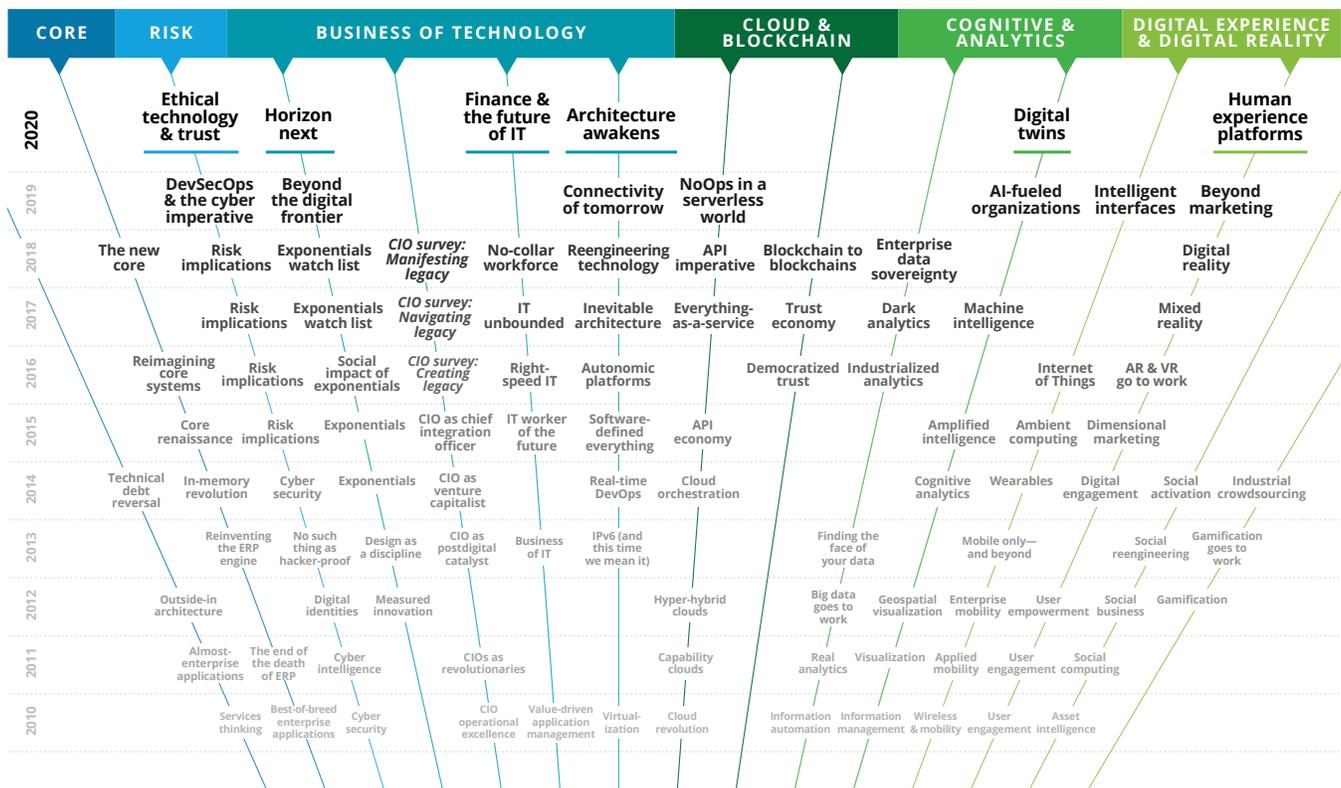




Tech Trends 2020

Trending the trends: Eleven years of research



Introduction

IN 2020, THE next stage of digital's evolution welcomes us with the promise of emotionally intelligent interfaces and hyperintuitive cognitive capabilities that will transform business in unpredictable ways. Yet as we prepare for the coming decade of disruptive change, we would be wise to remember an important point about yesteryear's leading-edge innovations: Architects of the 1980s designed mainframe systems that continue to run and generate business value today. Sure, they're outmoded by today's standards, but how many of us will build systems that run for decades? And how's that for a legacy?

Architecting for longevity and adaptability requires a deep understanding of both today's realities and tomorrow's possibilities. It requires an appreciation for the technology and market forces driving change. And finally, it requires a long-term commitment to focused and incremental progress.

Against this backdrop, we present *Tech Trends 2020*, Deloitte's 11th annual examination of the emerging technology trends that will affect your organization over the next 18 to 24 months. Several of this year's trends are responses to persistent IT challenges. Others represent technology-specific dimensions of larger enterprise opportunities. All are poised to drive significant change.

