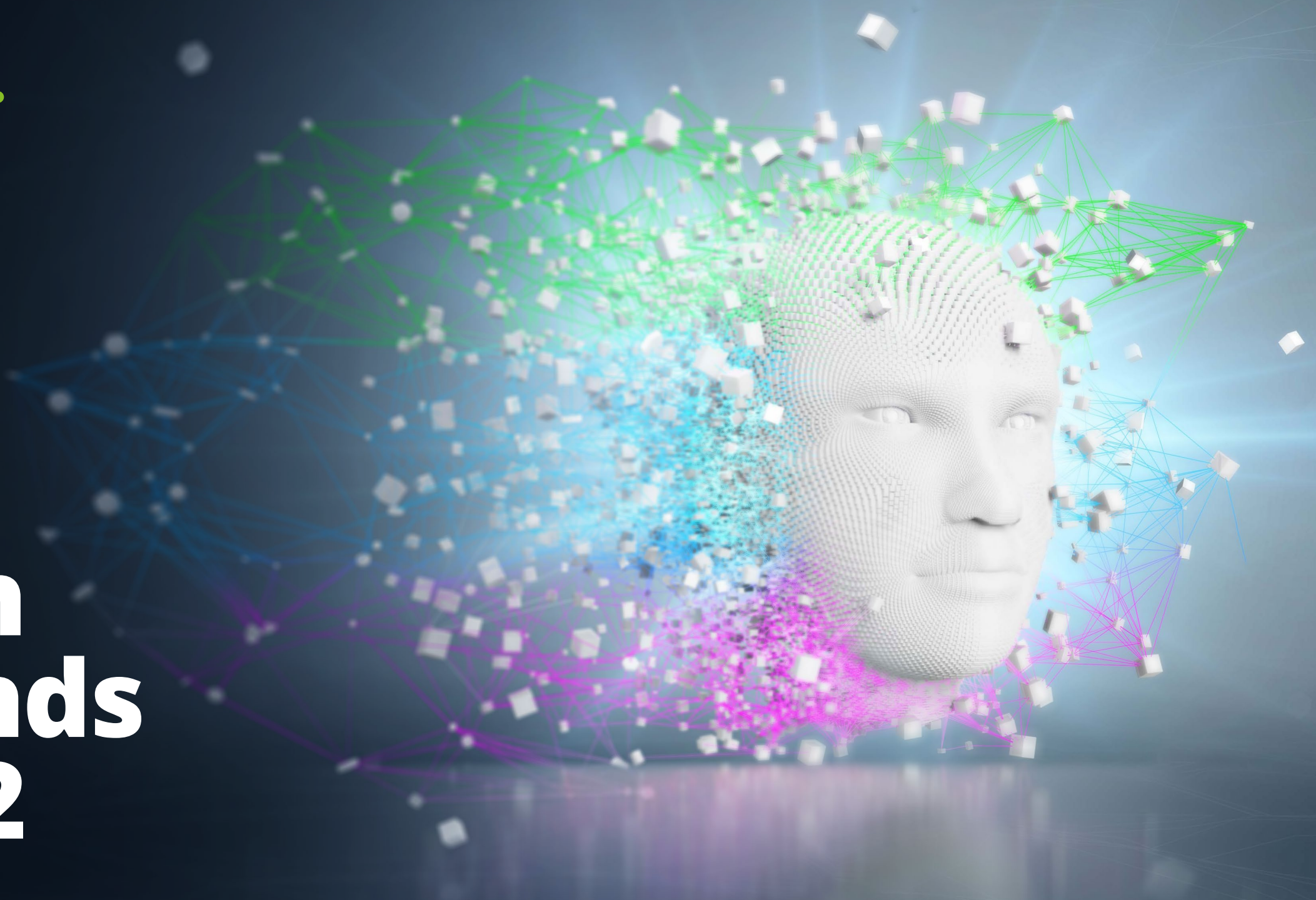


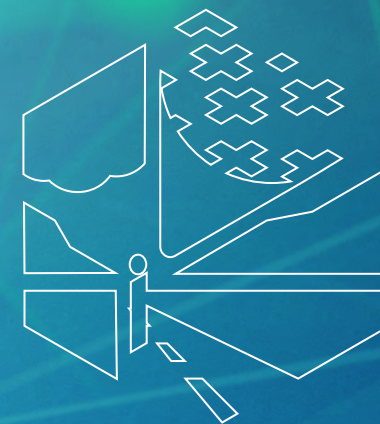
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Insights

# Tech Trends 2022





# Field notes from the future



QUANTUM AND  
THEN SOME

Quantum research  
goes commercial  
in the next decade.

