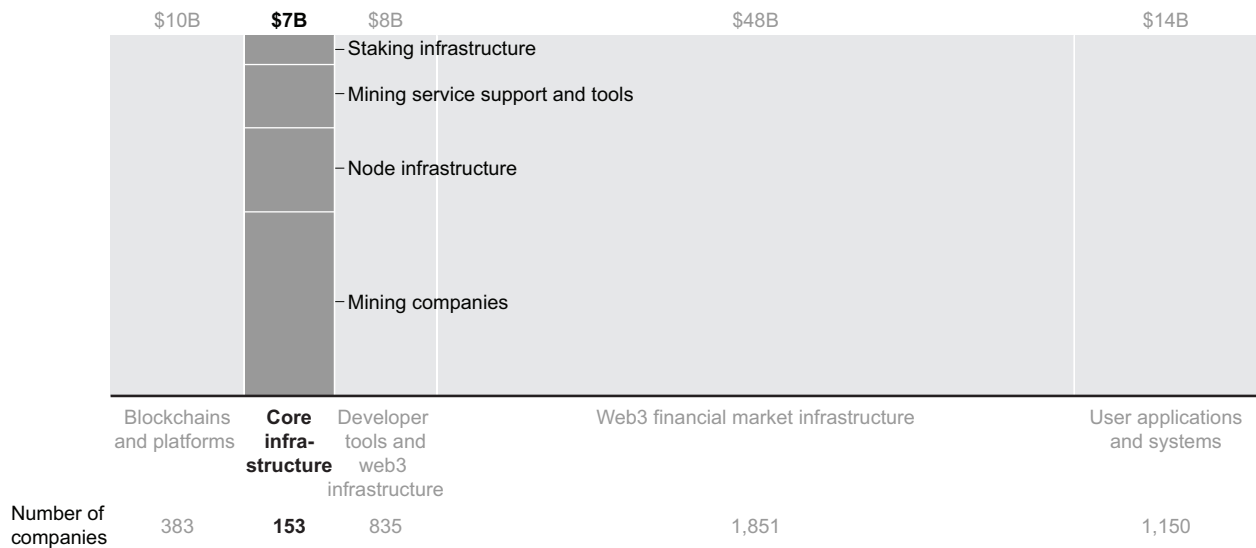Imagine a highly simplified banking analogy. Instead of holding $1,000 in Bank A and $500 in Bank B, both acknowledge that you have $1,500 total, and the banks are just a service layer on top of your assets. You could even go to a Bank C, and it too would see you have $1,500 instantly available. The opportunity for simplified asset transfers and interoperability in this example shows how this type of decentralized infrastructure turns common business models on their head.

By 2020, wallets had started to evolve into much more than just digital accounts. With the rise of decentralized applications, users began to interact with web3 applications, and wallets played an important role. To connect to the popular decentralized exchange Uniswap, for example, you might just click "connect wallet." There's no need to create an account. By connecting a wallet, platforms can see the digital assets you own and grant access or permissions based on a token you hold, for example, or an NFT ticket you might have collected by attending an event.

In the bank analogy, when you "connect wallet" at Bank C, it might, based on your activity elsewhere, offer preferential loan refinancing terms for your debt with Bank A.

The pace of innovation has continued to accelerate, and companies are creating specialized tools that abstract away the complexity of wallets, while leaving core benefits in place. Here are three examples.

- **Digital assets and goods.** Similar to the bank example, you may use a wallet to transport other types of digital goods across platforms. Whether holding video game assets like skins, digital artwork, or next-generation loyalty tokens, the ability of wallets to promote interoperability and help users freely move assets unlocks benefits that could threaten customer stickiness and existing business models.

- **Credentials and access.** Wallets have the potential to disrupt several types of identity and access tools. Companies like Civic, for example, are using tokens to denote certain regulatory conditions. This could enable wallet users who are over 21 to prove their age and purchase alcohol in a delivery app without ever revealing their license. Other web3 firms, like Mintgate, are focusing more on content-related access. These platforms provide holders of certain tokens (such as an NFT ticket) or loyalty points with gated entry to forums or entertainment.

- **Data and content.** While content creation on the Internet today is decentralized, its publishing tends to be centralized on major platforms. Wallet-related firms hope to upend this ownership model by moving data and content rights away from platforms and toward the user. Companies like Lens Protocol and Farcaster are working to build social graphs in which all of your content—likes, comments, and other data—is decentralized and available to you. In this world, social media platforms would just read social graph data while you could carry your social interactions and content between platforms without being locked in.

These examples represent just a few of the areas in which web3 may reshape digital identity, with continual development for years to come.

Implications for executives today

Web3 can no longer be ignored. The ecosystem is robust. It has sizable funding and clear targets to disrupt. While this discussion of identity and wallets is most relevant for certain tech platforms, it also demonstrates the broader risk and opportunity that web3 poses when innovation challenges commonly held beliefs about who owns what and how to build defensible profit pools. All companies have to understand the scenarios that may affect their core markets now, and where they might find opportunity in the future.

US-China Decoupling Accelerates, and Shockwaves Spread

The separation of the world's two largest economies is growing faster, wider, and deeper than predicted.

By Anne Hoecker, Jason Ding, Karen Harris, Ravi Vijayaraghavan, and Jue Wang

At a Glance

▸ The Ukraine crisis and Covid-19 have added to preexisting tension, accelerating the geopolitical detangling of China and the US.

▸ Ramifications are radiating beyond the two countries, with Europe taking a regulatory lead and Asian countries attracting businesses leaving or seeking alternatives to China.

▸ To avoid prematurely cutting off access to markets or lower-cost production, companies must time their decoupling to match the pace of the markets.

In the past 12 months, the geopolitical detangling of China and the United States that began several years ago rapidly accelerated. As the world moves away from unconstrained globalization centered on growth and efficiency and toward a fractured system of competing technological standards, higher costs, and increased constraints, technology companies and their leaders must thread a narrow passage. Pull out too soon from lower-cost manufacturing arrangements and a company ends up functioning at a cost disadvantage relative to competitors. Fail to invest enough in the future, and it risks finding itself with an insufficiently robust supply chain when the next unexpected emergency arises.

Geopolitical concerns are already fueling supply chain diversification and other realignments *(see Figure 1)*. As the Chinese Internet moves further away from the global web and toward its local version, Internet platforms including Airbnb, LinkedIn, and Yahoo have left the market due to censorship or operational difficulties. And recent data indicates that early start-up investment is significantly slowing in China. As investments are made and factories built in new places, a more permanent decoupling becomes more likely.

Covid-19 has been a powerful accelerant. Half of the CIOs and CTOs surveyed by Bain in June said that China's zero-Covid policy has affected their business, and at least a dozen major US technology companies have blamed the lockdown of Shanghai for missing quarterly revenue and earnings estimates.

The virus has contributed to a talent decoupling as well, reducing the exchange of ideas and innovation as the number of foreigners by China fell by half over the past two years, according to data from the China Demographic and Economic Census, and the share of nonimmigrant visas issued by the US to Chinese citizens dropped from 16% in 2018 to 4% in 2021 *(see Figure 2)*. Student exchange is off sharply too.

The Ukraine crisis accentuated companies' need to make geopolitical moves quickly, and their willingness to prioritize geopolitics over economics in certain instances. By early June, at least 133

Figure 1: Amid geopolitical concerns, electronic supply chains are diversifying

Current export value	Growth rate multiple, 2015 to today		
$12B →	Ireland	2.5	
	India	2.4	
	Vietnam	2.2	
	Hungary	1.8	
	Malaysia	1.7	
	Netherlands	1.6	**High growth**
	Czech Republic	1.6	
	Poland	1.6	
$900B →	China	1.5	
	Romania	1.5	
	Italy	1.4	**Medium growth**
	Philippines	1.4	
	Germany	1.3	
	Hong Kong	1.2	
	South Korea	1.2	
	Japan	1.2	
	Mexico	1.1	**Low growth**
	US	1.1	
	Singapore	1.1	
	France	1.0	
	UK	0.9	

Note: Today is defined as 2019 for Hong Kong; 2020 for South Korea, Singapore, Vietnam, France, and Ireland; and 2021 for other countries
Sources: Trading Economics; Bain analysis

Figure 2: China's share of nonimmigrant visas to the US has declined by 75% since 2018

Share of nonimmigrant visas issued by the US
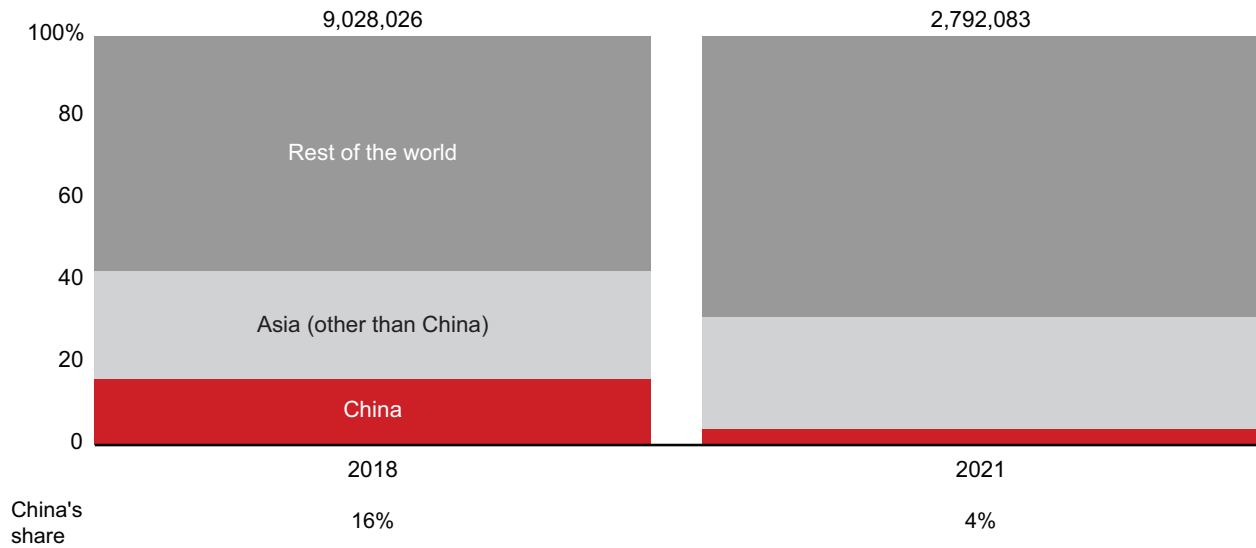
Source: US State Department

technology companies had withdrawn from or suspended operations in Russia. Though Russia is a smaller market and easier for many to exit than China, the degree of response remains remarkable.

The ramifications of the US-China decoupling are radiating around the world.

China

China has committed $1.4 trillion over five years to build strategic technologies and digital infrastructure domestically, including 5G, smart cities, and Internet of Things applications for manufacturing.

In a retreat to something closer to the model multinationals used when they first sought access to China, some companies are closing research and development (R&D) labs and other operations there, and setting up partnerships to sell and distribute products developed and made outside of the country. Companies that retain extensive local operations must comply with regulations that can be quite expensive. Greater China is the largest global market for electric vehicles in terms of both exports and sales, and Tesla's revenue in China grew more than 120% to $6.7 billion in 2020 after its Shanghai Gigafactory opened. China now accounts for more than 20% of the company's total revenue. But in a sign of the limits for multinationals, Tesla vehicles have been banned in recent months from districts and certain city streets during political events, apparently due to concern about the data gathered by their cameras and sensors, even though all data is stored inside the country.

The United States

The US continues to restrict trade with China and heighten its regulatory oversight of Chinese companies operating in the US. In June, a law blocking most imports from China's Xinjiang region, home to many Uyghur, went into effect, threatening to further interrupt shipments of polysilicon, a material essential to making solar energy panels, and raise compliance costs. This could add to inflation and, over time, accelerate a shift of some supply chains out of China.

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The CHIPS for America Act, which establishes investments and incentives to support US semiconductor manufacturing, independent R&D, and the supply chain, was signed into law by President Joe Biden in August. China's Semiconductor Manufacturing International Corp. is on the US Commerce Department's entity list limiting the company's access to key US technologies.

There have been a few glimmers that the US and China could work together. In May, Shanghai's Semcorp Advanced Materials Group announced it will establish a manufacturing facility in Sidney, Ohio, to make separator film, a key component in electric vehicle batteries. And in August, the two governments reportedly reached an accommodation that would allow US officials to inspect audits of Chinese companies listed on US stock exchanges. The deal could avoid the delisting of more than 200 companies valued at roughly $1 trillion.

Europe emerges

Intense scrutiny and regulation of data sharing and privacy has Europe emerging as a regulatory leader. Rising tensions with China are fueling a desire for tech independence, including domestic chip production. In response to Chinese sanctions on European human rights advocates, the European Parliament passed a resolution on May 20, 2021, to freeze ratification of the EU–China Comprehensive Agreement on Investment. Ten months later, Intel announced its initial investment in the EU.

Asia beyond China

This region has become something of a buffer zone, attracting businesses leaving or seeking alternatives to China, as well as those seeking to generally broaden their geographic footprint, especially in semiconductors. In addition to domestic and European investments, US semiconductor giant Global-Foundries is spending more than $4 billion to expand its Singapore wafer plant and capacity. Industry leader Taiwan Semiconductor Manufacturing Co. is boosting to $8.6 billion its investment in a new plant in Kumamoto, Japan. Rohm Semiconductor, a Japanese semiconductor and electronic components designer and manufacturer, has opened a new center in India to tap local engineering talent, technology, and partners, and the South Korean government plans to invest $451 billion in its own chipmakers.

What should companies do now?

Untangling these markets is complex, and even with this year's acceleration, will take time. Companies must consider what investments they need to balance potential short-term shocks, like the war in Ukraine, with building a long-term, geopolitically resilient business mix. The difficulty of cross-border M&A means companies have to think through smaller acquisitions and new approaches to growth. Planning the talent pipeline for each market, navigating increasing cross-border regulation, and investing in supply chain diversity and resilience are complicated and expensive. All this must happen while managing rising inflation, supply chain shortages, and general market turbulence.

Pacing the rate of decoupling to reflect what customers and competitors are doing will help companies avoid disadvantaging themselves by prematurely cutting off access to markets or lower-cost production.

Competitive Battlegrounds

Competitive Battlegrounds

Incumbents vs. Disrupters:
The Best Defense Is Offense

Traditional enterprise software companies face intensifying competition, but they
can regain their edge with a three-step plan to fearlessly disrupt themselves.

By Prasad Narasimhan Sulur, Jesse Klein, and Ravi Vijayaraghavan

At a Glance

▶ More than 75% of the largest venture capital investments in recent years went to IT infrastructure
and industry-focused enterprise software companies, illustrating the potential for innovation
perceived in these sectors.

▶ Many incumbents overlook or underestimate the signals of impending disruption until it's too late.

▶ The most successful reject the legacy mindset, effectively monitor emerging business threats,
invest in a clear R&D and M&A strategy, and fearlessly disrupt themselves.

When 75% of the largest venture capital investments move assertively in one direction, it's time to
take notice.

That's the situation in which the leaders of incumbent enterprise software companies find themselves.
From 2017 to 2021, more than three-quarters of VC investments of $100 million or more went to IT
infrastructure and industry-focused, or vertical, software companies, according to Bain & Company
analysis of our Startup Investment Cruncher database *(see Figure 1)*.

Figure 1: Venture capital firms are investing more in infrastructure and industry-focused vertical application software

Software investments, 2017–21 ($B)
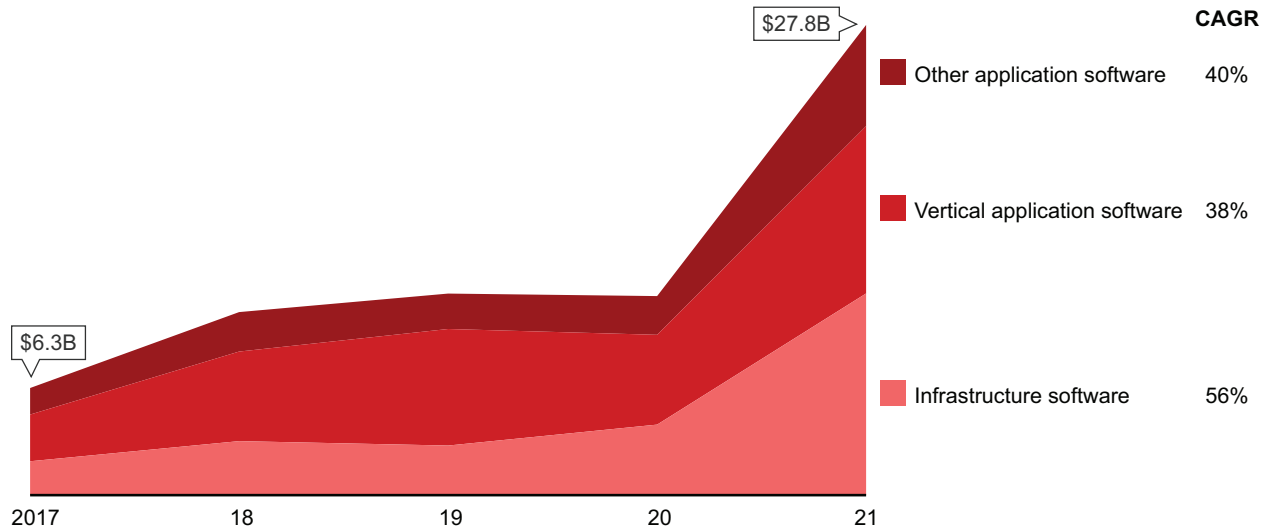
Notes: Includes funding rounds of notable companies and/or companies that have raised $100 million or more from 2017–21 (223 companies); excludes private equity investment.
Sources: Bain & Company Startup Investment Cruncher database; CrunchBase

Investors are backing start-ups that are taking aim at software markets supposedly immune to disruption in industries as disparate as education, healthcare, restaurants, and auto dealerships. These markets historically had high barriers to entry and loyal customers, and the cost of switching to alternative vendors was high.

Now, however, companies can develop and deploy new software more quickly and easily than ever, thanks to open-source software architectures and platforms that make it possible to develop apps with little to no coding expertise. As a result, start-ups are no longer afraid of markets that long appeared untouchable and are gradually winning over customers.

Consider Toast, which in just over a decade has emerged as a leader in restaurant point of sale software with nearly $2 billion in annual revenue, thanks in part to a direct sales model and a simplified technology developed specifically for restaurants. Or look at legal management software provider Onit, which has used its cloud-based, "no-code" platform with a simple user interface to make products that are generally faster to implement and easier to use than legacy systems. That formula has made Onit one of the fastest-growing tech companies in North America.

Unfortunately for incumbents, many don't pick up signals of impending disruption until it's too late, or worse, they recognize the signals, but disregard them because they believe they're in a niche,

sufficiently sheltered market. In a 2022 Bain survey of executives at 98 tech companies, nearly 50% said they see disruptive threats to their company's market share position as mild or not critical at all; only 5% saw such threats as severe. But other evidence suggests that tech companies are highly susceptible to the kind of disruption that leads to sector underperformance—and that the longer a tech company underperforms, the less likely it is to turn around *(see Figure 2).*

The incumbents that don't heed signals of disruption continue to bet on the playbook that has worked for years: make a series of acquisitions, take out costs, manage the businesses for cash, and enjoy slow-but-steady growth. That playbook will likely remain valuable, but it's no longer sufficient to protect against what's coming. Although venture capital investment in and valuation of high-growth tech companies both declined in the first half of this year, such drops won't curb the long-term increased pace of disruption.

> The incumbents that don't heed signals of disruption continue to bet on the playbook that has worked for years: make a series of acquisitions, take out costs, manage the businesses for cash, and enjoy slow-but-steady growth. That playbook will likely remain valuable, but it's no longer sufficient to protect against what's coming.

Now is an opportune moment for incumbents to go on offense. In recent years, established companies were expected to deliver steady profits, and therefore had less freedom to invest in innovation, leaving them at a disadvantage against start-up competitors. But the rules are changing. Start-ups are under more pressure to deliver profits, not just growth. Incumbents have an opening to press forward and seize momentum.

