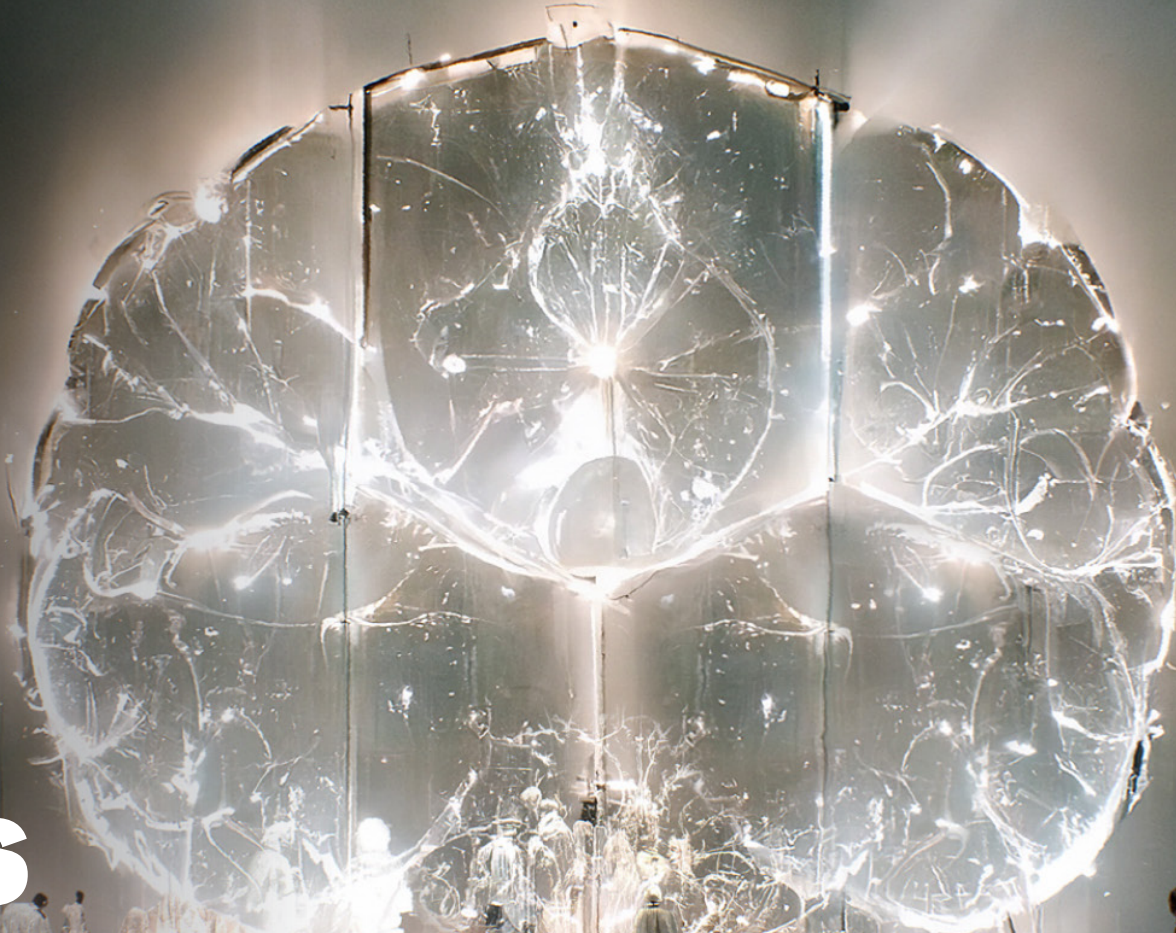**Deloitte.**
Insights

# Tech
# Trends
# 2023

# Executive summary

Deloitte's 14th annual *Tech Trends* report explores the impact of emerging technology opportunities in the innovation areas of interaction, information, and computation, and the foundational areas of business of technology, cyber and trust, and core modernization. Through the stories of pioneering organizations, we note what's happening now across sectors and geographies, highlight new technologies and approaches that stand to become the norm within 18 to 24 months, and project where the trends could be headed next during the coming decade.