EXPONENTIAL INTELLIGENCE:  
ONCE MORE, WITH FEELING

AI recognizes  
human emotions.

AMBIENT EXPERIENCE:  
LIFE BEYOND THE GLASS

Technology for  
everyone, everywhere.

## TREND 7

# Field notes from the future

## A look at three emerging technologies over the horizon

In the global arena of enterprise technology, optimism rules the roost. We are so enthralled by rapid fire innovation and the opportunity-laden disruption that follows that we have—with considerable justification—developed an abiding faith in technological progress. Today's acorns will become tomorrow's towering oaks, or so the preferred narrative goes.

The challenge with this narrative is that it almost always paints optimistic outcomes with a broad brush. The notion that rapid advances in AI will give rise to exciting new business models in five years is cold comfort to a chief financial officer sweating the next quarterly statement.

The question many leaders, strategists, and technologists rightly ask is, "What can we do right now to prepare for an event whose nature and timing is uncertain?" We offer this humble response: If you wager that something exciting will happen with a number of emerging technologies during the next decade, you will probably win that bet. What exactly will happen? We don't know yet—and neither does anyone else. But in this final chapter of *Tech Trends 2022*, we do offer a framework for thinking strategically about technology possibilities that currently appear small on the horizon.

We focus on three such possibilities that we feel are notable:

- **Quantum technologies**, which are poised to transform computing, sensing, and communications within the next decade
- **Exponential intelligence**, the next generation of AI technologies that promises to understand human emotion and intent
- **Ambient computing**, which will make technology ubiquitous in our work and home environments

We follow our discussion of these possibilities with an essay by Deloitte Consulting LLP's chief futurist Mike Bechtel, in which he looks to the past to find a glimpse of tomorrow.

Read on.



## Quantum and then some

Quantum computing, while maturing rapidly, remains the focus of several esoteric debates. One is whether Majorana fermions exist. Admittedly, most people don't have a dog in this fight, but those who do seem ready to rumble. One side believes that Majorana fermion particles—which theoretically contain their own antiparticles—could make remarkably stable quantum qubits. Doubters counter that nobody has been able to find evidence that these particles even exist and, until they do, Majorana's quantum possibilities remain just that: possibilities.<sup>1</sup>

In a way, this debate over theoretical particles encapsulates the state of quantum computing today: Everything is incredibly interesting and promising, but we are still in the early days of quantum exploration. Definitive timelines and research breakthroughs remain works in progress.

Yet there is a widely held belief that we will figure all of this out, and that quantum will loom large in our collective future. Indeed, quantum research is gaining momentum and is expected to migrate from labs to real-world commercial environments within this decade.<sup>2</sup> Technology giants, governments, and early-stage startups are investing billions in a race to achieve quantum breakthroughs.<sup>3</sup>

Promising areas of focus include:

- **Computing.** Quantum computers are special-purpose tools for solving advanced computational problems. They leverage quantum phenomena to process information and make highly specialized calculations. With this in mind, quantum computers probably will not replace classical computers. Rather, they will coexist with their legacy counterparts, and provide advanced computing power as needed for complex

computational workloads.<sup>4</sup> To give you a glimpse of quantum computing's potential, in recent demonstrations, quantum machines completed specialized tasks in five minutes that researchers say would have taken classical supercomputers thousands of years to complete.<sup>5</sup>

- **Communication.** Quantum communication is a hardware-based solution that uses principles of quantum mechanics to create theoretically tamper-proof communication networks that can detect interception and eavesdropping. Among several techniques for achieving this level of secure communication is quantum key distribution (QKD), in which parties exchange highly secure encryption keys to transmit data across optical networks. Even though QKD technology is not fully mature, several quantum communication networks have either been deployed or are in development.<sup>6</sup>

- **Sensing.** Thanks to the sensitivity of subatomic particles, quantum sensing devices are more responsive and accurate than conventional sensors. Within the next decade, it is likely that quantum sensors could replace conventional sensors in some applications. Indeed, there are promising use cases in the energy, transportation, and health care sectors, among others. Quantum sensors are available, but at present are somewhat limited. Researchers are working to make them cheaper, lighter, more portable, and more energy-efficient.<sup>7</sup>

Though quantum dynamics is fraught with mind-bending challenges, quantum technologies are advancing. As this maturation progresses, it will be altogether too easy to get caught up in the details of intriguing technologies. What technologist will be able to resist pondering things such as lasers freezing particles and temperatures colder than outer space?