Staying ahead of the game

Leadership that rejects the legacy mindset is the most important hallmark of software incumbents that have successfully defended against disruption. Not satisfied with slow-but-steady growth, these leaders want to be at the forefront of technology for their industry, and they take pride in what their products help their customers accomplish. This sounds like a given for any leadership team, but in truth many companies lose sight of these goals or only pay them lip service. That leaves their companies vulnerable to complacency and, eventually, irrelevance.

The most successful software incumbents put that mindset into action by focusing on three things.

Figure 2a: The longer a tech company underperforms, the lower its chances of a turnaround

Share of underperforming tech companies that transformed

Consecutive years of subpar performance before transformation
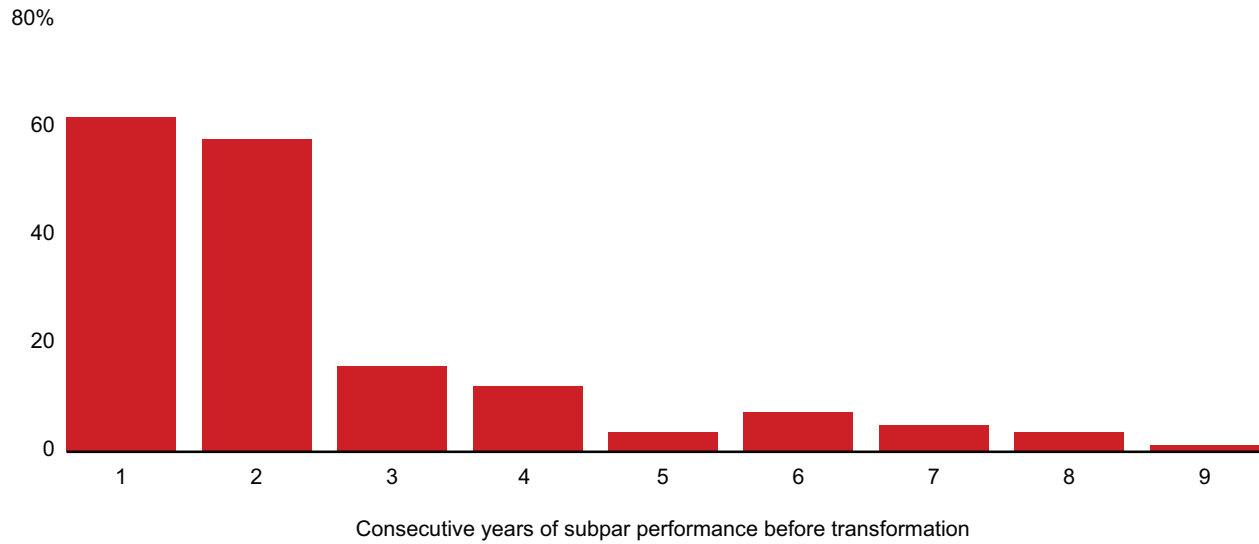
Sources: Bain analysis; Compustat

Figure 2b: Technology companies are easily disrupted

Share of companies that underperformed three or more years (1996–2018)
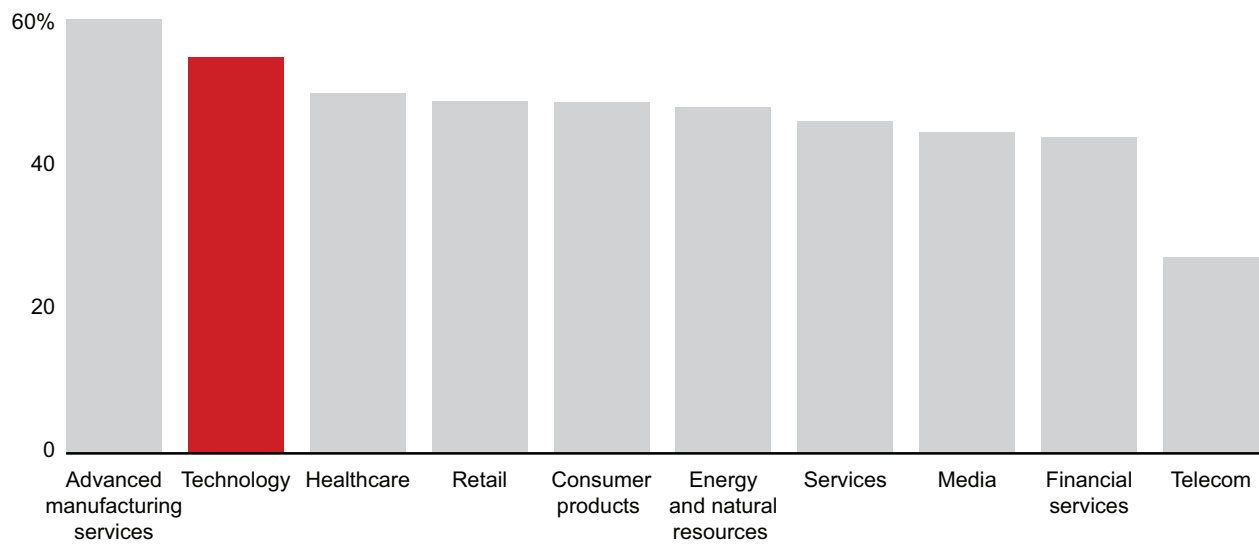
Note: Underperformance defined as three consecutive years of growth at least 2 percentage points below the three-year rolling average for the industry
Sources: Bain analysis; Compustat

Continually assessing potential threats and new business opportunities. Leading companies put defending against disruption at the heart of their strategy. There are a lot of ways to do this, but it's good to start by building competitive threat assessments into the annual planning process. Many tech companies have room to improve in this area. In a 2022 Bain survey of CIOs and CTOs, nearly half said their company doesn't have a strong ability to identify potential disrupters in their core market *(see Figure 3)*.

To avoid threat assessments becoming a check-the-box exercise, leading companies not only monitor the competitive landscape, but also think deeply about anything and everything that could emerge in the future to prey upon their business vulnerabilities. Paranoia is a virtue here.

Moving the CEO closer to the company's R&D roadmap of products and tech capabilities. Sometimes, the response to disruption might simply require refreshing product features or adding new ones. But when it calls for a fundamental redefinition of the company's core business, that's a decision only the CEO can make—and it needs to be made quickly to stay ahead of the competition. Closer collaboration between the CEO and the head of research and development can also help incumbent software companies make the appropriate investment trade-offs in order to fix their "technology debt," a common pitfall wherein companies choose incremental feature upgrades or additions at the expense of refreshing their core product, which can atrophy as a result.

Figure 3: Nearly half of tech companies say they lack a strong ability to identify disrupters in their core markets

How would you rate your company's ability to identify potential disrupters in your core market(s)?
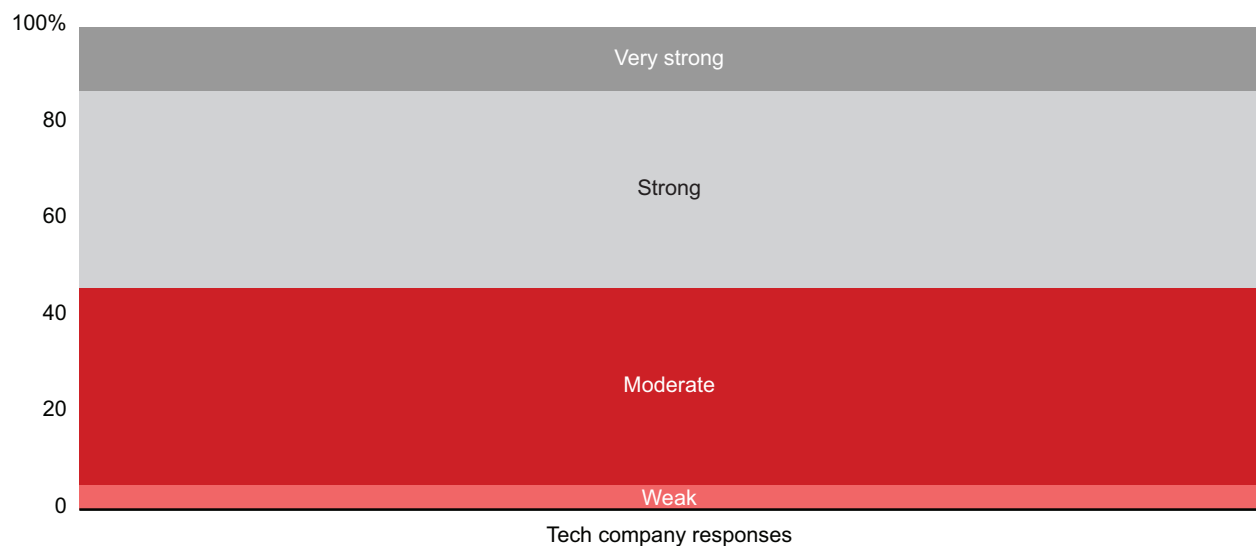
Source: 2022 Bain CIO/CTO survey (n=195), tech companies (n=98)

Investing in migrating customers to the new offering. Once the company is ready to scale up a new, innovative product or modernized technology platform, managing the transition in the market can be even more difficult than navigating the internal shift. Customers might be reluctant or refuse to switch, which might spook the sales team or discourage it from promoting the new offering. And the board might not want to risk upsetting the status quo, which has worked for so long.

Leading companies reorient the sales team's priorities to focus on the new offering, adjusting the team's incentives if necessary. They build targeted sales plays around the new offering and ensure close communication between sales and R&D to make the customer migration work.

The most successful companies start small by winning "lighthouse" customers, a targeted set of existing buyers willing to try out nascent products. Then they use those success stories to persuade more customers to switch. Genesys's cloud strategy illustrates how incumbents can turn potential disruption to their advantage *(see Figure 4)*.

In 2013, a year after Genesys was spun out of Alcatel-Lucent, it was operating almost entirely on-premise, with some hosting. Recognizing early that its customers were starting to prefer cloud-based products, the contact center software provider began shifting away from its legacy on-premise solution with a couple of small tuck-in acquisitions. It swung for the fences with the $1.4 billion purchase of Interactive Intelligence in 2016. To capture the value of the deal, the Genesys leadership team crafted

Figure 4: Genesys has grown by moving into the cloud and now faces a new set of competitors

Genesys revenue

	2013	2020
Primary competitors	Cisco Avaya Aspect Technology Noble Systems	Cisco Five9 8x8 Amazon NICE
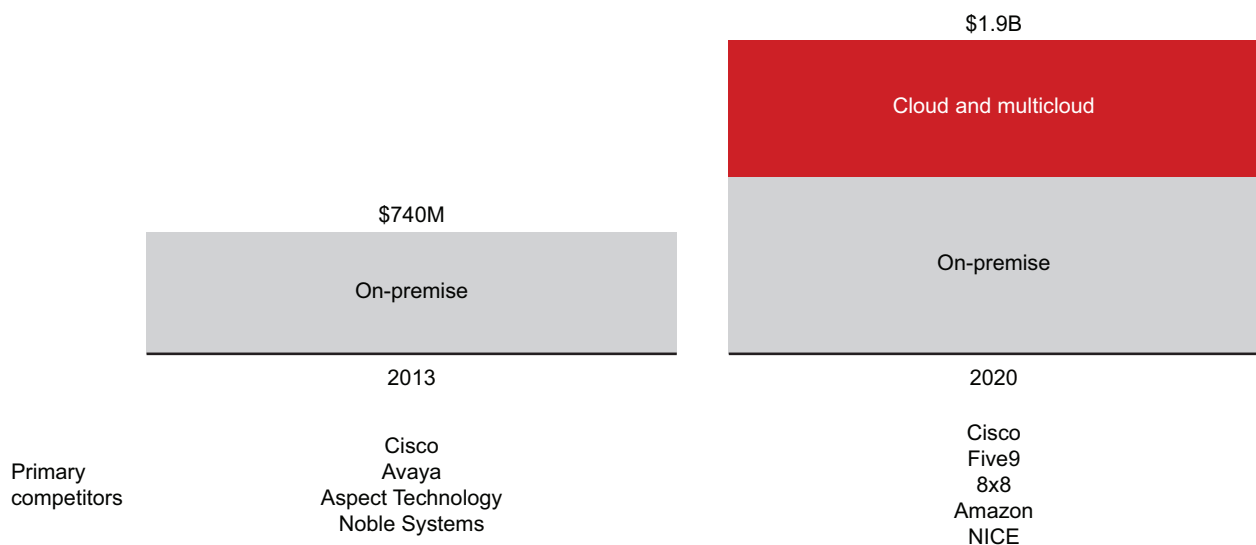
Sources: March 2022 Genesys earnings report; Business Wire report; Gartner Market Share Contact Center

a plan to win new customers and carefully manage the transition of existing customers to Interactive's more modern, multitenant cloud product. Through a series of moves, Genesys capitalized on the cloud trend responsible for nearly half its growth in 2022 and joined a new competitive set.

Meanwhile, Rocket Software's approach to staying ahead of the competition has combined focused R&D with prolific mergers and acquisitions. Making more than 45 acquisitions in its 32-year history, Rocket has built a diverse portfolio of enterprise software products supporting the legacy platforms of many of the largest companies worldwide. The company strategically reviews its products regularly to ensure it's serving customers' highest priorities, and then adapts its portfolio to deliver what customers need today or will in the near future.

Ultimately, even as incumbent enterprise software companies face intensifying competition, the traditional playbook can still yield solid returns for the foreseeable future. But more incumbents are starting to recognize there's a better way. Staying ahead of disruptive competitors will set them on a path to accelerate growth for years to come.

Now Is the Moment for Tech's New Growth Imperative

Serial business building can reignite growth at big technology companies.
Recent market volatility has created a rare opportunity to kickstart the process.

By James Dixon, Dunigan O'Keeffe, and Mikaela Boyd

At a Glance

▶ Three-quarters of the value recently created in the technology sector came from companies that aggressively pursue growth outside of their core business and closely adjacent fields.

▶ Many of these growth engines started with an acquisition, and the recent stock market drop has created an important opportunity for companies to invest in their future.

▶ Successful "Engine 2s" share four characteristics, and their growth follows an established pattern.

Over the past decade, the way businesses grow has taken a sharp turn. Digitalization, technology shifts and disruptions, regulatory changes, and a superabundance of capital have blurred traditional business boundaries and created radically different competitive sets. Bain & Company research has found that as much as one-third of all corporate value creation in recent years has come not from optimizing the core business or expanding into near adjacencies, but rather from entirely new businesses—what we call Engine 2s.

In technology, Engine 2 businesses have been even more important; three-quarters of the value created in the sector in recent years came from new businesses. Similarly, among the sustained growth and

value creators in tech, more than 80% derive significant valuation benefits from pursuing Engine 2 businesses. And in a recent Bain & Company survey, 60% of technology CIOs and CTOs executives said that building a new business is very important to their company's success.

Seven technology serial business builders—Amazon, Google, Apple, Microsoft, Tencent, Ping An, and Samsung—were responsible for 15% of all the positive market value created from 2007 to 2018 *(see Figure 1)*.

The recent stock market drop creates an opportunity for companies to invest in the future. M&A is a critical element in two of every three tech company Engine 2s, our research has found. Microsoft, for example, helped build its successful Engine 2 entry into artificial intelligence (AI) and the cloud with a series of strategic acquisitions, including GitHub, Lobe, and Citrus Data, that helped the company make AI accessible to developers.

Successful Engine 2s come in various flavors. Some are next-generation business models of the original Engine 1. Software as a service (SaaS) is the evolution of software sold as a perpetual license, for example. A second model is built on something distantly adjacent to the core engine, but newly accessible competitively due to a technology change. Facebook parent Meta's focus on the metaverse, for example, stands partly atop its 2014 purchase of the immersive virtual reality Oculus headset. Other Engine 2s are brand new businesses entirely unrelated to the core. Developing this type of growth engine

Figure 1: Tech serial business builders were responsible for 15% of all positive market value creation, $2.8 trillion, from 2007 to 2018

Percentage of positive market value created, 2007–18

The seven tech serial business builders that created $2.8 trillion in value

Amazon

Google

Apple

Microsoft

Tencent

Ping An

Samsung
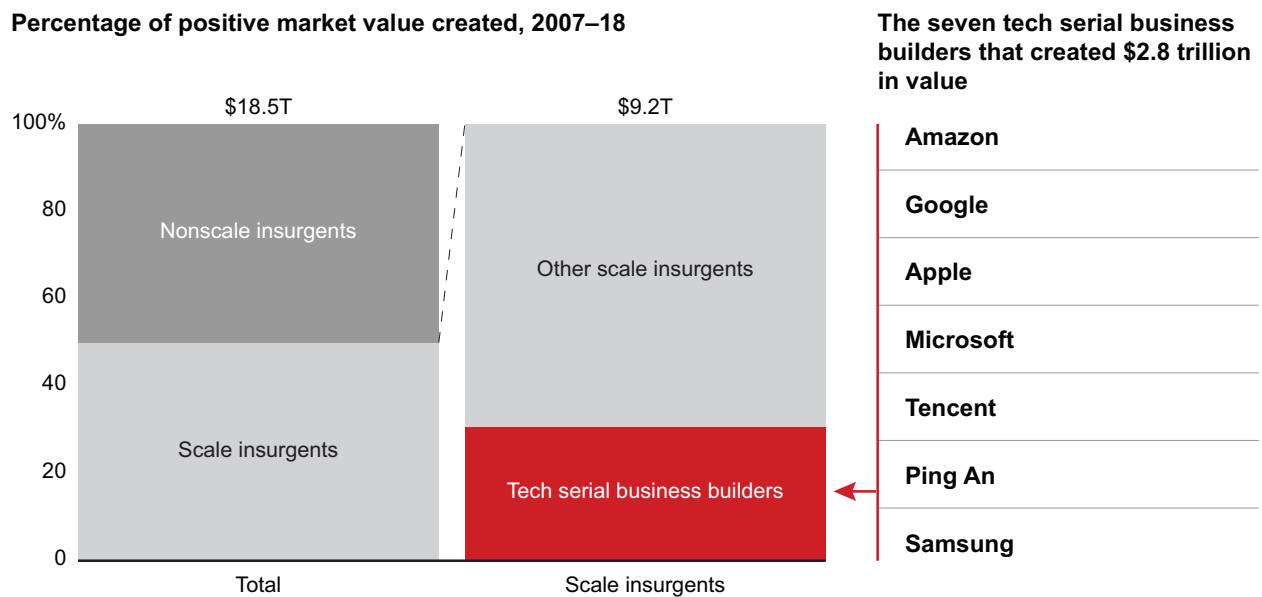
Notes: The total includes about 4,500 companies, with about 3,000 creating $18.5 trillion in positive value, and the rest losing $7 trillion in value; scale insurgents are defined as companies with more than $500 million annual revenue and real sales and profit growth at least twice the market average; serial business builders are scale insurgents that have built multiple Engine 2s over time
Sources: PFTC database; Bain analysis

is a specialty at Amazon, which now gets more profit each year from Amazon Web Services than the rest of the company combined, including its Engine 1 e-commerce site. Amazon continues to search out future Engine 2s. The company recently purchased One Medical for nearly $4 billion, for example, accelerating its aggressive move into the healthcare market.

The most successful Engine 2s have one or more of the following things.

- **A large, growing market and profit pool** fueled by technology disruption and megatrends. It helps if you can invent the market as AWS did. But digital disruption of the $4 trillion US healthcare market is a big opportunity for Amazon and others.

- **A new lever of competitive advantage** that enables entry, often because of a technology that changed the business boundaries, making once distant or highly defended markets more accessible. Ant Group, born from Alibaba's efforts to help online shoppers pay for purchases, runs the leading payment service provider in China. Alipay benefited from its link to Alibaba's tens of millions of customers. But unlike other online payment methods—and thanks in part to a conducive regulatory environment in China—Alipay also invested in serving consumers and vendors of all sizes. As a multisided platform, it has tapped even larger opportunities for growth.

- **The ability to create entrepreneurial conditions** inside the corporation, with a distinct culture, operating model, and funding model for the Engine 2 business. Strongly centered on its customer, Intuit has built on its Engine 2 purchase of TurboTax to embed automated touchpoints with predictive analytics, as well as live professional tax advice through TurboTax Live. Cisco uses a different entrepreneurial model, first spinning out Engine 2 teams, learning from their incubation phase, then reacquiring them at prearranged, and lucrative, valuations.