## Prologue: A brief history of the future

The entire history of IT has been a steady evolution of the same three enduring eternities: interaction, information, and computation. The future of IT will continue to march along these same three tracks toward specific, convergent endgames: simplicity, intelligence, and abundance. Three additional categories—the business of technology, cyber and trust, and core modernization—acknowledge the reality that business drives technology, not the other way around, and that extant systems and investments need to play nicely with pioneering innovations so that businesses can seamlessly operate while they grow. Taken together, these six macro technology forces are the backbone of information technology.

# Eyes to the sky:
# Three enduring eternities

The history of IT has been a steady evolution of pioneering innovations in interaction, information, and computation, the three enduring eternities of modern computing.

## Trend 1

### Through the glass: Immersive internet for the enterprise

For a generation, the connection to the digital world has been mediated through an ever-shrinking series of rectangular screens. Now, as technologists recognize that screens can't keep shrinking forever, the paradigm is shifting again, toward interfaces that take users through the glass and into immersive virtual experiences, including the digital world known as the metaverse. Over the next few years, tangible, conversational, and virtual interfaces will likely continue to graduate from tech to toy to enterprise tool. While some companies build lucrative business models around the unique capabilities afforded by an "unlimited reality," others provide immersive environments for employees to streamline operations or collaborate and learn. As technology advances further over the next decade, organizations should be ready for reality to move online through expanded ways of interacting with mixed reality.

## Trend 2

### Opening up to AI: Learning to trust our AI colleagues

With AI tools increasingly standardized and commoditized, few businesses may realize true competitive gains from crafting a better algorithm. Instead, what will likely differentiate the truly AI-fueled enterprise from its competition will be how robustly it uses AI throughout its processes. The key element here, which has developed much slower than machine learning technology, is trust. As machines encroach on humanlike tasks that go beyond basic number crunching and enter the realm of discernment and decision-making via AI, the business world is having to develop a new understanding of what it means to trust machines.

## Trend 3

### Above the clouds: Taming multicloud chaos

To simplify multicloud management, some enterprises are beginning to turn to a layer of abstraction and automation that sits above the burgeoning multicloud. Known alternately as metacloud or supercloud, this family of tools and techniques can help cut through the complexity of multicloud environments by providing access to common services such as storage and computation, AI, data, security, operations, governance, and application development and deployment. Metacloud offers a single pane of control for organizations feeling overwhelmed by multicloud complexity.

## Feet firmly on the ground: Three foundational forces

Existing systems and investments—represented by the business of technology, cyber and trust, and core modernization—should integrate well with pioneering innovations so that businesses can seamlessly operate while they grow.

### Trend 4

**Flexibility, the best ability: Reimagining the tech workforce**

In the last year, many organizations have been engaged in a heated competition for a limited supply of technology talent. Yet with technical skills becoming outdated every few years, hiring for current needs is not a winning long-term strategy. Rather than competing in scarcity, savvy leaders consider an abundance frame, wherein technology talent can be curated, created, and cultivated. Companies should be prepared to eschew IT orthodoxies and prize flexibility as the best ability. By building a skills-based organization, tapping into creative sources for finding talent, and providing a compelling talent experience, companies can meet their talent goals. In the longer term, organizations should plan to brush up on their humanities, as AI technology advances enough to carry out many of the lower-order tasks that IT teams are burdened with today.

### Trend 5

**In us we trust: Decentralized architectures and ecosystems**

Blockchain-powered ecosystems are becoming key not only to developing and monetizing digital assets but also to creating digital trust. As organizations begin to understand blockchain's utility, they're realizing that building stakeholder trust could be one of its primary benefits. From everyday enterprise applications to blockchain-native business models, decentralized architectures and ecosystems disintermediate trust, placing it not in a single person or organization but distributing it across the community of users.

Organizations may be able to cement their credibility by helping reinvent a more decentralized internet—Web3—in which a single, immutable version of the truth is based on public blockchains. In this world, digital natives are increasingly likely to demand higher-quality proof and higher-order truth. Digital ledger technologies and decentralized business models that achieve consensus through code, cryptography, and technology protocols are demonstrating that none of us is as trustworthy as all of us.