Likewise, what business strategist will ignore the investment enthusiasm surrounding quantum technology vendors going public?

## Within five years, we will understand much more.

While we may not know with precision the destination of our collective quantum narrative, we have a sense of its direction. And the good news is that within five years, we will understand much more. We may be able to use interesting machines to optimize things such as computing, communication, sensing, and even chemistry. Now is the time for your organization to begin thinking about *that* future. By taking a wait-and-see approach, you could miss critical opportunities to test and experiment with quantum technology while your competitors gain a competitive advantage.

## Exponential intelligence: Once more, with feeling

In data-mining folklore, there is an illustrative anecdote involving beer and diapers that many find useful in explaining the traditional state of AI. As the story goes, analysis of supermarket transactions revealed that by placing beer on shelves next to diapers, stores can boost beer sales. What is the correlation between diapers and beer sales, you ask? A data scientist whose name is lost to history theorized that wives ask husbands to pick up diapers on their way home from work. While husbands are picking up the requested supply of diapers, they realize they will need to fortify themselves with beer in order to deal with the tiny individuals who will be wearing said diapers.<sup>8</sup>

Beyond the enduring truth that parenting can be stressful, there is an important underlying lesson here: Machine-driven analysis of sales

transactions can only suggest causation between diapers and beer sales. It takes a human brain to infer and explain the customer emotions and psychology driving those sales. In other words, despite its much-vaunted analytic superpowers, AI has traditionally been unable to distinguish between *meaningful* and *meaningless* statistical connections.

During the next decade, this is likely to change dramatically. In previous *Tech Trends* reports, we examined how a nascent class of AI-powered solutions—referred to as “affective computing” or “emotion AI”—is adding an emotional quotient (EQ) to technology’s IQ, at scale.<sup>9</sup> During the next decade, affective computing will continue to morph and grow as innovators train machines, through next-generation deep learning techniques, to both recognize and emulate human traits such as charisma, charm, and emotion. They will, in turn, use “symbolic” and “connectionist” techniques to embed deductive reasoning and logical

inference capabilities into AI and artificial neural networks. Soon, these technologies will be able to look at a statistical correlation and, much like the human brain, determine if it makes sense or if it is just a random feature of the supporting data that has no intrinsic meaning. In other words, machines will be able to appreciate the world more as humans do, and less as a context-free collection of zeros and ones.

This represents a shift in our relationship with machine intelligence. Since the AI field emerged in the 1950s, we have valued this curious technology as much for what it cannot as for what it can. It has turbocharged our ability to extract insights from data while never undermining human cognitive and emotional supremacy. However, machines have grown exponentially in power and capability. In our quest for efficiency and insight, we are now designing them to have a level of emotional acuity that is erasing the traditional human-machine cognitive hierarchy.

Pioneering researchers are currently training AI applications to be both versatile and detail-oriented in a very human way. For example, by recognizing common questions in the order in which they are asked, AI-powered bots engage in remarkably humanlike interactions with customers in call centers, restaurants, and banks. The next step might be, for example, creating a senior-care bot with sensors that can distinguish between a lamp falling off a night table and an individual who has fallen and needs assistance. As AI grows in both intuitive and emotional capability over the next decade, bots may begin working as educators, writers, physicians, and even chief information officers.

We believe this process of development, training, and deployment will continue apace for the next decade and beyond. Things that seem uniquely human today will increasingly be expressed as sequences of code. As this happens, business leaders will finally be able

to realize automation's full promise, which will have a transformational impact on value chains, business models, and strategies. A decade may seem like a long time—particularly for decision-makers working feverishly to finalize their next quarterly report. But advances in exponential intelligence will not wait for you. The time to begin automating low-hanging fruit in your organization is now.

And about that scary, dystopian world that science fiction writers have been telling us about for so long? Fear not. The truth is that software has always been neutral, manifesting the explicit orders and tacit biases of its developers.<sup>10</sup> Recently, Deloitte futurists, in collaboration with the World Economic Forum, published *Technology futures: Projecting the possible, navigating what's next*, a vivid examination of future possibilities and approaches for realizing them.<sup>11</sup> On AI's future, the authors write: "As information technology continues to evolve from our *telling* machines

what to calculate toward *teaching* machines what to discern, it will be increasingly important for organizations, governments, and regulators to closely monitor the 'curriculum.' How can we develop artificial intelligences that embody our explicitly shared financial, social, and ethical values? We must teach our digital children well, training them to do as we say, not necessarily as we've done."