- **Access to a key asset or capability of Engine 1** that allows the Engine 2 business to use the scale advantages of the parent to grow. AWS benefited from starting alongside the largest e-commerce platform, where it could scale and innovate rapidly on cutting-edge cloud solutions. The founding teams of YouTube and Instagram created new ways for consumers to engage with content, but their success was fueled by the scale monetization engines of Google and Facebook. Technology companies have stronger business-building capabilities than many industries, but their biggest Engine 2 challenges include inconsistent and insufficient investment and a failure to use M&A and partnerships to accelerate their bet *(see Figure 2)*.

How to build an Engine 2

The first step in building a second growth engine is committing to a big investment theme, making focused investments based on these bold bets on the future, and then experimenting. This may emphasize owning areas of underserved need(s) where they have a distinct advantage and see a large strategic and commercial potential. Meta spent $10 billion in 2021 on its metaverse vision, 18% of cash generated. It plans to hire 6,000 new engineers for the project and has set aside $150 million for training key staff.

Figure 2: Many tech companies struggle to build new businesses due to inconsistent focus and ineffective use of partnerships and M&A

When your company has struggled to build new businesses, what are the most important root causes?

Percentage of respondents who cited these factors among the top three challenges

Factor	Percentage
Lack of consistent focus and investment	36%
Inability to leverage partnerships and M&A	31%
Poor execution	31%
Underfunding	30%
Inability to mobilize the right talent	29%
Lack of winning differentiation	22%
Lack of entrepreneurial approach to building	15%
An ineffective process for innovation	14%
Target markets too small	13%
Other	4%
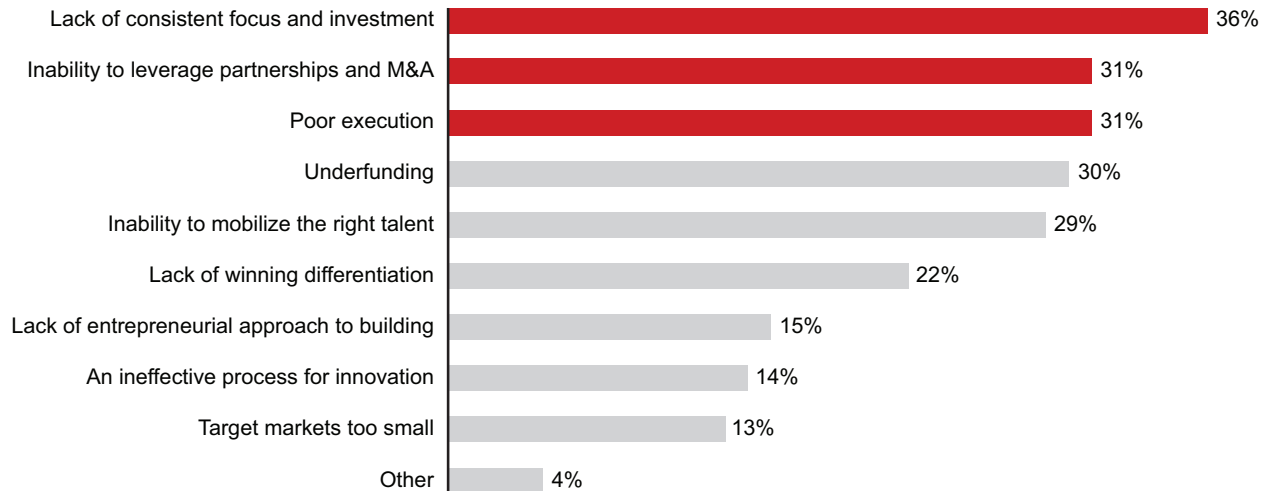
Source: Bain CIO/CTO survey, 2020 (n=98)

The next step is acquiring and building. Many companies grow their own business and use smart M&A simultaneously. Sometimes a company starts building internally and as it becomes more convinced of the power of its idea, looks for acquisitions to build scale quickly. Now is a good time for strong companies to take advantage of the downturn and make strategic investments.

Mergers and acquisitions can seed the new Engine 2, scale and extend the Engine 2 into its adjacencies, or bring in essential skills and capabilities that couldn't be built in-house fast enough. Salesforce has an extensive acquisition history, with CEO Marc Benioff publicly stating that inorganic growth is central to remaining competitive. Some of Salesforce's largest acquisitions include: Slack, $27.7 billion in 2020, bolstering Salesforce's social enterprise capabilities; Tableau, $15.7 billion in 2019, giving diverse visualization analytics and AI integration capabilities; and MuleSoft, $6.5 billion in 2018, which has an application programming interface-led approach to connectivity and helped expand to integration platform as a service (iPaaS). Integrating so many deals over the years, Salesforce has become especially good at getting its acquired products out to customers fast.

The final step is executing in an Agile, iterative way. The idea is to rapidly test venture ideas and pivot or discontinue those that can't establish a market fit, enabling the company to free up resources for pursuing better opportunities. One example is Amazon's decision to end both its Haven healthcare joint venture with JPMorgan and Berkshire Hathaway and also its independent Amazon Care service

so that Amazon can focus on its M&A-driven entry into primary and home healthcare services. The most successful companies design clear links between the core business and new ventures to take advantage of synergies and potential reintegrations. They outline team requirements and accelerate, build, and launch while developing the team in parallel.

The one thing companies don't need to do is worry about coming up with more innovation ideas.

The one thing companies don't need to do is worry about coming up with more innovation ideas. Only 10% of the tech executives in our survey cited that as a constraint. These companies don't struggle to generate ideas; it's prioritizing them that proves problematic. One way to start is by evaluating how many of the characteristics of successful Engine 2s an idea can tick off. Once the best bold idea has been identified, the company can begin to invest in building it in an Agile, iterative way, planting and nurturing the seeds of its future growth.

Customer Success: The Next Frontier of AI

Leaders are using artificial intelligence to create personalized customer journeys from product engagement through customer success.

By Paul Renno, Eric Sheng, and Jue Wang

At a Glance

▸ Investment in AI is growing rapidly, and nearly all technology providers say it's becoming critical for gaining market share and building customer loyalty.

▸ In customer success, AI has already moved past merely providing insights and is actively shaping product design and development, along with customer engagement.

▸ However, only about 20% of companies have the technology infrastructure in place to make the most of AI's potential.

Artificial intelligence (AI) is still more hype than reality in most businesses. However, given the explosive growth in the creation of digital data and the transition to web3 with more distributed data, it's increasingly clear that artificial intelligence and machine learning (ML) are the best path forward. Tech providers, particularly software-as-a-service (SaaS) companies, are on the leading edge, and 86% of tech providers say AI is important for gaining market share and building customer loyalty. A growing wave of investment in tech infrastructure is also accelerating this capability. Over the past five years, venture capital invested more than $170 billion in AI hardware and software platforms

and algorithms. That's on top of investments made by the leading cloud service providers (Amazon Web Services, Google, Microsoft Azure), which are the prime innovators in this space.

A key area where we see AI making significant inroads is customer success—helping businesses deliver more personalized and productive experiences. The potential for AI in customer success is promising. With a complete view of the customer—from first contact through onboarding, ongoing service and monitoring, to replacement and renewal—AI systems can provide sharp insights and specific recommendations to build closer relationships with customers and increase usage. AI can improve and automate functions such as customer segmentation, reducing churn, upselling, tailoring features, coaching sales reps, suggesting next best actions, and targeting service. In our recent survey, two-thirds of chief information and chief technical officers said that using AI for customer success is among their top priorities over the next two to four years.

Artificial intelligence is still more hype than reality in most businesses. However, given the explosive growth in the creation of digital data and the transition to web3 with more distributed data, it's increasingly clear that artificial intelligence and machine learning are the best path forward.

AI's expansive role in customer success

The integration of AI into customer success applications signals an inflection point where it moves beyond offering insights and begins to modify and tailor product development and features for specific customers. AI enables a more comprehensive perspective on customer engagement, allowing for more bespoke product development and fine-grained predictive analytics that signal opportunities and risks.

To get the full potential, companies need a number of critical capabilities:

• an effective product architecture and infrastructure for AI-infused offers;

• feedback loops for data capture and ongoing learning;

• the ability to track customer engagement throughout the customer journey; and

• feedback that enables product development teams to personalize offers using AI.

Figure 1: Many AI tools have been introduced, but few are being deployed at scale
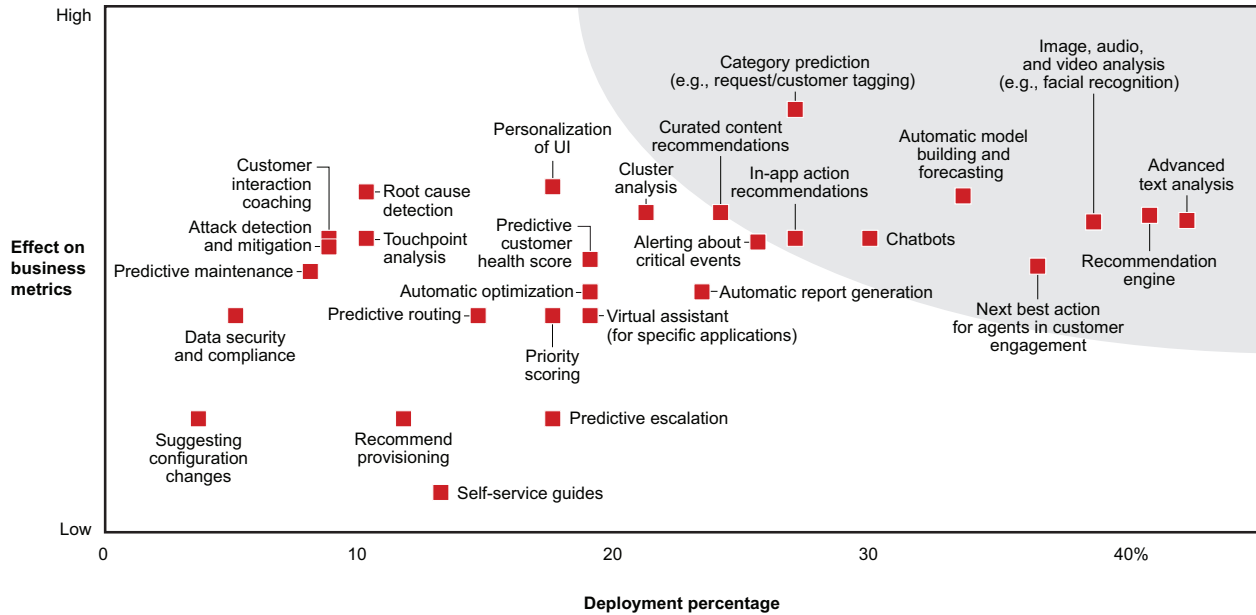
Notes: The survey asked executives which features are having a positive, negative, or no effect on implementation; deployment percentage refers to how widely the company has deployed the feature, with 100% being full-scale deployment
Source: Bain 2021 AI/ML Provider Pulse Survey (n=137)

To that end, fewer than 20% of companies have structured their products for AI with an integrated view of customer product usage, consistent data infrastructure with appropriate access rights, and effective feedback loops. Quite a long way to go.

We're still in the early innings of AI, and few of even the most common AI uses are being deployed at scale *(see Figure 1)*. The challenges to achieving the potential are both technical and organizational. Many organizations aren't aware how rapidly it's evolving and may not realize what it can bring to their products. Tech providers can invest more in educating their customers about these capabilities and showcasing AI's growing applicability.

Specifically, the next generation of AI tools differs from already familiar software in its ability to operate more autonomously, to better inform decisions, and to identify patterns that allow it to craft more specific actions or recommendations. AI's ability to offer insights at a more fine-grained level offers the promise of radical personalization. In the business-to-consumer space, a North American media company uses AI to address the issue of customer churn on its streaming platform. Going beyond the well-known capabilities of a recommendation engine, this AI helps the company identify which portion of the content is critical for drawing in customers and gaining new subscriptions. By offering insights on what a customer's current habits indicate about future viewing, the system can help the company make more informed decisions about where to invest in content development, acquisition, and marketing.

In the business-to-business space, AI systems are also increasingly adept at synthesizing the various stages of a customer's journey, to guide customers to potential purchases and recognize when interventions may help prevent churn. One B2B software company built an AI model to identify and attribute customer acquisitions to specific products and services across their portfolio. The company found that while many products expand revenue from its existing customer base, only a few acquired new customers. This discovery prompted the company to focus its investments in marketing and sales. The same company uses another AI model to understand product usage patterns, in order to learn more about what's popular and where the pain points are, helping to guide investments in product enhancements. Finally, AI helps this company reduce churn by showing that some customers are more sensitive to long turnaround times on ticket issues, while others are more bothered by reopened tickets, which helps identify which customers are most at risk of leaving.

Many organizations aren't aware how rapidly AI is evolving and may not realize what it can bring to their products. Tech providers can invest more in educating their customers about these capabilities and showcasing AI's growing applicability.

The task ahead

To capitalize on this opportunity, leading technology providers are connecting the dots and building out the infrastructure, processes, organizations, and customer engagement necessary to turn the customer's data signals into AI-driven recommendations that enhance success across the customer's life cycle. Most are taking significant actions in three areas.

- **Data and infrastructure.** Companies are introducing converged data platforms (with access to user engagement data across the customer life cycle) with appropriate access rights that expedite product development. For many, this means multitenant cloud with shared databases. Analytics is no longer back-office IT, but rather the differentiator for winning through personalized customer success.

- **Customer-led AI roadmap and processes.** Product development is integrated closer into the customer support infrastructure, so that feedback from products and services is directly accessible to the product developers and can be considered in upgrades and redesigns. Another goal is improving the ability to track engagement with customers across the entire journey, including targeting, usage, retention, and expansion, and to identify barriers to success.

- **People and processes.** Integrating AI engineers with product teams, centralizing data centers of excellence, and providing technical sales and marketing with AI capabilities are all essential to successfully applying AI's capabilities to customer success efforts. Continuous training in AI and ML tools and skills are essential, given how rapidly the technology is progressing.

Tech leaders are investing in AI because they see it as the path to taking customer-centricity to the next level. Although our research finds that these investments have yet to match executives' aspirations, the direction of travel seems clear.

To Scale the Industrial Internet of Things, Don't Forget Hardware

Just like software companies, OEMs and hardware makers are critical to getting the industrial IoT to the next level.

By Michael Schallehn, Ann Bosche, and Neil Malik

At a Glance

▸ Bain's 2022 survey of industrial IoT decision makers finds more companies piloting the technology, cutting costs, and increasing revenue, but struggling to scale.

▸ Scaling these pilots and getting the industrial IoT to the next level of automation and intelligence requires addressing problems that hardware vendors and manufacturers are well positioned to solve.

If you're looking for good news on the industrial Internet of Things (IoT), there's plenty. Our 2022 survey of 500 IoT decision makers in Europe and the US found that the number of organizations implementing proofs of concept grew nearly 20% from 2018 to 2022 and is expected to grow another 20% by 2026. Nearly all report that their deployments are going as well as or better than expected, with cost reductions and revenue increases of 30% to 40%.

Yet despite these good results, IoT hasn't enjoyed rapid, widespread adoption. Why?

It's mainly because of a struggle to scale beyond initial proofs of concept; 80% of buyers scale fewer than 60% of their pilot projects. The top reasons include the complexity of integration, vendors

that are unable to support scaling, and inadequate life cycle support of the IoT solution *(see Figure 1)*. In a proof of concept, such challenges can be solved by throwing engineering resources and programmers at the project, but that's not sustainable once a company is ready to scale something to the broader organization.

One thing that's not standing in the way is security. Regulators have pushed for—and IoT specialists, security providers, and device manufacturers have developed—important security solutions. So, while security remains a concern broadly, in IoT it no longer causes as much angst it once did *(see Figure 2)*.

Industrial IoT initially focused on software, but today much of the low-hanging fruit—the benefits quickly garnered from adding sensors for equipment, people, and materials in the field—has been harvested. The next step, developing and realizing integrated IoT uses, is more complex. It requires the next level of intelligence, which will rely on integrating information technology and operational technology, technical expertise in areas like artificial intelligence (AI) algorithms and data science, and capacities like interoperability that become more complicated when machines become self-automated.

Making this jump requires addressing problems hardware vendors and industrial original equipment manufacturers (OEMs) know how to tackle and solve. In addition to manufacturing devices, hardware vendors have many other essential attributes, including industry expertise, feet on the street, and experience with shop floor implementation. Their field application engineers, a rare asset

Figure 1: Four-fifths of companies are scaling fewer than 60% of IoT proofs of concept, and integration is a bigger obstacle than pilot failure

What percentage of your proofs of concept are you turning into scale implementations?
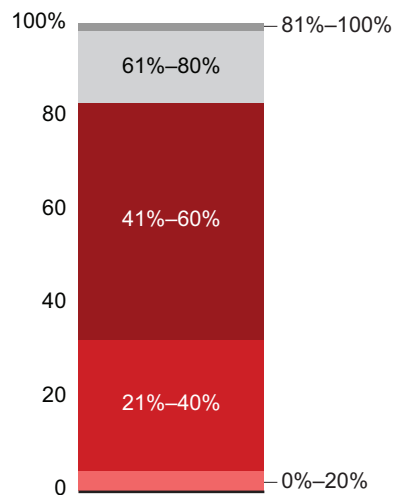
After a proof of concept, what holds you back from scaling the solution?
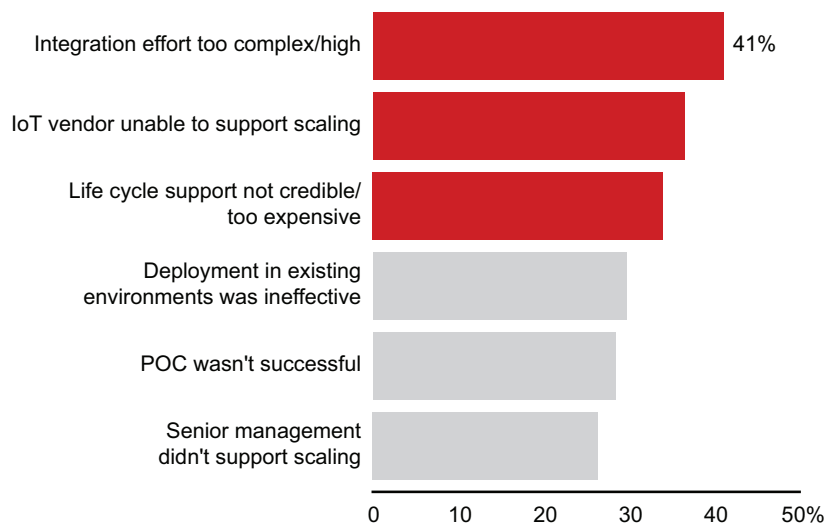
Source: Bain IoT Customer Survey, 2022 (n=490); 394 answered the question on percentage of POCs being scaled

Figure 2: Barriers to IoT adoption still exist, but buyers are increasingly focused on implementation

Percentage of respondents who said these are the most significant barriers to adopting IoT/analytics solutions

2018

Barrier	
Security	42%
IT/OT integration	
Unclear ROI	
Technical expertise	
Interoperability	
Data portability	
Vendor risk	
Transition risk	
Legal/regulatory	
Network constraints	
Vendor lock-in	

0 10 20 30 40 50%

2022

Barrier	
IT/OT integration	39%
Technical expertise	
Interoperability	
Transition risk	
Unclear ROI	
Security	
Vendor risk	
Legal/regulatory	
Vendor lock-in	
Network constraints	
Data portability	

0 10 20 30 40 50%

Note: Respondents were asked to choose three barriers
Source: Bain IoT Customer Survey, 2018 (n=627); Bain IoT Customer Survey, 2022 (n=490)
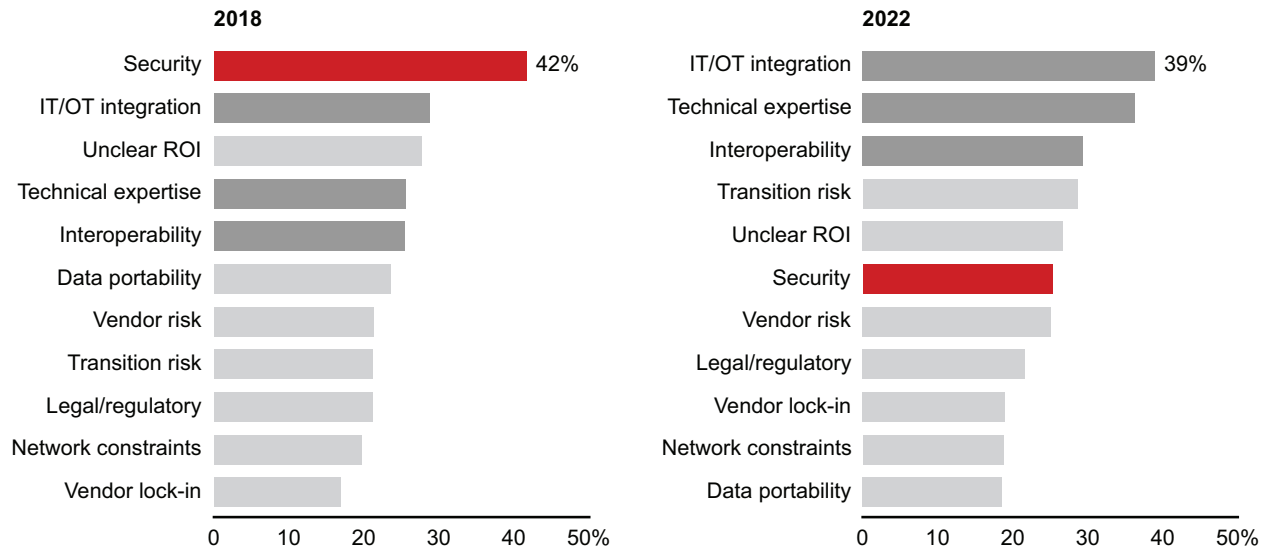
in the industrial IoT, can solve implementation challenges at the customer site. Using their system competence, they can help develop edge computing systems for AI inference, for example, or address such implementation challenges as unreliable networks by deploying 5G private networks or other modern connectivity technology.