We begin *Tech Trends 2020* with a timely update on the nine *macro technology forces* we examined in last year's report. These forces—digital experience, analytics, cloud, core modernization, risk, the business of technology, digital reality, cognitive, and blockchain—form the technology foundation upon which organizations will build the future. This year's update takes a fresh look at enterprise adoption of these macro forces and how they're shaping the trends that we predict will disrupt businesses over the next 18 to 24 months. We also look at three technologies that will likely become macro forces in their own right: ambient experience, exponential intelligence, and quantum.

In subsequent chapters, we discuss trends that, though grounded in today's realities, will inform the way we work tomorrow. Our chapter on *ethical technology and trust* takes an in-depth look at how every aspect of an organization that is disrupted by technology becomes an opportunity to lose—or earn—the trust of customers, employees, and stakeholders. We follow with a discussion of *human experience platforms* that will enable tomorrow's systems to understand context and sense human emotion to respond appropriately. Pioneering organizations are already exploring ways in which these platforms can meet the very human need for connection.



Trends evolve in unexpected ways. And often, the most interesting opportunities happen at the places where they intersect. Several of this year's trends represent fascinating combinations of macro forces and other technology advances. For instance, *digital twins* represents the culmination of modernized cores, advanced cognitive models, embedded sensors, and more—a recipe that is in itself a trend, even as it builds on evolving individual technologies.

We hope *Tech Trends 2020* offers the insights and inspiration you will need for the digital journey ahead. The road from today's realities to tomorrow's possibilities will be long and full of surprises, so dream big and architect accordingly.

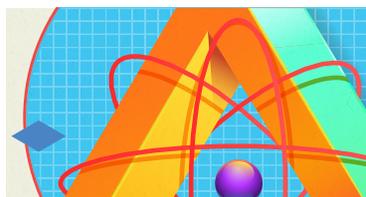


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Executive summary



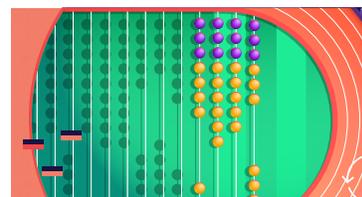
Macro technology forces

Last year's *Tech Trends* report explored nine macro technology forces that form the backbone of business innovation and transformation. For a decade, we've been tracking the emergence and eventual ascent of digital experience, analytics, cloud, digital reality, cognitive, blockchain, the business of IT, risk, and core modernization. This year's update takes a fresh look at enterprise adoption of these macro forces and explores how they're shaping the tech trends we predict will disrupt businesses over the next 18 to 24 months. To realize the full promise of these forces, organizations are exploring how they intersect to create more value as well as new ways to manage technology and the technology function. This necessary step is becoming increasingly important as businesses prepare to tackle emerging forces that appear farther out on the horizon: ambient experience, exponential intelligence, and quantum.



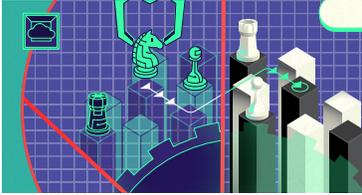
Ethical technology and trust

In a growing trend, leading companies are realizing that every aspect of their organization that is disrupted by technology represents an opportunity to gain or lose trust. They are approaching trust not as a compliance or public relations issue, but *as a business-critical goal* to be pursued. In this light, trust becomes a 360-degree undertaking to ensure that the many dimensions across an organization's technology, processes, and people are working in concert to maintain the high level of trust expected by their many stakeholders. Business leaders are reevaluating how their products, services, and the decisions they make—around managing data, building a partner ecosystem, and training employees, among others—build trust. CIOs are emphasizing “ethical technology” and creating a set of tools to help people recognize ethical dilemmas when making decisions on how to use disruptive technologies. Leaders who embed organizational values and tech ethics across their organization are demonstrating a commitment to “doing good” that can build a long-term foundation of trust with stakeholders.



Finance and the future of IT

As technology strategy has increasingly become a core part of business strategy in organizations, the demand for improved outcomes has grown. To achieve this, we expect to see more IT and finance leaders working together to develop flexible approaches for innovating and operating at the speed of agile. Whether under the name of supporting innovation, defending against disruption, or enabling digital transformation, IT will need finance's support to effectively rethink governance of technology innovation, adapt to Agile methodologies, and secure creative capital. The work of transitioning to new finance, budgeting, and accounting processes that support innovation will not happen overnight. But there are strong incentives for both CIOs and CFOs to find ways to effectively fund innovation. Some companies are already embracing this trend and are exploring possibilities. They are at the leading edge and will likely be the first to enjoy the competitive advantages that come when finance funds innovation at the speed of agile.