## Ambient experience: Life beyond the glass

Following the advent of command-line interfaces in the 1960s, it seemed only futurists and science fiction writers dared imagine a world in which technology was truly ubiquitous, rather than sequestered behind screens. For most, the understanding that we access computer capabilities and the internet through a glass rectangle became dogma.

Over time, these glass screens became much smaller. They now fit in our pockets and on our wrists. What's more, the number-crunching and networking technologies behind these shrinking screens have become exponentially more powerful and sophisticated, so much so that we're beginning to interface with the cloud directly, without the intermediation of glass. Think about smart speakers. It wouldn't occur to children growing up today in homes with smart technology that there are alternatives to "asking the room" to provide the weather forecast.

During the next decade, ambient computing—a catchall term for a growing field of technologies and techniques that make digital reality available to users anytime and anywhere—will become our standard modality and, in doing so, will usher in an era of life lived beyond the glass.

What does this life look like? Consider the following scenarios:

- **Less friction.** Think back to your first encounter with a desktop computer. Odds are, it came with a hefty paper manual. By contrast, today's mobile devices need only feature a "quick start," itself a digital app. While underlying technologies have gotten more complex, user experiences have gotten simpler. Ambient technologies promise to further lower the friction required to learn and use new tools because—like our children asking the room for a weather forecast—all you have to do is talk. Or gesture. Or glance. You no longer have to journey to a computer lab, or log into a laptop, or even check a mobile device. Indeed, ambient interfaces will lie in wait, patiently inferring what next steps are needed and proactively offering the most efficient way to accomplish them.

We envision futures in which numerous technologies continuously monitor our environments, working in harmony to automate, or at least streamline, our work and personal lives. Of course, there will be some security and privacy concerns to work through. But we can say with certainty that a more streamlined, frictionless life will become a reality for many of us today, and certainly for our children. Simple wins.

- **More proactive and intuitive.** Imagine a world in which everyone has a personal assistant, one who is exceptionally smart, capable, and attentive. These high-performing assistants are digital, and are backed up by a broad array of sensors, voice recognition, analytic, and exponential intelligence capabilities that work 24/7 to monitor your environment and reduce friction wherever possible. For example, your digital assistant might

alert you that it is time to depart for the airport. Rather than having to determine the best way to get there and then using a mobile app to check in, the assistant knows your schedule, preferences, and intent, and will do it all for you. As you pick up your bag and walk out the door of your home, the digital assistant will turn off power to nonessential devices, adjust the air-conditioning to an optimal setting, and activate the home security system.

- **The eyes have it.** Augmenting an individual's physical experience with digital information will be another major dimension of life beyond the glass. We are already seeing how early adopters are using smart glasses and virtual or augmented reality (VR or AR) headsets to overlay digital information onto some workers' fields of vision. Think of this as bringing reality itself online—or, perhaps, painting atoms with bits,



albeit with somewhat primitive brushes. Researchers and entrepreneurs alike are already exploring possibilities for using smart contact lenses and even implanted brain chips to augment our senses and (literally) read our minds. Think about it: Why wouldn't it be natural to look at the sun and see how many hours until sunset? Or look at a bus stop and see how many minutes until the next bus arrives? Curious to be sure, but perhaps preferable to staring at our phones all day.

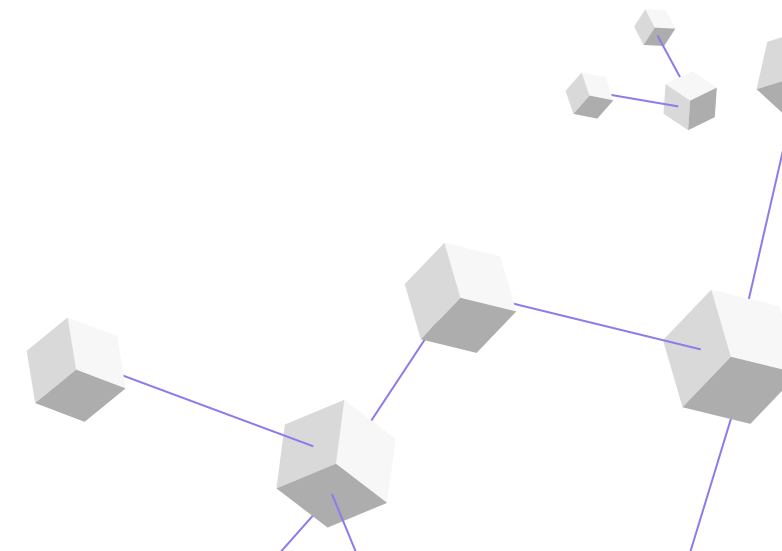
**A more streamlined, frictionless life will become a reality for many of us today, and certainly for our children.**