Recognizing the importance of systems integration, leading hardware companies are building their capabilities. A decade ago, Krones, which provides packaging and filling lines for the food and beverage industry, began to develop industrial IoT-enabled digital solutions focused on food safety and quality and on enhancing line-operating and financial performance. Building both organically and through acquisitions, it has branched out from its hardware roots to offer software and systems integration as well. Krones's IoT-focused Syskron division was an important contributor to its 2021 gross margin of approximately 51%, 15 percentage points higher than that of peers.

Both hardware vendors and OEMs have strong customer relationships that could benefit software, cloud application, and platform vendors, who all listed customer access as one of their top three concerns when surveyed. Many industrial OEMs and hardware vendors have go-to-market and service and support capabilities tailored to specific industries and built with years of investment. Their higher customer lifetime values and more favorable customer unit economics mean they can more easily recover such investment than software companies.

Companies that don't have all the things IoT entails beyond software—sensors, hardware, implementation, and integration support—must either partner with companies that do or build those capabilities through acquisitions or internal development. Hilti, a builder of high-performance tools and fastening and protection devices, has used its direct-to-customer model, large field force (two-thirds of its 31,000 employees), strong brand recognition, and customer loyalty to build interest in its industrial IoT solutions, including ON!Track, one of the bigger point solutions in construction technology. Recently the company added solution consultants and integrators to expand its go-to-market and systems-integration capabilities.

Almost all IoT buyers want some sort of cloud connection, and Amazon Web Services and Microsoft Azure have invested especially heavily in programming frameworks and development platforms with predefined IoT applications. This has attracted developers that software vendors and analytics vendors want to work with *(see Figure 3)*. In our survey, cloud service providers, software application and analytics vendors all cite device or hardware leadership as either their biggest or second-biggest shortcoming. This opens an opportunity for industrial OEMs like Siemens, Schneider, and Hitachi, as well as companies like Intel and Cisco, to help them work on the toughest industrial IoT problems and, in turn, attract skilled developers with industry-specific expertise.

Working together will only become more important as industrial IoT solutions grow more sophisticated, requiring a combination of hardware, software, and services to deliver the expected benefits. Often,

Figure 3: Cloud and analytics platforms are the most popular among developers; Amazon's lead is significant

Number of developers on LinkedIn who mentioned each platform
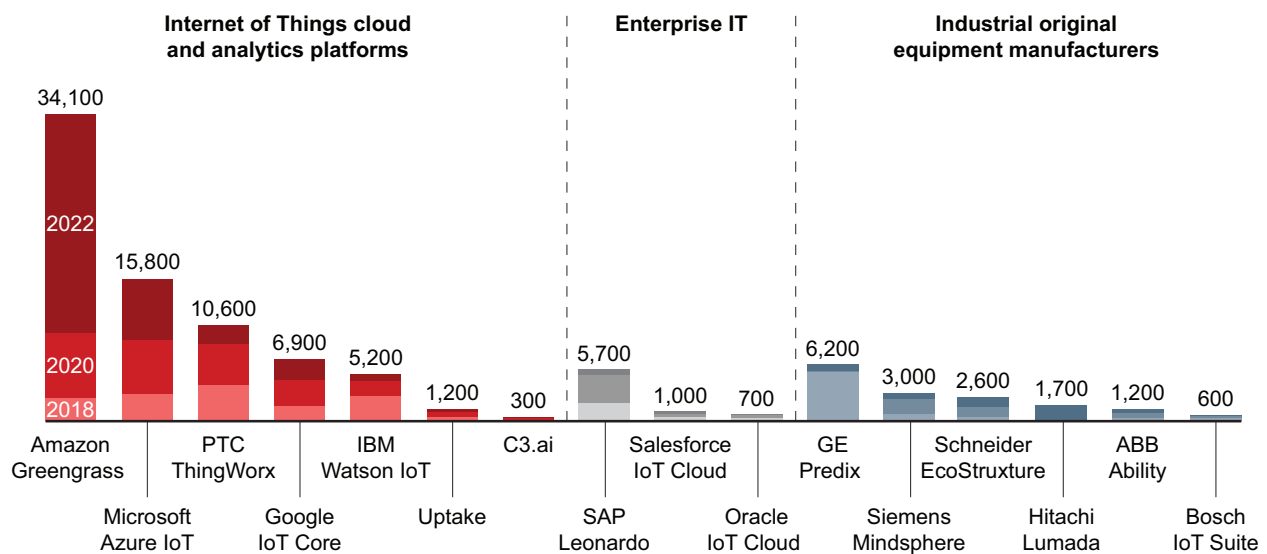
Notes: Mentions pulled from April 2018, July 2020, and February 2022, using keyword strings on LinkedIn; numbers rounded to nearest hundred
Sources: LinkedIn; company websites; Bain & Company

they'll have to tie into existing infrastructure and environments. It's a level of integration that requires domain know-how and industrial specificity. In construction, Hilti is showing how an incumbent can build an IoT-focused business. In packaging, another manufacturer has improved line performance stability by 30% and cut product defects and waste in half by using connected machines, mobility apps, and remote support to predict maintenance and spot performance deviation. Hardware companies and industrial OEMs have the industry expertise, integration experience, and partnerships to provide services and support that can take the industrial IoT from a series of successful pilot programs to something truly transformative.

Since integrating the assets and capabilities of software companies is so important, hardware vendors and OEMs building up an IoT business are smart to consider how they can partner with top software vendors and how they need to adjust their go-to-market strategy to include software in the mix. Likewise, software vendors can think about which hardware vendors could best close any gaps they have.
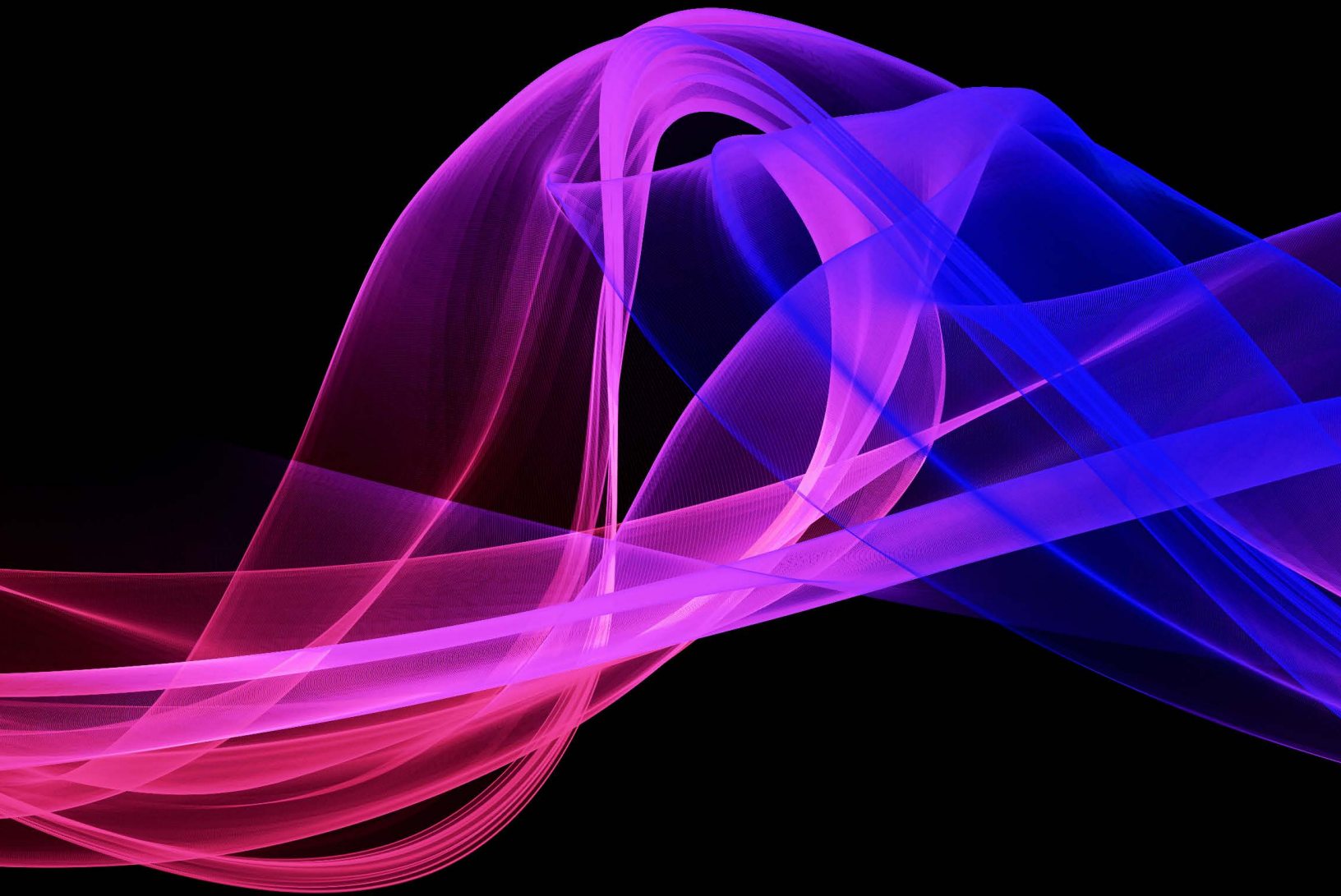
Operational Advantage

Is 60 the New (Rule of) 40? Setting a New Standard of Software Excellence

Elite software companies are beating the gold standard of performance and pointing the way for others to follow.

By Ann Bosche, Simon Heap, Rohan Narayen, and Christopher Schorling

At a Glance

▶ New market leaders have emerged that are far exceeding the performance gold standard Rule of 40, hitting numbers in the 50s, 60s, and even 80s.

▶ Bain has identified four archetypes among these superperformers.

▶ By using their archetype to tune investment in products and sales and marketing, companies can set an ambitious, yet realistic, performance target.

Even with recent stock market fluctuations, the growth and profitability of leading software companies remains strong by historical standards. When a company's year-on-year revenue growth rate and its earnings before interest, taxes, depreciation, and amortization (EBITDA) margin add up to 40, a company is balancing growth and profitability well. Recently, new market leaders have emerged that are far exceeding even that strong performance *(see Figure 1)* and doing so in all market conditions *(see Figure 2)*.

This has left executives asking two questions: How high should our target be? And how can we achieve it? The answers lie in better understanding what these superperformers are doing.

Figure 1a: Most software companies don't beat the Rule of 40, but four types of companies can and often do exceed it

EBITDA margin, 2021
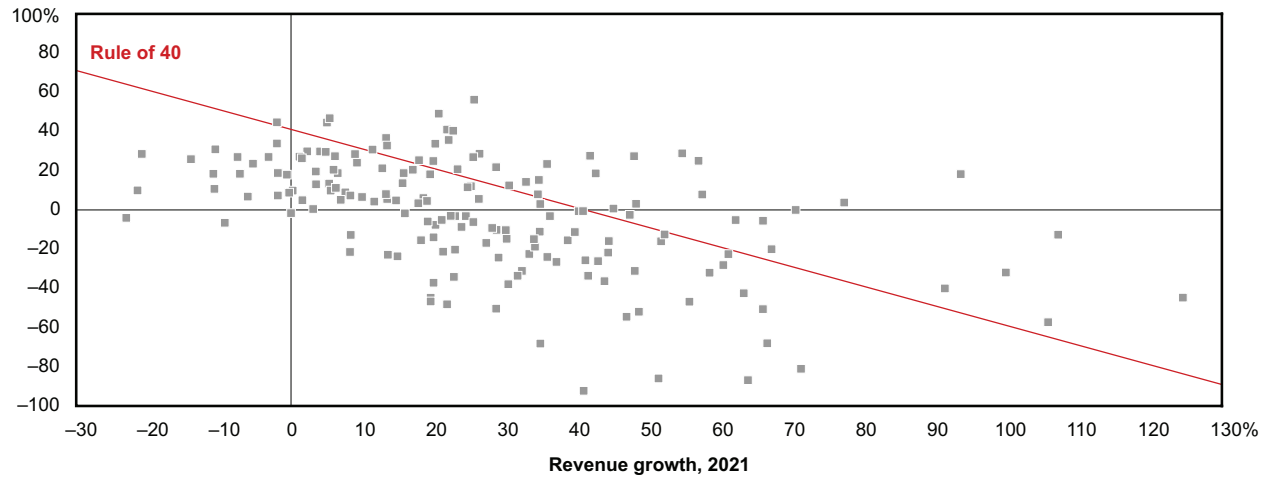
Note: The Rule of 40 holds that a company has effectively balanced growth and profitability when the sum of its year-on-year revenue growth plus EBITDA margin is 40 or more
Sources: S&P Capital IQ; Bain & Company (n=170 public companies)

Figure 1b: Hypergrowers scale quickly, offer a superior value proposition, rapidly distribute their products, and build a strong customer base

EBITDA margin, 2021

■ Hypergrowers
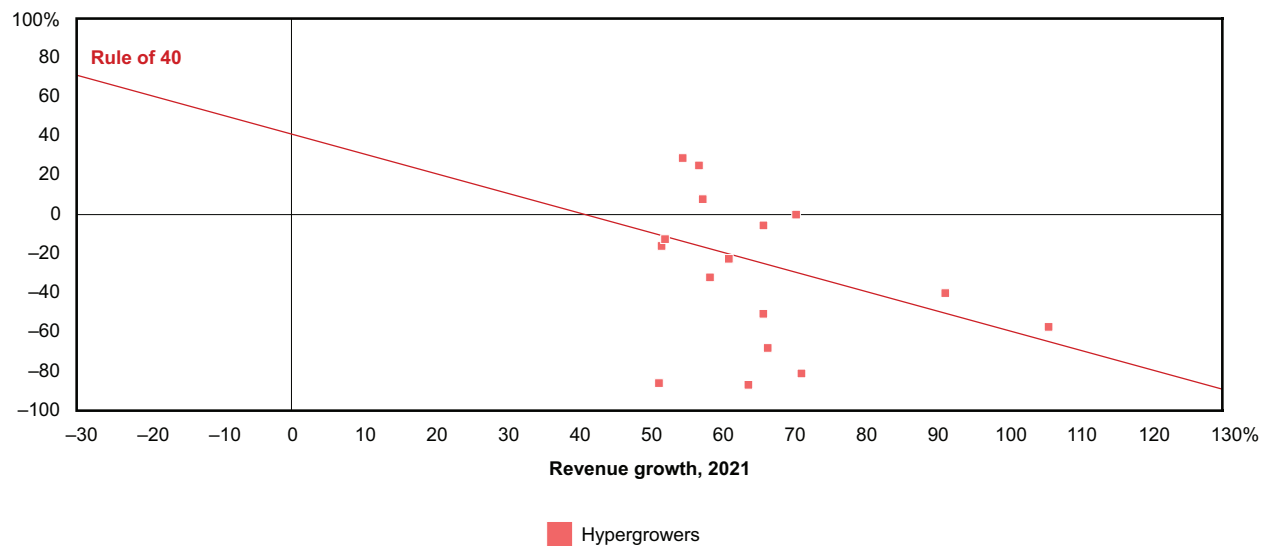
Sources: S&P Capital IQ; Bain & Company (n=170 public companies)

Figure 1c: Product-led growers are 1.5 times as likely to be above 40 as the typical company in our analysis

EBITDA margin, 2021
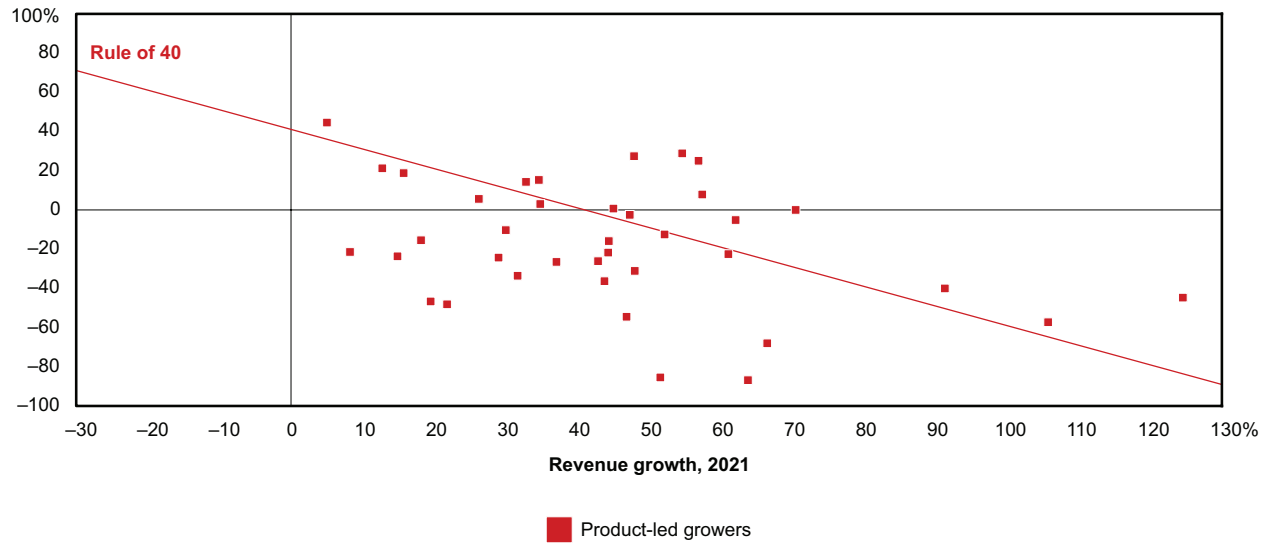
Product-led growers

Figure 1d: Category champions build sustained, highly profitable business around dominant core products