### Trend 6

**Connect and extend: Mainframe modernization hits its stride**

Rather than rip and replace legacy core systems, enterprises are increasingly looking to bring them into the modern era by connecting and extending them to emerging technologies. Through tried-and-true approaches to legacy system modernization, businesses are leveraging mainframes—and their precious data—to drive digital transformation.

## Epilogue:
## Widening the aperture—
## From infoTech to xTech

Historically, to enterprise audiences, "technology" has served as shorthand for *information* technology. But separate and distinct from enterprise IT, an extended set of technologies—or xTech—are on the horizon. Rooted in the formal, natural, and social sciences, these academic and research areas are brimming with patent and startup activity, technology maturity and advancements, academic and grant investments, and venture capital funding. And they're attracting the best and brightest talent. We anticipate six emerging technology disciplines to eventually rival IT in their impact on business innovation: space and aeronautical engineering; cellular and biomolecular engineering; brain and nervous systems applications and interfaces; climate, sustainability, and the environment; autonomous and precision robotics; and power, energy, and battery technologies.

# Prologue

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## A brief history of the future

Several years ago, at a demo day at Silicon Valley's Computer History Museum, I came face to face with the history of the future. At the time, I was a venture capitalist on the hunt for the next big thing. During a break from startup pitches from the best and brightest entrepreneurs, I wandered among the museum exhibits, where I stumbled upon a modern recreation of the first computer, designed in the 1840s by English polymath Charles Babbage.

I was fascinated to read about Babbage's Victorian-era designs, particularly his Analytical Engine, a mechanical general-purpose computer that he worked on with fellow mathematician Ada Lovelace. The Analytical Engine shared many features with modern digital computers, including three key components: the reader, the mill, and the store.

The reader took in punch cards, permitting user interaction with the machine. The store held information—numbers and interim results—until they could be acted upon by the mill, which performed mathematical computations.

Babbage couldn't have known then that these three fundamental functions would still exist today, serving as the enduring foundation of modern computing. In fact, as we demonstrated in a joint research report with the World Economic Forum, the entire history of IT has been a steady evolution of these same three eternities: interaction, information, and computation.[1] In turn, it stands to reason that the *future* of IT will continue to march along these same three tracks toward specific, convergent endgames: simplicity, intelligence, and abundance (figure 1).

# Interaction: Toward simplicity

Electronic, digital general-purpose computers appeared about 100 years after Babbage's design. Room-sized computers weighed tons and were programmed with punch cards, but within three decades, users interacted with desk-sized computers using the command-line interface.

By the 1990s, desktop-sized computers boasted graphical user interfaces, and simple iconography replaced arcane computer syntax. Later, point-and-click evolved to touch-and-swipe on portable computers carried in pockets and worn on wrists, and to virtual assistants that can understand voice commands. Today, extended reality can take us to immersive 3D universes where our digital doppelgangers interact and engage in virtual experiences.

**FIGURE 1:** A brief history of the future

| TIME (years) | ←  t–175 | t–75 | t–50 | t–25 | t–10 | t | t+10 | t+n | t=∞  → |
|---|---|---|---|---|---|---|---|---|---|
| **Eternities** | **Babbage's design** | **First digital computer** | **Mid-20th century** | **Late-20th century** | **Early 21st century** | **2023** *Today* | **Horizon next** | **Furthest stars** | **Endgames** |
| **Interaction** | Reader | Punched cards | Command-line | Graphical user interface (GUI) | Mobile devices | Extended reality | Ambient experiences | Neural interfaces | **Simplicity** |
| **Information** | Store | Arithmetic calculation | Relational databases | Descriptive analytics | Predictive analytics | Cognitive automation | Exponential intelligence | General-purpose AI | **Intelligence** |
| **Computation** | Mill | Mainframe | Mini-computer | Client server | Cloud architectures | Decentralized platforms | Spatial web | Quantum computing | **Abundance** |

Source: Deloitte, Technology Futures Report 2021, accessed October 2022.

## What's next for interaction?

The technologies that power human-computer interaction get more complex, but user experiences get *simpler*.