How will our collective journey to an ambient world play out? Incrementally, with future-forward organizations focusing right now on low-hanging fruit and moving steadily to more transformational projects over time. As first step, these pioneers are already working to determine where friction exists right now in their organizations. It may be in interpersonal interactions, cumbersome long-established processes, or even in the way employees use technology. They then explore ways to reduce these pockets of friction with technologies *that are available today*. As an example of this proactive approach in action, consider the airline industry. During the last decade, air carriers have completely transformed the customer experience through digitization, reimagining everything from ticket sales to baggage-handling to seat selection. This effort remains a work in progress, but no one who flew commercially 20 years ago can deny that the path from ticket to tarmac is a simpler customer

experience than before. There are similar efforts well underway in retail, hospitality, and finance, among many other sectors.

For customers and workers alike, “easier” goes a long way. The technologies you need to support all of your ambient ambitions may not be available today, but it’s clear that they’re just over the horizon.

Start living life beyond the glass right now.



MY TAKE

# Mike Bechtel

Chief futurist,  
Deloitte Consulting LLP



As futurists, my team and I spend the lion's share of our time studying the past.

I like to say that we're closet historians. Specifically, we research the history of various technologies and how they've impacted, or failed to impact, the way the world works and lives. With a collective 25 years of innovation study under our belts, we know that predicting a single future is still futile—but projecting plausible futures by applying the patterns of the past can help organizations harness tailwinds, dodge headwinds, and more intentionally shape their next steps.

Looking back to the patent for the first computer in 1840, the basic elements listed are unchanged to this day: interaction (i.e., user interface); information (i.e., data); and computation (i.e., CPU). As outlined in this chapter, if these three elements are thought of as the basic train tracks of IT progress, we can understand what the next stops along the journey will likely be. Interaction beyond mobile devices and virtual reality leads to ambient computing, allowing us to abandon screens and experience the digital world alongside the physical. Information leads to exponential intelligence beyond

AI, a future where machines can learn how to be charming or to compose poetry as well as they calculate a variable. Finally, computation beyond digital bits leads to quantum, where we apply physics to solve problems that are intractable to mathematics.

Along the way to meeting these futures, many upcoming technology innovations that impact enterprise IT will first be manifested in art and leisure, where people take more risks. We've seen ideas such as the "like button" embraced first in consumer circles and then implemented in workplace chat platforms. Similarly, viral videos on social media today could pave the way for new forms of workplace training and onboarding. In other words, tomorrow's IT department might look to us like they're playing games in the metaverse, but, to them, that might be optimal knowledge-sharing.

In the same vein, just as content creation has been democratized, many of the historical

burdens around IT have been lifted as well. Problems of database management have been abstracted to the cloud and barriers to creating software have given way to open-source technology and code accelerators. The IT organization of the future will have a much bigger assortment of readymade building blocks available to connect and a much smaller number of applications to justify building in-house. The takeaway: Tomorrow's IT teams will be more conductors than songwriters, putting together the best configurations of existing products rather than inventing new ones for limited use.

The remit of IT leadership must also evolve with the changing remit of IT teams. As technology continues to proliferate and the right set of tools becomes an enabling context as opposed to a key issue, CIOs will increasingly shift their focus to information instead of technology. By spending less time as technicians, they can free up time for higher-order insights about their business and their market. The future

CIO stands to become the right hand of the CEO, a consigliere trusted to help steer the organization toward what's new, what's next, and where the organization should invest.

### *Eyes to the skies; feet firmly on the ground*

To bring about this change, IT teams need a constitutional commitment to exploration; otherwise, all their resources will default toward operations. They should firewall and dedicate 5 to 10% of their workforce to pure exploration of what's next, and another 15 to 20% to iterative implementation of the most promising innovation candidates. As Oren Harari said, "The electric light did not come from the continuous improvement of candles." Though the cost may seem prohibitive, the rewards of creating that next lightbulb can be *exponential*. Organizations that manage this balance—both optimizing what's now and enabling what's next—can steer toward their preferred tomorrow.



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