EBITDA margin, 2021
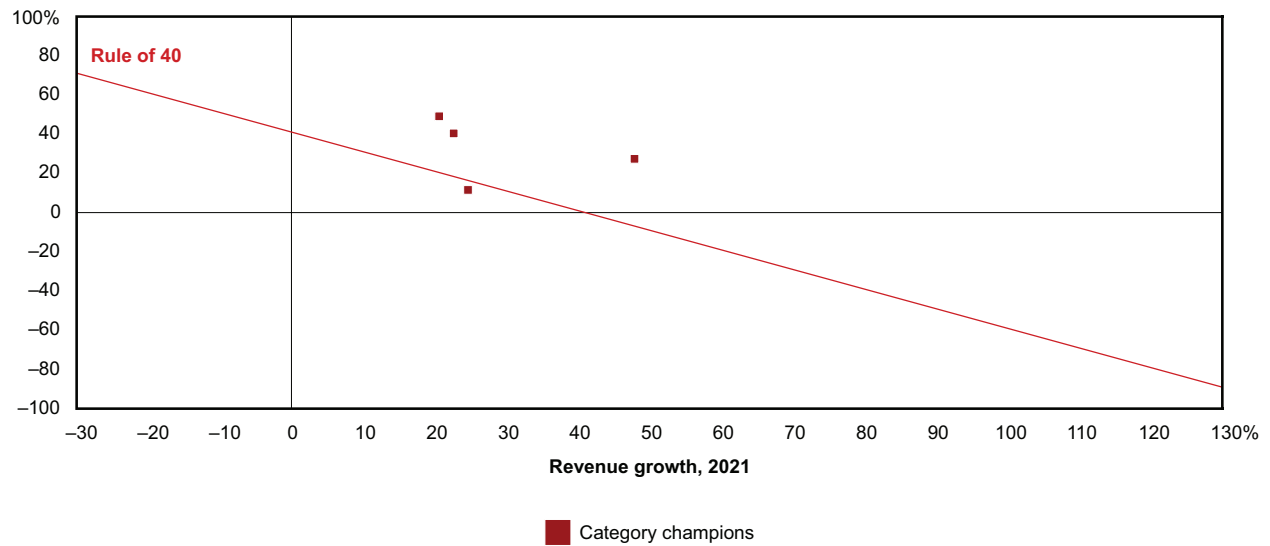
Category champions

Figure 1e: Consumer/small to midsize business digital winners operate with a streamlined cost structure, grow well, and scale quickly

EBITDA margin, 2021
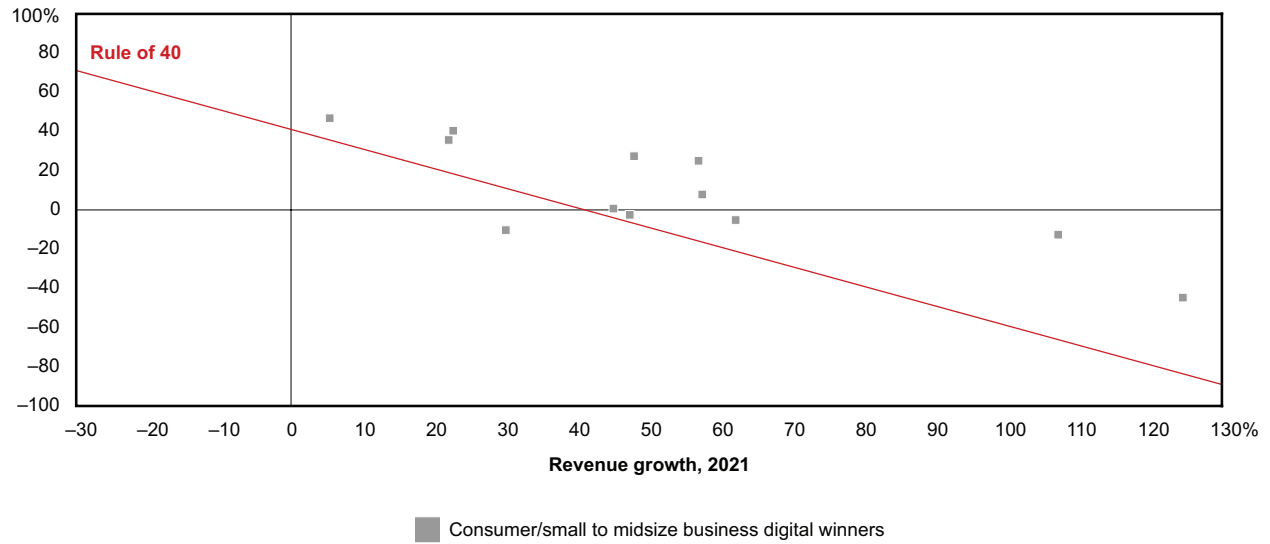
Consumer/small to midsize business digital winners

Figure 1f: Some strong performers fit multiple categories

EBITDA margin, 2021
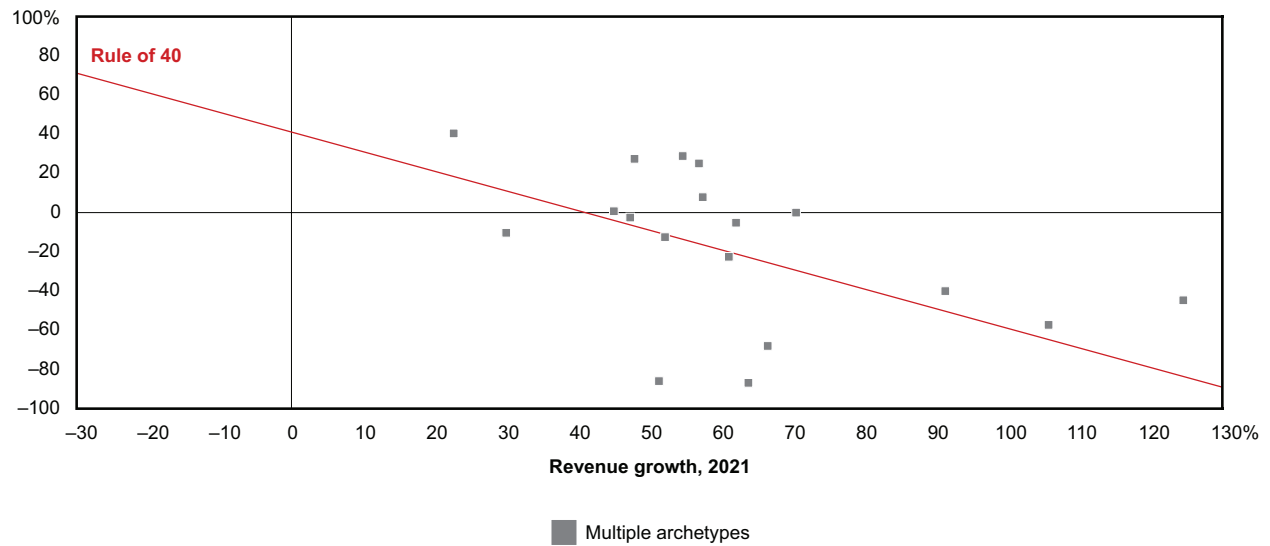
Multiple archetypes

Figure 1g: Hypergrowers, product-led growers, category champions, and consumer/small to midsize business digital winners often beat the Rule of 40

EBITDA margin, 2021
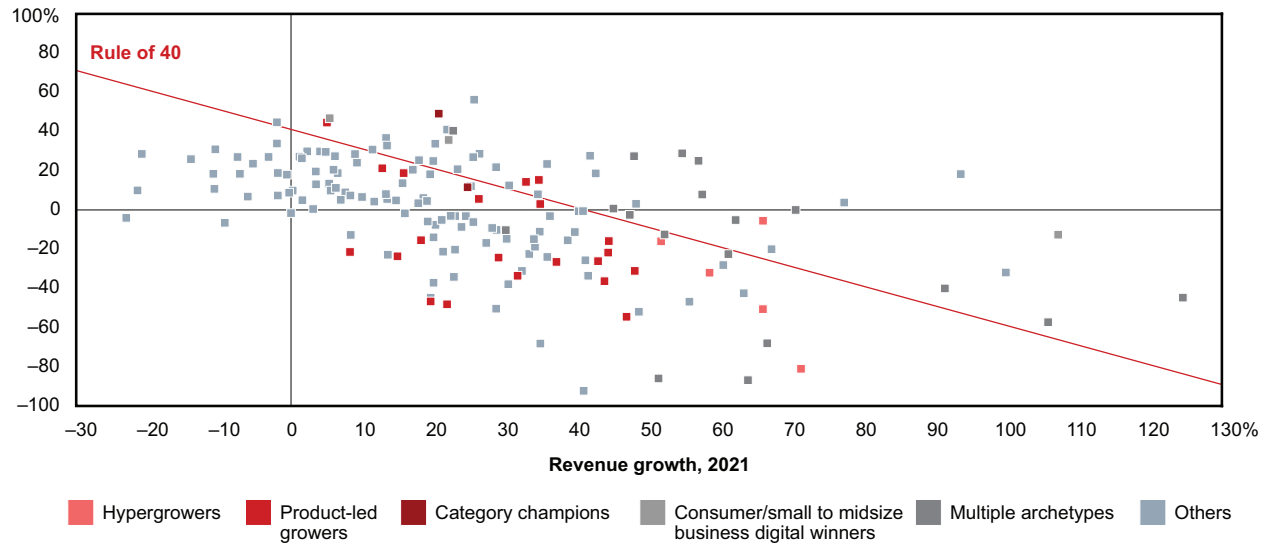
Sources: S&P Capital IQ; Bain & Company (n=170 public companies)

Figure 2: Whatever the broader market conditions, valuation multiples align with growth and profitability

Market capitalization/revenue, 2017–current

	Less than 30	30–39	40–49	50–59	60 or more
	6.5	9.1	11.8	11.1	10.9

YoY revenue growth percentage + EBITDA margin

| Current count | 103 | 21 | 17 | 10 | 19 |

— 2017 — 2019 — 2021 ▢ Current
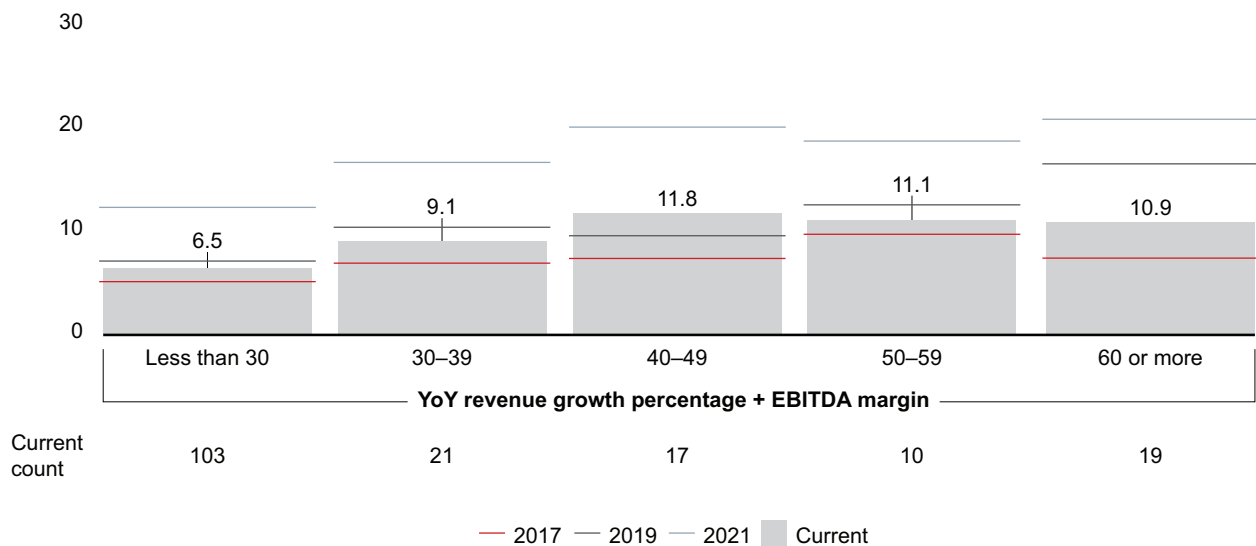
Note: Data as of May 24, 2022
Sources: IDC; S&P Capital IQ (n=170)

Four archetypes of superperformers

Not every company can realistically aim to exceed the Rule of 40, but through our research and experience in the market, we have identified four archetypes of companies that can, and often do, perform significantly above that, and some companies fit more than one type.

- **Hypergrowers.** Companies that fit this type include Datadog (73) in observability, CrowdStrike (61) in cybersecurity, and IT service management company ServiceNow (now 43 following a higher-growth period). All reached leadership scale rapidly and have made the most of market growth and their superior competitive value proposition, distributing their product to rapidly gain share and install a customer base that will be their most important asset in the long run.

Even with recent stock market fluctuations, the growth and profitability of leading software companies remains strong by historical standards. When a company's year-on-year revenue growth rate and its earnings before interest, taxes, depreciation, and amortization (EBITDA) margin add up to 40, a company is balancing growth and profitability well.

- **Product-led growth.** Companies like online meeting platform Zoom (83), observability platform Dynatrace (47), and signature platform DocuSign (46) set themselves apart by investing in valued product attributes, marketing, and pricing. They enable users to discover, download, adopt, and expand use of their product, often without ever having to involve a sales rep. Product-led growers are 1.5 times as likely to be above 40 as the typical company in our data set. Product-focused outperformers that are also hypergrowers include cloud warehouse Snowflake (49), application creation and work management platform Monday.com (51), and Datadog.

- **Category champions.** Software giant Microsoft (70) and digital media and marketing company Adobe (63) built sustained, highly profitable businesses around dominant core products. There are also many private companies, often industry-focused, that operate in more protected niches and enjoy strong pricing and lower competition.

- **Consumer and small to midsize digital winners.** Companies like cybersecurity software maker Avast (52) and Adobe sell digitally to small to midsize businesses or consumers and with a streamlined cost structure, achieve strong growth and scale rapidly.

Even for companies with outsized growth or profitability, consistent performance is not a given. The stock prices of a number of these companies have dropped in recent months, for example, as inflation and the overall stock market adjustment has hit high-growth businesses particularly hard. The question of how much they can continue to grow must be revisited often, and for businesses that are decelerating, this can be challenging.

How to achieve your target

Once a company has understood and appropriately defined its growth potential and set a Rule of 40, 50, or 60+ target, the next challenge is achieving it. That comes down to two things: (1) effectively managing sales and marketing expense and (2) achieving high returns on research-and-development spending.

Companies can begin their evaluation by carefully identifying and setting their growth and EBITDA targets, based on what's appropriate for their archetype, then launch into the work of improving sales and marketing productivity and pursuing product-led growth.

Effectively manage sales and marketing expenses. Sales and marketing is often the largest item on any company's profit-and-loss statement and the one function that most governs the top line. A key operational measure for managing profitable growth is the so-called magic number, which measures how many dollars of annual revenue growth are gained from each dollar spent on sales and marketing *(see Figure 3)*. Companies with low growth and systematically poor performance have low magic numbers because they haven't adjusted their sales and marketing spending to their slower growth rate. Higher-growth businesses can often significantly improve their magic number either through improved coverage models or digital tools.

Many small to midsize and consumer businesses wish to expand digital customer journeys and use test-and-learn techniques to improve those journeys over time. Ease of interacting or purchasing should always be top of mind, but using self-service to streamline sales, deploying digital training

Figure 3: Companies that achieve higher revenue growth and EBITDA targets tend to have higher magic numbers

Magic number for software companies, 2021
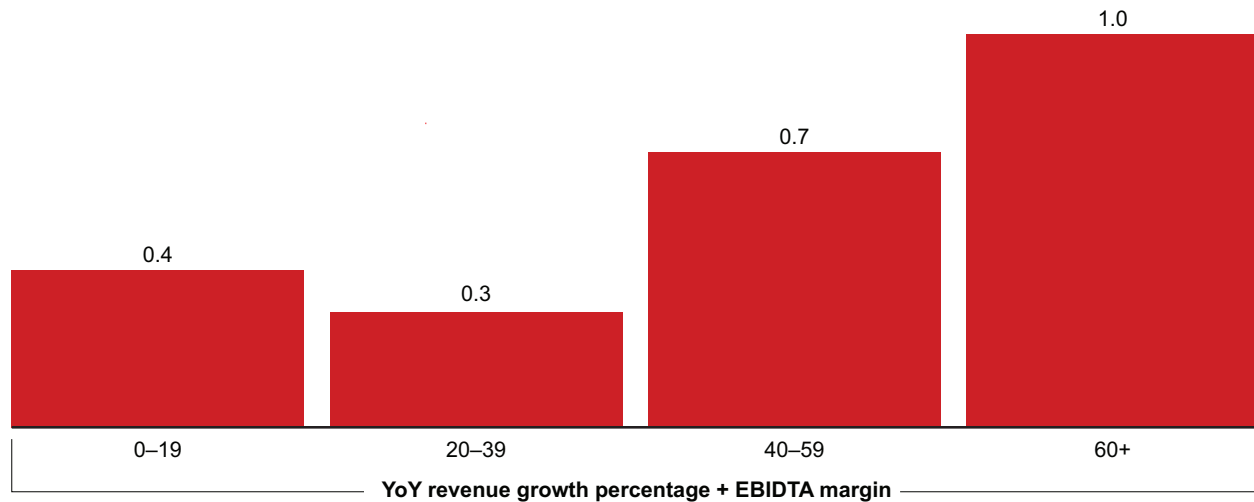
Note: A magic number is a measure of how many dollars of annual revenue growth are gained from each dollar spent on sales and marketing; 0.7 or less is considered overspending, 0.7–1.3 is balanced, and more than 1.3 is underspending
Source: OpEx Engine

and trigger-based product exploration, and integrating marketing into products with a philosophy of "see, try, buy" all offer an opportunity to reduce sales and marketing costs while increasing customer satisfaction.

Such steps can boost a low magic number, but a magic number that's too high is also a warning sign. The business may be playing it too safe and not fully exploiting the growth opportunity, even when growth is quite high. Boosting investments in sales, then marketing that well-established growth opportunity, can improve overall performance even more.

Embed marketing and selling into the product experience. What a company spends on its products vs. sales and marketing doesn't capture all the factors that affect a software company's performance, but this is an increasingly popular comparison that sheds light on how some companies are meeting and exceeding the Rule of 40.

Datadog is a prime example of a company that has grown quickly and achieved strong performance by investing in its products and pursuing product-led growth. With an EBITDA margin of zero, Datadog exceeded a Rule of 70 in 2021, spending 40% of its revenue on R&D and 30% on sales and marketing,

the opposite of what most companies do. Datadog's IT monitoring products are designed so customers start with a free trial but can easily increase the number of workloads, taking advantage of more than 500 vendor-backed integrations in their observability platform. This investment in the product experience has helped revenue grow 70%, while lowering the amount spent on sales and marketing as a percentage of revenue.

Whatever a company's performance goal, whether the Rule of 40 or something higher, that aspiration should be grounded in a realistic view of its growth opportunity. Companies can begin their evaluation by carefully identifying and setting their growth and EBITDA targets, based on what's appropriate for their archetype, then launch into the work of improving sales and marketing productivity and pursuing product-led growth.

Four Ways Tech Companies Can Boost Sales Productivity, Even in a Downturn

To grow revenue faster than sales and marketing expense, leading companies systematically improve their coverage models and invest in their sales reps' productivity.

By Jonathan Frick, Simon Heap, Jordan Lee, and Justin Murphy

At a Glance

▶ Only one in five technology companies increase revenue 10 percentage points faster than sales and marketing expenses, and only 3% do so consistently over four years, according to Bain research.

▶ Productivity leaders continuously improve the sales coverage model by taking four specific steps.

One ratio has for years been the gold standard of long-term success in technology: revenue growth that exceeds growth in sales and marketing expenses. While challenging to achieve, some companies nevertheless do it, and many others aim to *(see Figure 1)*. Now, with the significant recent drop in tech valuations, a tighter funding environment, and a less experienced salesforce due to the Great Resignation, it's that much more important for tech companies across the board to grow without big increases in spending.

Bain & Company research has found that the median productivity for technology companies is basically flat. Only one in five grow revenue 10 percentage points faster than sales and marketing expenses in a given year. And only 3% do that consistently over four years.