So what's simpler still? Ambient experiences, in which ubiquitous digital assistants monitor the environment, awaiting a voice, gesture, or glance, reacting to (or proactively anticipating) and fulfilling our requests. And beyond that? Neural interfaces that afford direct communication between biological thought and digital response. Today's smart thermostats accept voice control; tomorrow's will know you feel chilly and proactively adjust to ensure your comfort. Researchers are already exploring how neural interfaces might help people with certain disabilities use brain signals to control external devices.

# Information: Toward intelligence

When Babbage designed his Analytical Engine, information meant numbers and, later, mathematical operations. Over time, arithmetical calculations gave way to relational databases of clearly defined and structured data. By the aughts, databases became advanced enough to manage unstructured data such as text, audio, and video. This structured and unstructured data could, in turn, be mined for patterns and trends. So began the era of descriptive analytics.

The last decade or so saw the rise of predictive analytics: what we can expect to happen based on observed patterns and trends. Today, cognitive automation systems combine predictive analytics with algorithms and AI to make useful data-driven decisions in real time.

## What's next for information?

As our information systems continue to advance, machine intelligence itself will become increasingly well rounded.

Computer scientist Larry Tesler once quipped, "Artificial intelligence is whatever hasn't been done yet."[2] The future of AI, then, might be broadly defined as exponential intelligence: a progression up the curve of capabilities that have, to date, seemed "uniquely human."

Affective AI—empathic emotional intelligence—will result in machines with personality and charm. We'll eventually be able to train mechanical minds with uniquely human data—the smile on a face, the twinkle in an eye, the pause in a voice—and teach them to discern and emulate human emotions. Or consider generative AI: creative intelligence that can write poetry, paint a picture, or score a soundtrack.

After that, we may see the rise of general purpose AI: intelligence that has evolved from simple math to polymath. Today's AI is capable of single-tasking, good at playing chess or driving cars but unable to do both. General purpose AI stands to deliver versatile systems that can learn and imitate a collection of previously uniquely human traits.

## Computation: Toward abundance

Computation turns inputs into outputs. From mill to mainframe to minicomputer to client server, advances in computation were a story of miniaturization: Moore's law and the relentless march towards better, faster, cheaper, and stronger. In practice, that changed over the decades with advances in virtualization, culminating in modern cloud architectures. Computing became a distributed utility, promising elasticity, flexibility, and possibility to those embracing it.

Today, the shift to the cloud has, in turn, given further rise to decentralization—technologies and platforms rooted in the cryptographically secure blockchain. Decentralization recognizes that millions of processors, disks, and resources sit idle for much of the time, and that they can be marshaled as resources. Decentralized storage, compute, domain name system (DNS)—and yes, currencies—spread the work and the trust across a community of network participants, demonstrating that none of us is as capable, or as trustworthy, as all of us.



## What's next for computation?

As computers continue to miniaturize, virtualize, and decentralize, our capacity to process data, create and curate content, develop and code, and solve problems is on an unstoppable march toward abundance.

Fueled by decentralized networks, edge computing, and advanced connectivity, the spatial web is likely to blur the lines between physical and virtual environments. As reality itself increasingly comes online, digital content will be seamlessly woven into our physical spaces, inseparable from our shared personal and professional experiences. And waiting in the wings? Quantum computing—going beyond bits entirely, and harnessing the quirky laws of quantum mechanics to speedily solve previously intractable problems with physics rather than mathematics.

## *Tech Trends 2023:* **Eyes to the skies, feet firmly on the ground**

Futurists don't have crystal balls. Instead, we subscribe to the notion that "the future is already here, albeit unevenly distributed." Our *Tech Trends* team has spent the better part of 14 years looking across all sectors and geographies for glimpses of pioneering leaders building distinct facets of the future, today. Fully half of the trends that we've chronicled fit into the three enduring categories of interaction, information, and computation described above.

But why only half?

Startups often embrace the mantra "move fast and break things." It's easier for them to be disruptive because they're definitionally starting from zero and don't yet have a legacy to protect. Established organizations, on the other hand, very much do. Successful businesses realize they can't risk breaking "now" in pursuit of "new." Our responsibility is to balance our pioneering inclinations with the solemn duty of stewardship; to do no harm, the Hippocratic oath of IT. Responsible enterprise professionals must nurture what they have now as they seek to navigate to what's next.