Figure 1: Few technology companies consistently improve commercial productivity

Annualized revenue growth 2017–21

Annualized growth in sales and marketing expenses 2017–21

◆ Revenue grew at least 10 percentage points more than sales and marketing expenses for all four years

Note: Consists of 131 software and 13 hardware companies with three or more years of available data from 2017 to 2021
Sources: S&P Capital IQ; Bain analysis

Today, many executives believe the route to the top of that chart lies in some combination of better training, generating demand, and deploying one or more of the nearly 10,000 digital sales and marketing tools available today.

One thing not often on their list: the sales coverage model. It's not surprising that following the disruption of Covid-19 and the rapid introduction of virtual selling, many executives hesitate to revisit their coverage model yet again, but productivity winners recognize the value of doing just that. They recognize that getting the right people focused on the right activities for the right customers at the right point in the sales cycle is a dynamic process that benefits from regular tuning. It's an approach that reduces attrition, gets new sales reps up to speed quickly, and cost-efficiently ensures that the right sales experts connect with customers at the right point in their journey.

Four areas of coverage model opportunity

Many elements of coverage models can be optimized, but leading companies consistently do four things.

Streamline and simplify specialty sales coverage. Growth through acquisition or new product launches often leads to the creation, and eventual proliferation, of specialized sales organizations. While initially important, if left alone, these roles often rust in place, leading to overlapping responsibilities for sales reps and frustration for both customers and reps. Once the salesforce is broadly knowledgeable about

the new products or buyers, sales teams can collapse specialist organizations and avoid this issue. This streamlining improves the customer experience, and the reduction in total interactions per customer can unlock significant team productivity. When, a few years after acquiring EMC, Dell merged the server and storage specialist teams in its corporate segment, rep productivity jumped approximately 20%.

Structure inside and outside sales roles to reduce travel and make it possible to cover more accounts. One of the many lessons from the pandemic is that inside sales reps can be as or more productive than outside reps when they put the time they aren't traveling into customer interaction at more accounts. Specialists or presale reps may find it easier than account executives to shift to these inside sales roles, since they typically aren't the primary relationship owner. A strong inside sales group ensures customers can work with experts on any topic, no matter where they're located, improving customer service and bringing real value to the company, often at a lower cost.
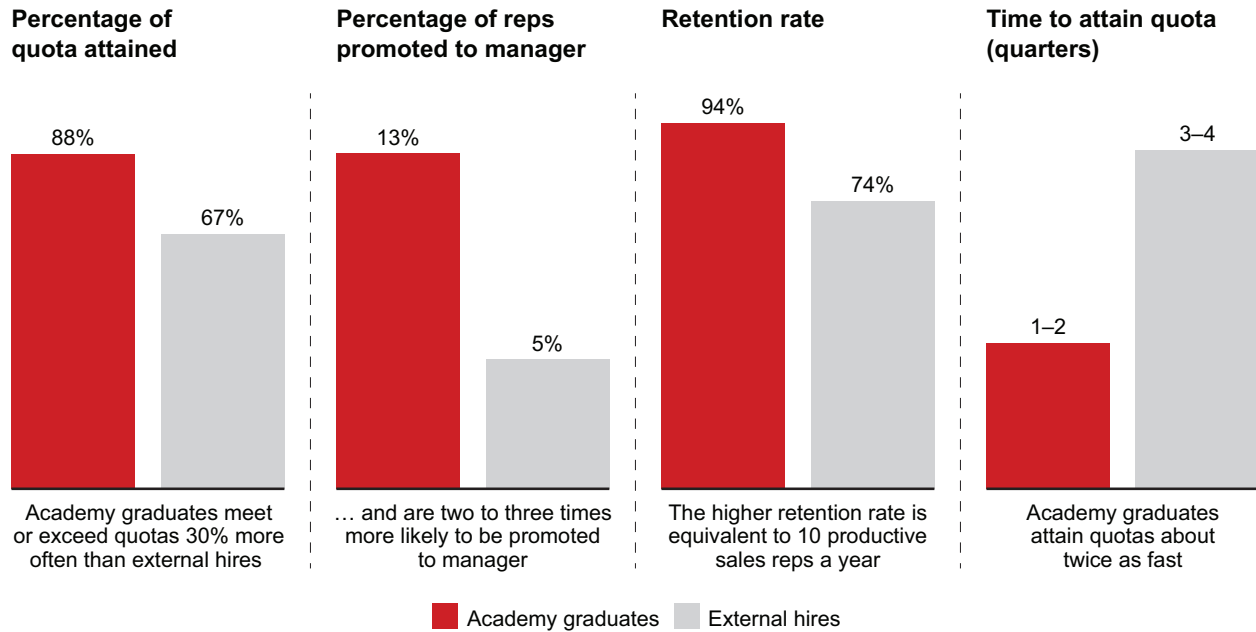
Train new reps at inside sales academies. In a world where talent is scarce and attrition increasing, a best-in-class inside sales academy that feeds the account executive pipeline is enormously valuable. Time in a role is the single biggest contributor to rep productivity, according to Bain research, with every two percentage points of attrition correlated with a one-percentage-point drop in productivity.

When one hardware company built its sales development program, it had a "rookie ramp" of roughly 12 months. That's how long it took new reps to reach their steady state of productivity. With many sales reps new to the job due to spiking attrition and talent shortages across the industry, the company built a well-designed inside sales academy to strengthen its bench *(see Figure 2)*. Graduates of the academy reached their quotas twice as fast as external hires and met or exceeded those quotas 30% more often. They were significantly more likely to stay with the company and more than twice as likely to be promoted to manager. Even before they took on account executive roles, the performance of these reps as inside sellers improved 30% after the training program was launched.

Maximize productivity by moving some high-cost quota-bearing roles to lower-cost and high-performing support staff. Once reps have to carry a product bag with too broad a scope, their productivity begins to suffer, and that's an easy mistake to make when a company is growing fast. At smaller companies with high growth rates and expanding product portfolios, optimizing sales roles likely involves injecting more specialized, back-office resources into both the sales and after-sales process.

At ServiceNow, a workflow management and enterprise-operations cloud-computing platform, revenue grew more than 30% last year to $5.9 billion, while sales and marketing expense grew 24%. One of many steps that contributed to that result is an effort executives launched to ease the administrative burden on their busy sales staff. In surveys, both customers and sales staff reported that renewal planning was among their greatest struggles. So the company took a step that saved account executives as a group tens of thousands of hours and improved their job satisfaction: transferring certain data collection and renewal planning to a less-expensive team in India. Planning the renewal for customers with sunsetting products can be quite tricky. The renewal team identifies the best replacement options to offer to these customers, freeing reps to focus on other areas of customer service. And because this group in India does so much of this work, it recognizes patterns and can more efficiently identify

Figure 2: A sales academy strengthened one company's sales staff

Percentage of quota attained

Academy graduates meet or exceed quotas 30% more often than external hires

- 88%
- 67%

Percentage of reps promoted to manager

… and are two to three times more likely to be promoted to manager

- 13%
- 5%

Retention rate

The higher retention rate is equivalent to 10 productive sales reps a year

- 94%
- 74%

Time to attain quota (quarters)

Academy graduates attain quotas about twice as fast

- 1–2
- 3–4

■ Academy graduates   ▢ External hires

Source: Bain & Company

the best options, improving customer satisfaction. As the business grows over time, these patterns can become the basis of a recommendation engine that automatically maps migration options, enabling these specialists to focus on reviewing more plans and refining migration strategies, further improving productivity.

Whatever the company's stage of growth, sales rep productivity can be greatly improved by making the right changes to the coverage model and complementing them with initiatives and digital tools that improve individual rep productivity. By consistently growing revenue faster than sales and marketing expenses, leading companies demonstrate the benefits of systematically improving coverage models while simultaneously investing in the productivity of frontline reps. For this select few, dynamic sales coverage models and a broader approach to productivity provide a powerful competitive advantage.

Is Consumption-Based Pricing Right for Your Software?

Some of the most successful SaaS companies charge for their software based on its usage, but that model works only when the conditions are right.

By Simon Heap and Sukh Brar

At a Glance

▶ Charging based on the use of software instead of by subscription is the model fueling some of the fastest-growing and highest-valued SaaS companies, and Bain consumer research points to more growth in the future

▶ Companies can determine if this is the right model for them by considering three critical questions: Can we create the right meter? Do our customers want this? Can we develop the capabilities needed?

Revenue for software-as-a-service (SaaS) companies has grown 22% a year compounded since 2017, evidence of its popularity with customers tired of underused "shelfware" software licenses and of managing their own infrastructure. Whereas traditional subscription-based SaaS is typically paid in advance based on a predetermined capacity, such as seats licensed, the latest evolution of SaaS uses consumption-based models that calculate the price based on measures of actual use, such as data ingested, messages sent, or hours used. There are many flavors of consumption pricing, ranging from pay-as-you-go to allowances that are burned down and limits that are capped, but all with payment that is ultimately based on usage and aligned with value.

Figure 1: Consumption-based pricing models are associated with some of the most highly valued software companies

Enterprise value/trailing 12-month revenue
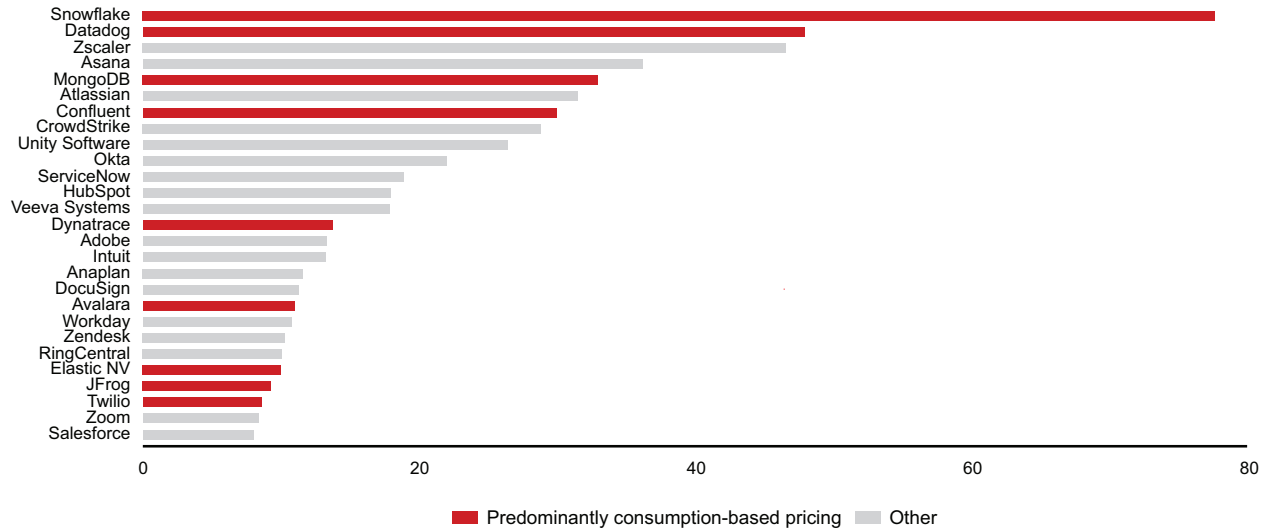
Notes: Data as of February 21, 2022; revenue measured by net dollar retention reported in companies' latest available financial report; NDR not available for all companies; some figures reported as estimates in 10-K filings
Sources: S&P Capital IQ; company 10-K filings

It has quickly become popular with customers. With consumption pricing, 80% of customers report better alignment with the value they receive, according to Bain & Company research. Nearly half of software companies using it say it has helped them acquire more customers, and two-thirds say it's helping them increase revenue with existing customers. Indeed, many of today's most valuable, fastest-growing SaaS companies employ consumption pricing *(see Figure 1)*.

In 2021, companies with primarily consumption-based models, including Snowflake, JFrog, Elastic NV, Datadog, and Confluent, increased revenue approximately 8 percentage points higher on average than companies that mainly license or sell subscriptions to their software. Among the software companies with the highest valuation multiples, those offering consumption-based pricing on average earned 10 points higher revenue retention from existing customers, as measured by net dollar retention (NDR).

Our research finds that customers expect to more than double their use of this model in the next one to three years, with most of that growth in the next 12 months. But even with this momentum, consumption-based pricing isn't suited to every situation *(see Figure 2)*. Three-quarters of software is still sold as a subscription or perpetual license, models that work well when customers know exactly how much they need. Consumption pricing has really taken off with platforms-as-a-service; cloud service providers like Amazon Web Services, Microsoft Azure, and Google Cloud; and infrastructure software and software tools serving developers.

Figure 2: Customer preference for consumption models outpaces current use in almost all types of software

Share of customers currently using consumption models vs. those who want to use them
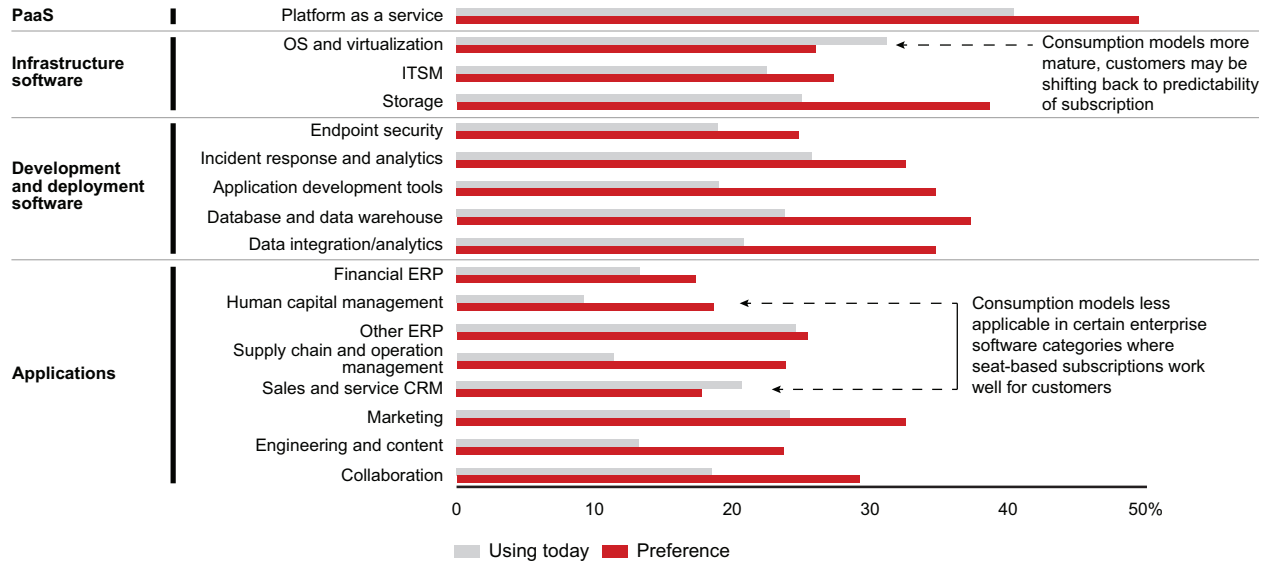
Notes: Current use is based on the number of positive allocations for all pricing models, with the total number of positive allocations for consumption-based models divided by total number of positive allocation for any model; preference shows the percentage of customers who prefer a consumption-based model; OS is operating system; ITSM is IT service management; ERP is enterprise resource planning; CRM is customer relationship management
Source: Bain consumption-based pricing model customer survey, November 2021 (n=1,015)

Choosing the right pricing model

Consumption models offer potential new growth, but before adopting one, a vendor must think through important strategic, operational, and investment considerations, and realize that this transition can take multiple years. Software companies can begin by asking themselves three guiding questions.

1. Can we directly tie the value of our offering to a clear, transparent consumption metric that makes sense for both customers and vendors?

Cloud software company Snowflake offers a usage-based pricing model with two metrics. For data storage, the company charges a certain dollar amount per terabyte per month after compression. For querying data, the metric is a dollar amount per second per warehouse, a flexible figure that enables customers to purchase any size and number of data warehouses. Because these metrics measure the use and value of the product's two primary functions, they clearly align with the value delivered to customers. Defined and quantitative, they allow for granular tracking, and customers have embraced them. Today, 93% of Snowflake's revenue is consumption-based.

A successful meter has several characteristics.

- **Value-based.** It aligns with the value customers receive.

- **Flexible.** Customers can control how much they use and pay only for that. Snowflake, for example, offers automatic suspension of warehousing charges when no query is running.

- **Scalable.** Value moves with consumption instead of being "worth it" only after or before a certain amount of use, and it feels fair to both small and large users.

- **Predictable.** Usage can be estimated and used to inform budgeting. This is difficult to achieve. More than 90% of users who prefer subscription models cite a lack of predictability as the main downside of consumption models.

- **Feasible.** The meter should be easy to monitor.

2. Are customers in our industry interested in paying based on consumption, and are competitors offering it?

In some applications like enterprise software for enterprise resource planning (ERP), human capital management (HCM), and customer relationship management (CRM), subscriptions based on seat count work well, and few customers are interested in changing models. For them, the value of the software lies in each user's ability to create a unique workspace and workflow for managing customer and prospect pipelines. Start-ups in these categories aren't using consumption models to disrupt. Operating system and virtualization software customers appreciate how the predictability of subscriptions aligns with corporate budgeting.

3. Do we have or can we see a path to developing the capabilities to operate the business in a consumption model?

The selection of the pricing meters and packaged offerings was just the start of a much larger journey for an infrastructure software company that recently shifted to consumption pricing. Each function in the organization has adapted:

- product development, by engineering telemetry into the product, creating dashboards to inform users of real-time usage, and featuring predictive models for forecasting;

- sales, by creating "land and expand" sales plays and enablement, and adjusting sales staff incentives to support ongoing consumption instead of Day 1 booking;

- services, by creating quick-start services that support starting small and then expanding;

- customer success, by finding ways to support incremental usage;

- sales operations and finance, by creating a plan to migrate to the new model and a business plan that balances new growth with the short-term drop in revenue expected from current customers who pay less in a consumption model; and

- systems, by building tools to estimate the cost of using the product and systems that route usage data to billing, customer reporting, financial systems, and sales and customer success dashboards.

The answers to these three questions will help determine if consumption pricing is right for your company. If it is, there will certainly be work ahead to develop the capabilities and offerings needed to make the transition a success, but it will give your company a shot at growth and valuation rivaling that of some of the best businesses in software.

Operational Advantage

Product Management: The Key to Unlocking Return on Your Software R&D Investment

Product management is instrumental to boosting returns on software development investments, but few companies do it well.

By Bill Radzevych, Rakesh Mehrotra, and Jay Bhatnagar

At a Glance

▸ Only 25% of chief technology officers say the return on their company's software development investments meets expectations, Bain research shows.

▸ Companies that excel in product management are over 40% more likely to beat the Rule of 40 performance metric.

▸ Leading companies build successful product management teams by empowering and properly funding them, focusing them on delivering value to customers, and better managing the product portfolio.

As companies across industries struggle to generate meaningful returns on their software research and development (R&D) investments, many overlook a solution that's right at their fingertips: effective product management.

Only 25% of chief technology officers feel the return on their software development investments meets the expectations of senior management and the board, according to a 2022 Bain & Company survey.

Executives know what derails these investments. It's usually some combination of an underdeveloped product roadmap that doesn't truly embody the company's strategy, poorly prioritized product features, poor software development execution, released products that don't address customer problems, and opaque engineering activities that make it difficult to focus on the right priorities or even understand what those priorities are.

While some of those challenges are squarely in the domain of the CTO or engineering leadership, effective product management can play an outsized role in resolving them. Bain evaluated more than 60 factors and found that strong product management is perhaps the single most important ingredient in achieving software development goals. And it leads to better performance in the market. Our analysis found that companies that excel in product management are over 40% more likely to beat the Rule of 40, the principle that a software company is balancing growth and profitability well when its combined revenue growth rate and profit margin exceeds 40%, regardless of company size, growth stage, or market (see sidebar "About the Rule of 40"). That's important because software companies that outperform the Rule of 40 have valuation multiples (measured by the ratio of enterprise value to revenue) an average of 50% to 60% higher than companies that underperform the rule, according to Bain research.

About the Rule of 40

Venture capitalists began to popularize the Rule of 40 in 2015 as a high-level health check for software-as-a-service companies, but it's broadly applicable to most software companies. The metric neatly captures the fundamental trade-off between investing in growth (including new products and customer acquisition) and short-term profitability. Analysts have differed on which measure of profitability to use—most use earnings before interest, taxes, depreciation, and amortization (EBITDA), but some have proposed free cash flow, EBIT, or net income as alternatives. We use EBITDA, a publicly available profitability metric that excludes the effect of taxes and accounting policies.

Most executives understand product management plays an integral role in software development. After all, product managers essentially own the product. They're responsible for building product roadmaps, coordinating development, and prioritizing which features to add. They also bring a valuable cross-functional perspective to development activities.

However, when we evaluated seven capabilities critical to a world-class product management organization (see sidebar "How We Measure Product Management Maturity"), we found very few companies do all of them well. More than 40% of companies in our survey self-reported significant gaps in two or more of the critical capabilities in our Product Management Maturity Index, saying they rarely or only occasionally demonstrate those capabilities.

How We Measure Product Management Maturity

- **Customer centricity.** Does the company deeply understand customer needs, such as purchase criteria, segmented by customer group?

- **Strategic roadmaps.** Are the company's product roadmaps well prioritized, and do they link to its overall business strategy?

- **Empowerment.** Do the company's product managers have ownership of the product's vision and strategy?

- **Engineering collaboration.** Do the product management and engineering teams work together to prioritize, appropriately scope, and deliver on product development efforts?

- **Marketing collaboration.** Do product managers work closely with product marketing on the go-to-market strategy, such as how to best position the product publicly and providing appropriate guidance to field sales teams?

- **Product life cycle.** Do product managers own and make effective decisions about the product life cycle, such as the launch and timing of retirement of the product?

- **Shared best practices.** Does the product management team have a defined set of best practices in areas such as product roadmaps, customer feedback, and market analysis?

In a company's early days, product management often has a leadership role, or at least a strong partnership. As the number of products increases and product management becomes one of many functions in a highly complex organization, the capability often atrophies. Too often, just when product managers are most needed to deal with complexity and simplify the product line, their role is reduced to program management, with important decisions led by engineering, finance, and sales. That can leave product managers frustrated, disenchanted, and more likely to leave.

Indeed, attracting and retaining top product management talent has grown more difficult. In this year's survey, about 40% of product management executives reported attrition rates of more than 15% during the prior 12 months, and 60% said attrition is worse now than it was three years ago *(see Figure 1)*.

How to reinvigorate product management

For most companies, any software R&D turnaround starts with putting product management back in the front seat. In our work with companies around the globe, we've found three steps critical to developing world-class product management.

Figure 1: Software product management executives report high attrition, and it's getting worse

What's the rate of attrition for product managers within your R&D organization over the last 12 months?

107

- Less than 5%
- More than 5%
- More than 10%
- More than 15%
- More than 20%
- More than 25%
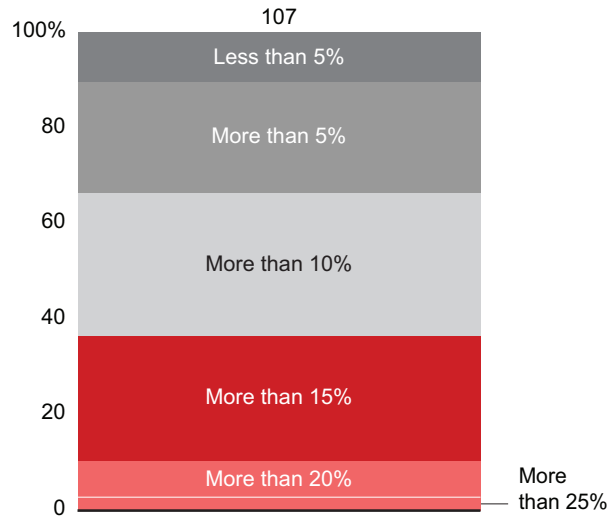
How does today's attrition rate compare with the attrition rate three years ago?

104

- A lot less
- Somewhat less
- Same
- Somewhat more
- A lot more

Notes: Data for product managers only; totals differ due to some respondents indicating "do not know"
Source: 2022 Bain Software Product Development survey (n=230)

Empower the product management team. Product management holds significant authority and leadership responsibilities at the most successful software companies, either as general managers or through an influential chief product officer. Giving product management teams responsibility for products from launch to retirement tends to increase their effectiveness *(see Figure 2)*. At leading companies, product managers direct product strategy decisions, and have significant cross-functional influence. And they have clearly defined expectations that everyone in the company understands *(see Figure 3)*.

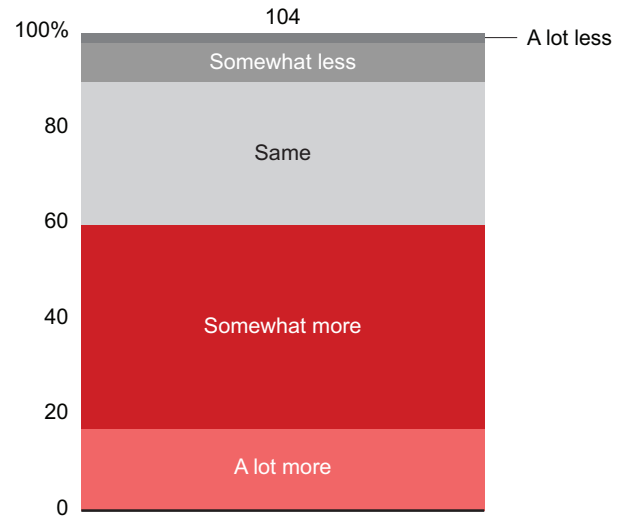Leading companies also dedicate sufficient resources to this function. Every company is different, of course; the need for product managers will vary based on the maturity of the product and the product manager's skills. But overall, too many companies expect great results without explicitly assigning product managers to all areas of software development or ensuring each area has the right level of support. Our research shows that the sweet spot for the best-performing product management organizations is one product manager for every 11 to 15 software engineers. Results decline when product management has fewer resources.

Strengthen the portfolio management capability. Clarifying the process for managing the product portfolio is a powerful way to align teams. It also tends to improve investment decisions.

In this context, portfolio management refers to key processes that nearly all companies have but often don't actively manage or explicitly document. Best practices start with linking the product

Figure 2: Empowering product managers to make decisions increases the team's effectiveness

Percentage of product managers who make decisions on product life cycle (e.g., launch and end of life)
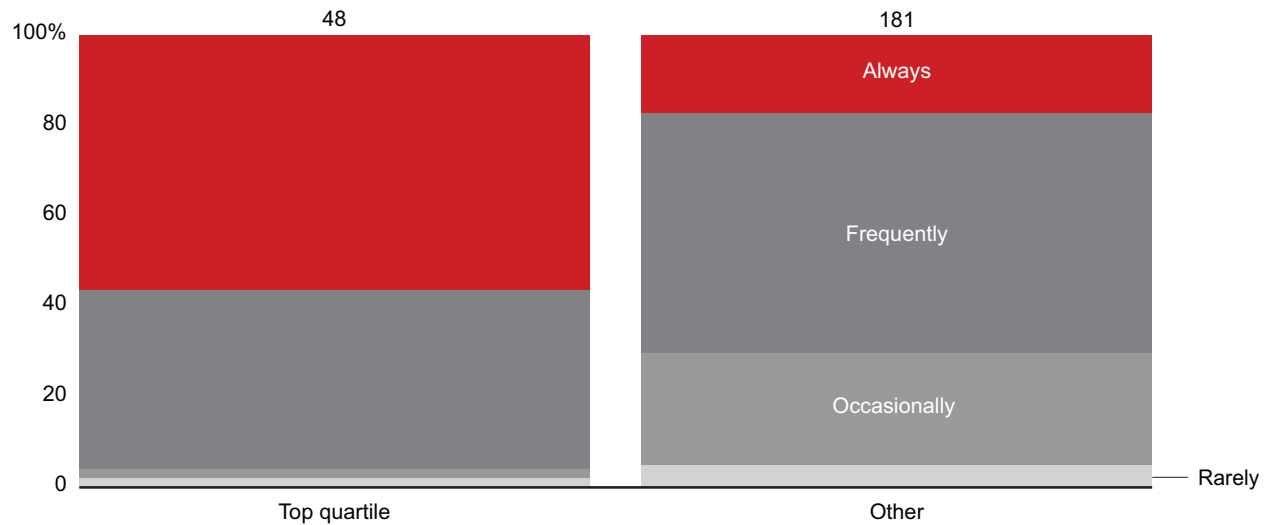
Note: Top quartile reflects product management maturity score calculated on four dimensions: decision effectiveness, portfolio management, resource management, and execution effectiveness
Source: 2022 Bain Software Product Development Survey (n=230)

Figure 3: High-performing companies create clear expectations for their product managers

The role of product managers in the organization is clearly defined and agreed upon

Agree ■ Strongly agree ■ Neutral ■ Disagree ■ Strongly disagree
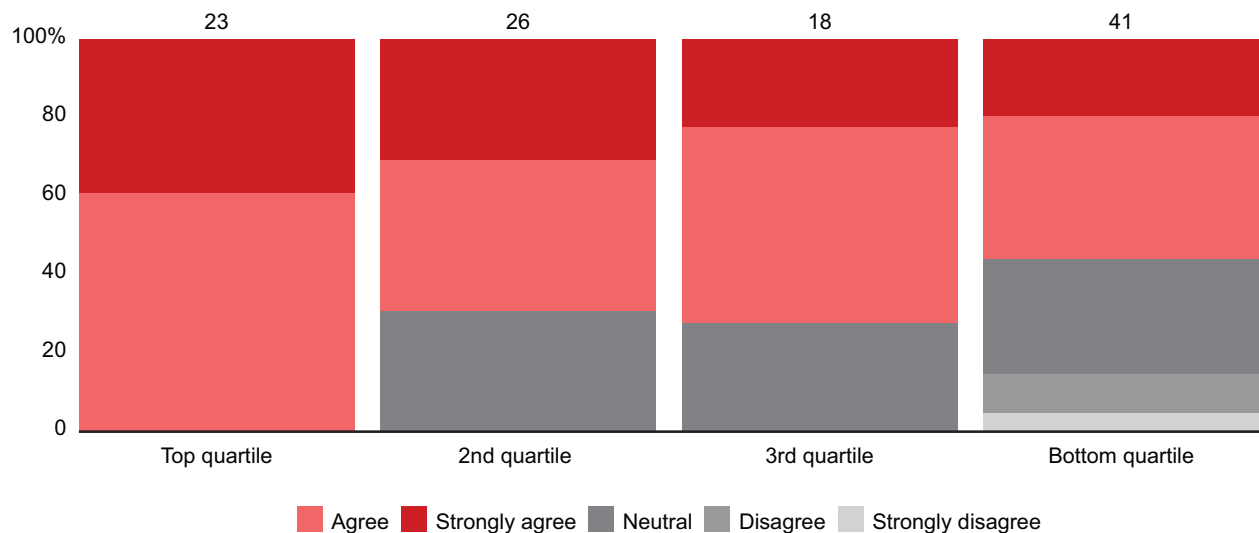
Note: Quartiles reflect product management maturity scores calculated on four dimensions: decision effectiveness, portfolio management, resource management, and execution effectiveness
Source: 2022 Bain Software Product Development Survey (n=230)

strategy to execution using a common language to describe distinct investments by product line and market. Next, companies institute a regular cadence to review and reset product investments. Finally, they make explicit who owns product decisions, and have well-defined methods for prioritizing within the portfolio. By creating a common framework and putting product managers in position to own and direct sections of the portfolio, companies avoid the common pitfall of failing to truly reevaluate the portfolio and instead repeatedly renew past decisions.

One software company freed up significant funds to invest in new growth areas simply by improving its portfolio management. The company redefined its product taxonomy, mapped its current investments so all teams were working from the same set of facts, and then clearly articulated its objectives for each part of the business. As a result, the company reallocated about 20% of its product budget to new sources of potential value creation, including one product that could power the company's growth in the future, all without disrupting existing businesses.

Focus on systematically delivering value to customers. At leading companies, this means regularly assessing product investment priorities based on hard data about customer usage, adoption, and engagement. Product managers have the autonomy to invest in areas that don't always pan out, with the understanding that investments will be adjusted as new data arrives.

These companies recognize that data alone doesn't tell the full story, so they also engage directly with customers. All product objectives aim to solve customer problems, and product managers often spend time with customers. Some even build customer meetings into their onboarding of a new product manager.

Top of the agenda

Product management is no longer primarily the purview of the head of product; at leading companies, it's top of mind for the entire C-suite and board of directors. They realize it can play a powerful role in directing engineering effort, maximizing precious R&D resources, eliminating low-value investments, and, ultimately, achieving and sustaining financial growth that outperforms the competition.
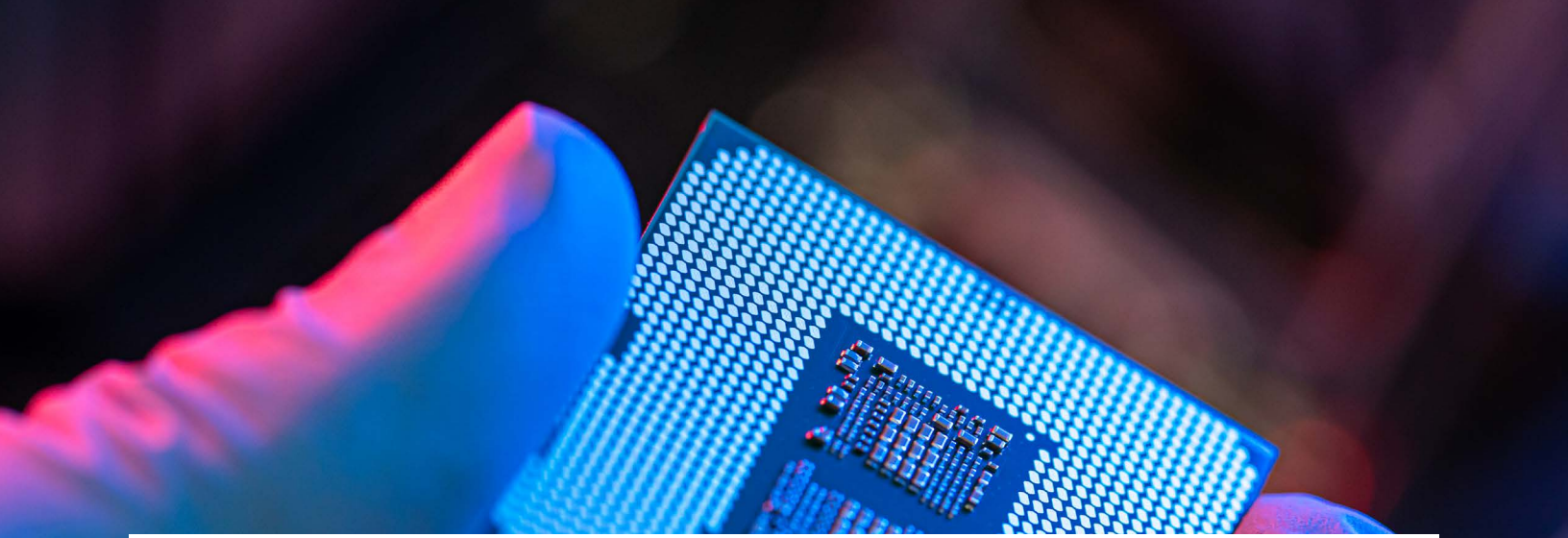
When Will the Chip Shortage End?

Even with recent investments and signs of improvement, the recovery will be uneven and depend on such wild cards as general economic activity, geopolitical tensions, and shortages of "bleeding-edge" chipmaking equipment.

By Anne Hoecker, Peter Hanbury, Hans Joachim Heider, and Sophia Zou

At a Glance

▶ The semiconductor shortage won't end on a single date. Some companies are starting to see relief this year, while others may have to wait until 2024 or later.

▶ Softening demand is the fastest route to relief, and it's conceivable given the slowdown in the global economy.

▶ Leading companies are designing their products to increase resilience, systematically assessing risks, investing in value chain innovations, and revamping their operating model.

As the global semiconductor shortage drags on, every tech executive is asking the same question: When will it end? But the more salient question might be: When will *my company* get relief?

The reality is the chip crunch probably won't end on a single date. Many disruptive factors continue to dog semiconductor supply chains—acute events such as Covid-19 lockdowns and extreme weather that lead to short-term operational disruptions, as well as structural supply chain weaknesses that have caused shortages of "leading-edge" 12-inch wafers with transistors of 28 to 130 nanometers, "lagging-edge" 6- and 8-inch wafers, and advanced substrates for "bleeding-edge" chips with transistors of 5 to 14 nanometers. Each has its own timeline to resolution. As a result, some companies are starting

Figure 1: Automotive and industrial companies are starting to see relief from chip shortages, but advanced computing products remain in a challenging period

Semiconductor use by industry
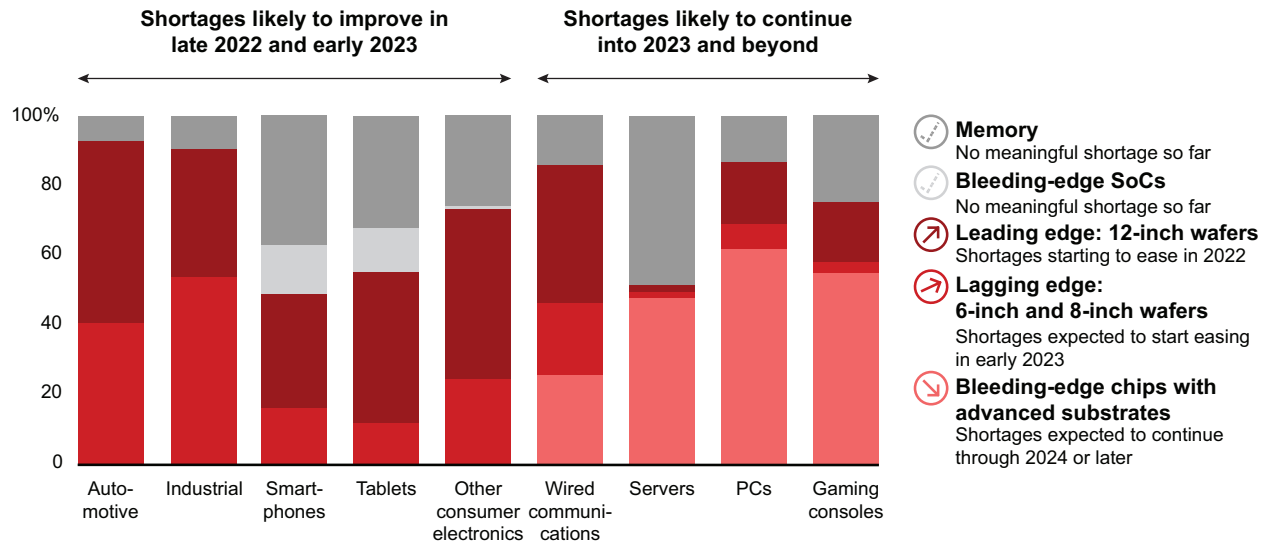
Note: SoC is a system on a chip
Sources: Gartner; Bain analysis

to see relief this year, while others may have to wait until 2024 or later *(see Figure 1)*. At the same time, several wild cards could cause more disruption, including the global economy, geopolitical tensions, and shortages of equipment for manufacturing bleeding-edge chips.

Many have followed how automotive companies cut back orders when Covid-19 hit, only to find themselves at the back of the line for wafers when they later needed them. But the larger impact has come from skyrocketing demand for technology products, and the long lead times required to build the fabrication plants that supply their chips has led to a chip shortage that has often played out unevenly but has affected nearly every end market in some way.

Some chip types (and the industries that rely on them) have been hit harder and at different times. After shooting up in 2021, lead times for chip deliveries have flattened at elevated levels in recent months *(see Figure 2)*.

These shortages will improve faster for certain products and industries, depending on the types of chips they use, but more tech executives are recognizing that the next phase of the shortage will be like the arcade game Whac-A-Mole. As one shortage recedes, giving affected chip buyers all the computing components needed to produce a complete product, those buyers will start to consume chip supplies in another area, causing new shortages to pop up.