To this end, we further chronicle emerging trends in three *additional* categories—the business of technology, cyber and trust, and core modernization—to acknowledge the reality that business drives technology, not the other way around, and that extant systems and investments need to play nicely with pioneering innovations so that businesses can seamlessly operate while they grow.

Taken together, we call these the six macro technology forces of information technology (figure 2).

We've arrived at this year's trends through both primary research and lived experience, interviewing both industry and public sector leaders who have developed innovations in everything from resilient manufacturing and data repatriation to digital and biometric credentialing. Their input helped us shape the six trends chronicled in *Tech Trends 2023*.

**FIGURE 2:** Six macro forces of information technology
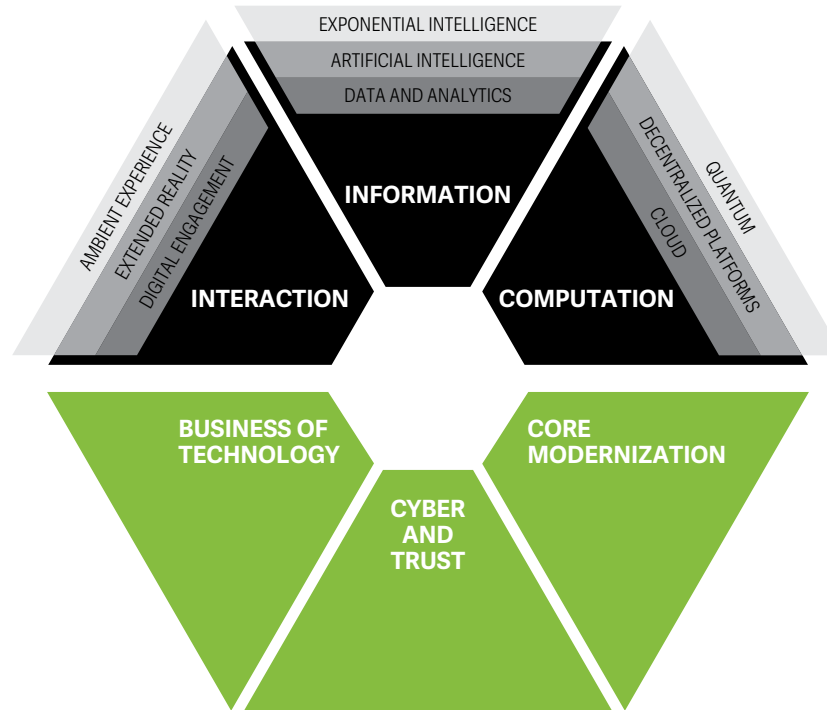


Source: Deloitte analysis.

As we prepare for launch, I'd encourage a moment of perspective-cum-humility. Futurists are secretly historians. And as Mark Twain reportedly said, "History doesn't repeat itself, but it often rhymes."[3] Having worked in all things newfangled for 25 years, I've seen literally thousands of self-styled "world-changing technologies," but *none* that have marked "the end of history." It's a sobering thought to realize that today's white-hot innovations will indeed become tomorrow's legacy applications—that our pioneering advances might one day be dismissed by the new generation as "the old way." This is not meant to depress, but to embolden. It might be said that success for us as makers is building something significant and sustainable enough that our successors take notice and flag it for further modernization. Our job, dear reader and fellow leader, is not to hubristically chase "future-proof," but to humbly target "future-friendly."

Onward,
~!mb

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Spoiler alert: What if I told you that information technology is just the tip of the proverbial iceberg? We're witnessing the rise of many additional technology areas that will have an equally significant impact on business innovation. We'll spill the tea in our epilogue. In the meantime, enjoy *Tech Trends 2023*.

# Endnotes

1. Deloitte, *Technology Futures Report 2021*, accessed October 28, 2022.

2. ThinkAutomation, "**Tesler's theorem and the problem of defining AI**," accessed October 27, 2022.

3. The quote is often attributed to Mark Twain, although no evidence exists that he said it. See: "**History does not repeat itself, but it rhymes**," QuoteInvestigator.com, January 12, 2014.

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