Figure 2: After spiking in 2021, semiconductor delivery times flattened at elevated levels

Lead time (weeks)

| Average lead time | 10 | 11 | 11 | 12 | 13 | 14 | 15 | 18 | 20 | 24 | 26 | 25 | 28 | 32 | 29 | 33 | 36 | 31 | 32 | 30 | 30 | 30 | 30 |
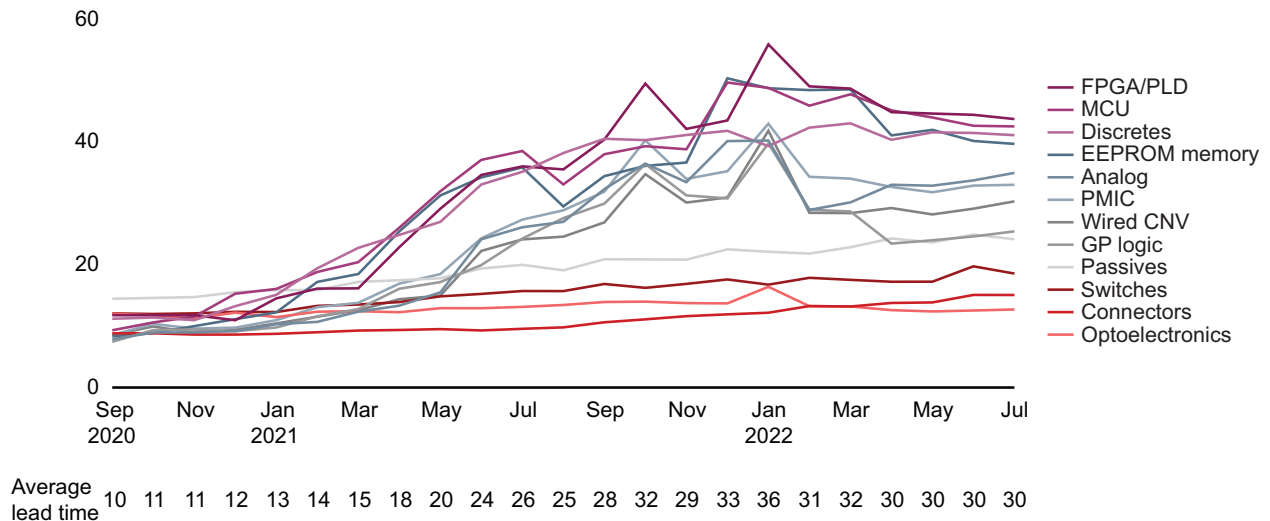
Notes: FPGA/PLD is field-programmable gate arrays/programmable logic device; MCU is microcontroller unit; EEPROM is electrically erasable programmable read-only memory; PMIC is power management integrated circuit; CNV is copy number variation; GP is general purpose
Sources: LevaData; Bain analysis

Three wild cards will determine how the shortage plays out.

- **Demand pullback.** Unfortunately, the fastest route to relief is softening demand. Inconceivable for the past 2 ½ years, this now seems a distinct possibility, given the economic outlook. There are already reports of tech companies temporarily pausing new component orders and asking suppliers to delay or shrink shipments amid inflation worries and growing inventories.

- **Shortages of extreme ultraviolet (EUV) lithography equipment.** These $150-million-a-pop machines are necessary to build bleeding-edge fabrication plants, and there's only one supplier, ASML. This bottleneck will likely grow over the next three years or so, potentially constraining capacity and limiting new plant openings at a time when semiconductor makers plan to spend well over $150 billion on new bleeding-edge production facilities *(see Figure 3)*. For more data on these projects, please visit our companion article at www.bain.com.

- **Geopolitical frictions.** The semiconductor supply chain has become a major strategic asset in geopolitical maneuverings, and not just in China and the West. This year, Russia limited exports of noble gases, including neon, a crucial ingredient in chipmaking. That followed Japan's 2019 restriction of exports to South Korea of high-purity hydrogen fluoride, an etching gas used in semiconductor manufacturing. Growing tensions between China and the US threaten to further

bifurcate the global technology ecosystems. The US has already cut off China from receiving advanced tools, and domestic-first policies in China may make it difficult for Western firms to access lagging-edge chips from China, where there's a concentration of lagging-edge wafer manufacturing hubs coming online. And these are just a few of the reasons that semiconductor consumers will need to increasingly consider geopolitical risks when sourcing their chips.

These wild cards are largely out of tech executives' control, but companies can take several pragmatic steps to protect themselves against chip shortages and the myriad disruptions to electronics supply chains that are undoubtedly coming.

Design products for flexible resilience. Leading companies constantly refine their products to increase resilience, ideally beginning early in product development and before a supply disruption hits. In our work with clients and analysis of the global landscape, we've found that certain things consistently succeed: reducing a product's number of parts, reusing components, using standard design approaches and flexible product architecture wherever possible, and decoupling software from hardware. In a chip shortage, for example, the fewer "hooks" the product has into silicon, the better.

Assess risks regularly. To help identify the next big supply crunch, leading companies proactively and continuously assess risks across their entire supply chain and all scenarios they can imagine. After chasing parts for 18 months, one global technology company recently stepped back to evaluate

Figure 3: Bleeding-edge fabrication plants will receive the lion's share of semiconductor capital investments in the next few years

Notes: Not exhaustive; includes select large fabrication plant expansions; category reflects the smallest production node at the plant; dates indicate start of production; STM + GF is a joint venture of STMicro and GlobalFoundries
Sources: Company announcements; lit search; Bain analysis

the potential magnitude and duration of a wide range of risks, including those related to specific suppliers, natural disasters, and geopolitical tensions. This helped highlight where investment was most critical to shoring up supply chain resilience. To reduce its reliance on a single supplier for key components, the company had to pay extra to keep multiple suppliers active and bring its procurement department into product development discussions earlier. As a result, the company should be able to fulfill more orders during the next major component shortage, potentially saving several hundred million dollars of revenue it would have otherwise lost.

Get closer to the semiconductor supply chain. In this era of increasingly frequent and intense supply disruptions, traditional supply chain approaches won't cut it. Many leading tech companies are developing closer relationships with their suppliers and the semiconductor ecosystem. Some are subsidizing suppliers' production capacity in exchange for a guaranteed, agreed-upon volume of product. Foxconn has gotten even more hands-on, forming joint ventures to build chip fabs in India and Malaysia. Others are doing more semiconductor design in-house and developing new capabilities to do so.

Revamp the operating model. To pull all of this off, leading companies are refreshing their operating model to improve collaboration among engineering, sales and marketing, and procurement—the teams critical to managing through and preparing for supply disruptions. For example, these companies create rapid feedback mechanisms to help the three departments communicate better and prioritize the most important customer requests and the highest-value product redesign opportunities. They further strengthen these operational muscles by emphasizing cross-functional collaboration in their training programs.

After two years of chaos, some tech companies are finally starting to see some relief from the chip shortage. The recovery will be choppy, but leading companies are moving quickly to control what they can, investing in supply chain resilience so they're ready for whatever comes next.

How Companies Can Build a Supply Chain for the Circular Economy

Reselling and recycling products can offer tech hardware providers a competitive advantage.

**By Tessa Bysong, Jeff Fortner, Peter Hanbury, and Joshua Hinkel**

At a Glance

▶ Technology hardware providers see new opportunities in circularity: the reuse, remanufacturing, and recycling of products and their components.

▶ Some companies are developing new revenue streams from selling second- and third-life products, which have been reclaimed from first-use customers and restored for resale.

▶ Circular supply chains have benefits, such as maintaining reliable supplies when inflation hits commodity markets, helping companies reduce waste and emissions, and staving off new competitors.

▶ Successful circularity efforts identify new ways to create value, anticipate disruption to profit pools, and plan for scale.

Technology companies are under pressure from investors, customers, and regulators to reduce their carbon footprint and become more sustainable. For some tech hardware companies, improving the circularity of their products—repairing, reusing, and recycling products and their materials—creates new value and supports their plans to become more sustainable, though most plans lack specific goals (*see Figure 1*).

Figure 1: Nearly two-thirds of technology companies don't have specific circularity goals

Have you committed to specific circularity outcomes, such as using 100% recycled packaging, recapturing e-waste, or refurbishing used equipment?
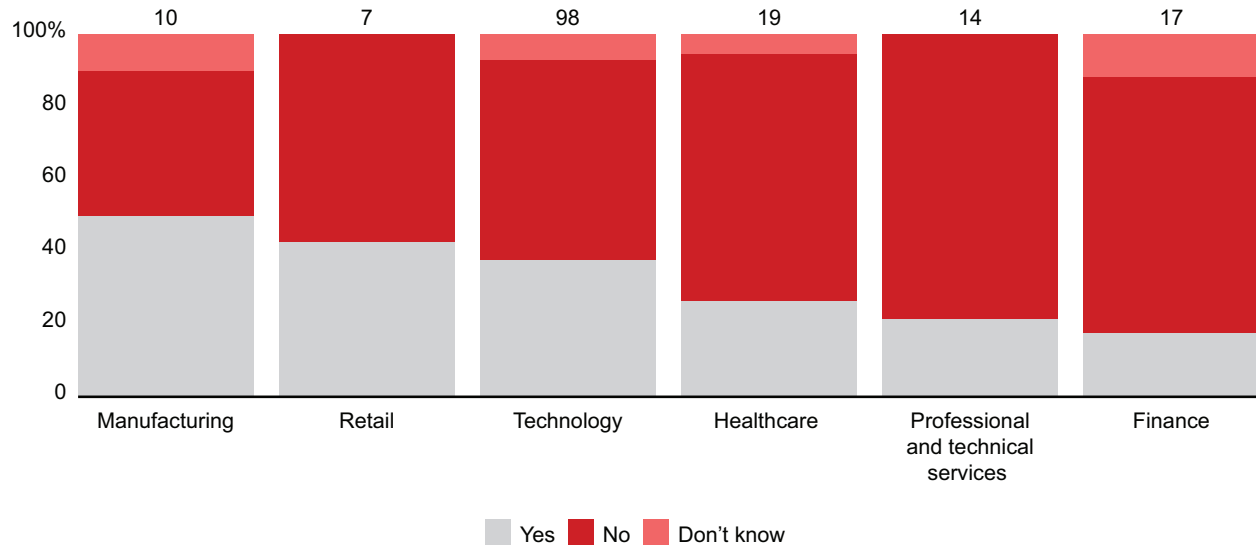

Source: Bain CIO/CTO Survey, 2022 (n=195)

Circularity can be particularly challenging in tech, where supply chains span continents, carbon footprints are large, and products are complex with short lives. The raw inputs for advanced technology products derive from a wide variety of sources, and improving circularity requires a deep understanding of the flow of materials before, during, and after the product's useful life *(see Figure 2)*.

But even with these challenges, the advantages and opportunities are hard to ignore. As inflationary pressures hit commodity markets and supply chain bottlenecks threaten to limit access to raw materials, executives are looking for new and innovative ways to ensure access to alternative sources of supply. Circularity also helps manage competition from other sectors for strategic materials, for example, battery materials such as lithium for electric vehicles. More circular and repurposed products could also earn a green premium from concerned customers.

If those are the carrots, there are also sticks. Regulations governing emissions and electronic waste are only going to increase, and more circular models will be essential to hitting those goals. Also, as more tech hardware moves to as-a-service models, providers will increasingly maintain ownership of the physical products, and circular models will help maximize reusability—and therefore, margins. Finally, private equity investors are wading in; if tech hardware providers don't extend into second- and third-use revenue streams, others will take those profits for themselves.

Figure 2: A material flow chart for a mobile phone shows how a manufacturer is pursuing circularity
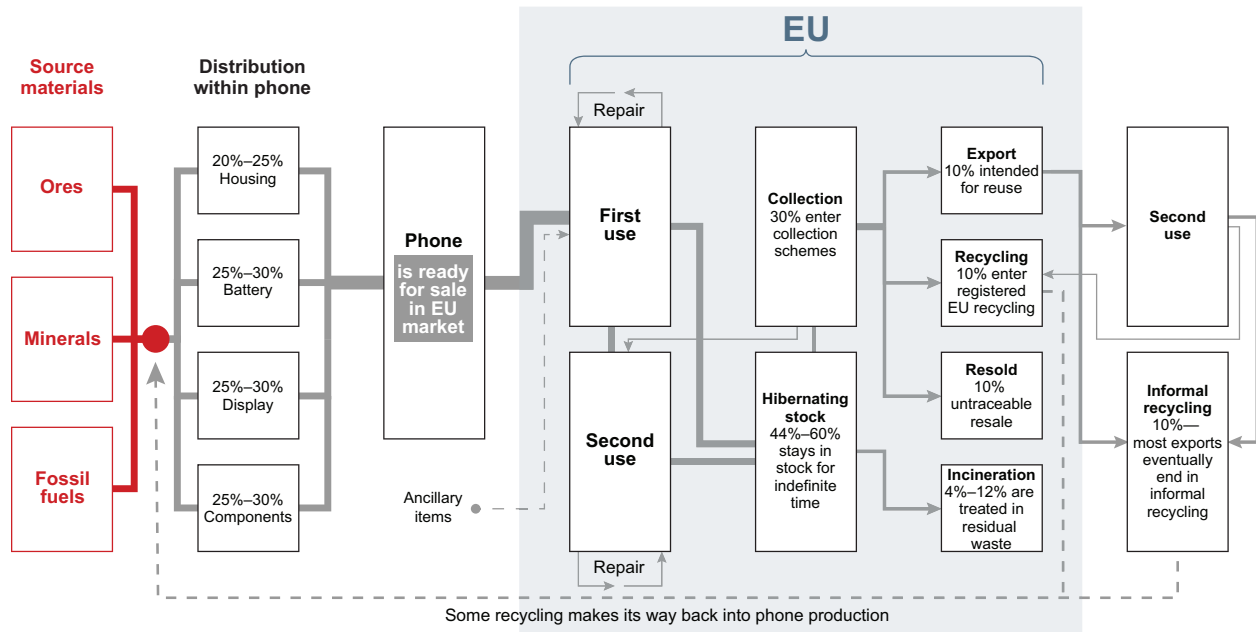
Notes: European Union example; hibernating stock refers to phones that are no longer used but haven't been collected or recycled
Source: Circle Economy

Seeing these opportunities, some tech hardware leaders have set ambitious circularity targets. For example, HP has said that it's designing products for long lives and to make it easier to recapture materials from products at the end of their useful lives. Dell has set a goal of sourcing all of its packaging materials and more than half of its product materials from recycled or renewable materials by 2030, and Apple has said that by 2030 every product it sells will have a net-zero carbon impact.

To meet such goals, companies are redesigning their products to make them easier to repair and more recyclable and are making plans to salvage and reuse valuable materials when products reach the end of their useful lives. This will require a coordinated internal strategy across product design, sales and marketing, and supply chain teams. And although most tech companies still don't have specific circularity plans in place, our research finds that tech companies have more detailed sustainability targets than companies in other industries do *(see Figure 3)*.

Some changes will be easier than others. But creating a more circular supply chain for any product is complex and will require the cooperation not only of the manufacturer, but also channel and other sales partners, along with the end consumer. Customers may not want to part with their old hardware or may not know the value in doing so.

Figure 3: Tech companies have more detailed sustainability plans than companies in other industries

Which of the following best describes your planning to hit sustainability targets?
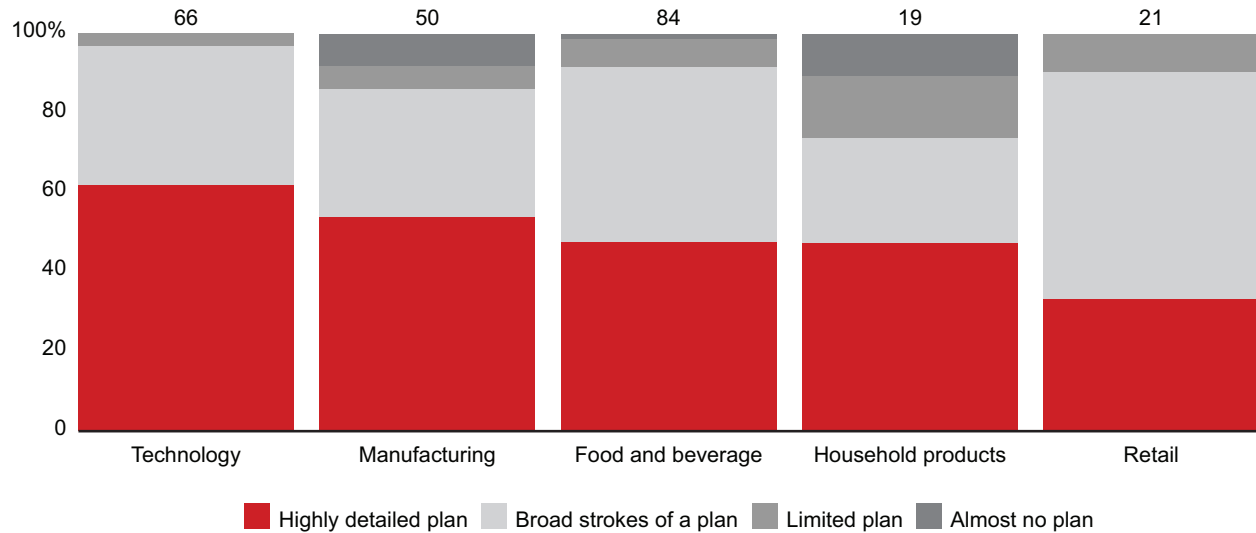
Note: Question asked only of companies pursuing circularity initiatives
Sources: Sales, Marketing, and Support Survey, Bain Circularity Survey March 2022 (n=246); Supply Chain Survey, Bain Circularity Survey, December 2021 (n=191)

Priorities of successful circularity programs

What can tech companies learn from circularity leaders that will help them develop momentum and generate new value? Successful circularity efforts focus on three priorities.

- **Identify new ways to create value.** Companies that view circularity through an investor's lens can get a jump on competitors by identifying new control points and business models that take advantage of them. Apple's planned iPhone subscription model is a good example, since it tilts the business more toward recurring revenue, which could do for hardware providers what the as-a-service model did for software. Interestingly, although tech hardware companies on average have more confidence in their ability to achieve their circularity goals than nonhardware tech companies, they're less confident of reaping the benefits.

- **Anticipate disruption.** Leaders plan for the possibility of their profit pools being disrupted by more circular rivals. The more invested a company is in circularity, the more concerned it is about disruption because its leaders are more aware of innovation and may have an earlier view of which new upstarts and business models are gaining traction.

As tech hardware players face the headwinds of commoditization, they can complement their investment in innovations for first-life products with an alternative profit stream from second- and third-life products, thus supporting the investment required to stay on the bleeding edge. For example, Dell's direct sales model is conducive to reclaiming and reselling its products for a second life, and that has allowed the company to build a robust business around refurbished equipment.

Circularity can be particularly challenging in tech, where supply chains span continents, carbon footprints are large, and products are complex with short lives. The raw inputs for advanced technology products derive from a wide variety of sources, and improving circularity requires a deep understanding of the flow of materials before, during, and after the product's useful life

- **Plan to scale.** Companies will need to do three things to scale their circularity solutions. First, they'll need to design products that can be repaired, refurbished, recaptured, and reused with less risk of damage, and are better suited for extracting recyclable materials. To ensure a pipeline of products to recycle, companies will need to retain ownership of the asset or create incentives for customers to return hardware, as some wireless carriers have with transparent pricing for buying back mobile devices when a customer upgrades.

  Second, supply chains will need to adapt to a more circular model, which means products must be more traceable. Knowing which products have gone to which customers in which regions, whether or not they have been returned, and where these products and their components are in the return value chain will be critical to supply planning. To achieve this, leaders need to develop their circularity efforts on platforms that suppliers and other external partners can support.

  Third, tech hardware makers will want to use technology to help disassemble products and optimize the mix of new and used. Apple uses artificial intelligence to predict the likely status of a returned device, the best channel to dispose of it (for example, resale or recycle), and the right offer to make on it.

Circularity is emerging as a necessity, and the tech hardware companies that move assertively to develop expertise and find the right business models—before regulators define the opportunities for them—will be more likely to meet their sustainability goals, achieve greater resilience in their supply chain, and capture higher profits from green premiums and second- and third-use revenue streams.

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