Digital twins: Bridging the physical and digital

The idea of using virtual models to optimize processes, products, or services is not new. But organizations are finding that increasingly sophisticated simulation and modeling capabilities, power visualization, better interoperability and IoT sensors, and more widely available platforms and tools are making it possible to create simulations that are more detailed and dynamic than ever. Digital twins can increase efficiency in manufacturing, optimize supply chains, transform predictive field maintenance, aid in traffic congestion remediation, and much more. Organizations making the transition from selling products to selling bundled products and services, or selling as-a-service, are increasing use of digital twins. As capabilities and sophistication grow, expect to see more organizations use digital twins to optimize processes, make data-driven decisions in real time, and design new products, services, and business models. In the long term, realizing digital twins' full promise may require integrating systems and data across entire ecosystems.



Human experience platforms

A growing class of AI-powered solutions—referred to as “affective computing” or “emotion AI”—are redefining the way we experience technology. In the coming months, more companies will ramp up their responses to a growing yet largely unmet demand for technology to better understand humans and to respond to us more appropriately. Historically, computers have been unable to correlate events with human emotions or emotional factors, but that’s changing as innovators are adding an emotional quotient (EQ) to technology’s IQ, at scale. Combining AI, human-centered design techniques, and technologies currently being used in neurological research to better understand human needs, human experience platforms will be able to recognize a user’s emotional state and the context behind it, and then respond suitably. Indeed, the ability to leverage emotionally intelligent platforms to recognize and use emotional data at scale is one of the biggest, most important opportunities for companies going forward.



Architecture awakens

Growing numbers of technology and C-suite leaders are recognizing that the science of technology architecture is more strategically important than ever. Indeed, to remain competitive in markets being disrupted by technology innovation, established organizations will need to evolve their approaches to architecture—a process that can begin by transforming the role technology architects play in the enterprise. In the coming months, we expect to see more organizations move architects out of their traditional ivory towers and into the trenches. These talented, if underused, technologists will begin taking more responsibility for services and systems. Likewise, they will become involved in system operations. The goal of this shift is straightforward: move the most experienced architects where they are needed most—into software development teams that are designing complex technology. Investing in architects and architecture and promoting their strategic value enterprisewide can evolve this IT function into a competitive differentiator in the digital economy.



Horizon next: A future look at the trends

There's growing interest among enterprises in looking beyond *what's new* to *what's next*, and no wonder—an understanding of what's coming may inform early planning and enable relationships that could make reaping future rewards possible. Leading organizations have disciplined, measured innovation programs that align innovation with business strategy and a long-term technology landscape. They take a programmatic approach to sensing, scanning, vetting, experimenting, and incubating future macro technology forces—such as ambient experiences, exponential intelligence, and quantum—until the technology, the market, and the business applications are ready on an enterprisewide scale. Other organizations should consider following suit, using the knowledge gained to reimagine and transform their enterprises, agencies, and organizations before they themselves are disrupted. In a world of seemingly infinite unknowns, it is possible to focus attention on a meaningful collection of known technologies that, taken together, can help you chart a path to the next horizon.

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Exploring intersections of the macro technology forces can drive purposeful, transformational change.

ENABLERS **FOUNDATION** **DISRUPTORS** **HORIZON NEXT**



DIGITAL EXPERIENCE

From channel to human-centered design



BUSINESS OF TECHNOLOGY

Reengineering "capital T" Technology



DIGITAL REALITY

Reimagining engagement



AMBIENT EXPERIENCE

Transparent, ubiquitous interfaces



ANALYTICS

Data management, architecture, and insights



RISK

Cyber, regulatory, and ethics



COGNITIVE

Predict, prescribe, augment, and automate



EXPONENTIAL INTELLIGENCE

Symbolic, deep, and broad reasoning



CLOUD

Flexibility and ubiquity



CORE MODERNIZATION

Reshaping the heart of the business



BLOCKCHAIN

Distributed trust and assets



QUANTUM

Exponential computation

Macro technology forces

A second look at the pillars of past, current, and future innovation

AS THE UNPRECEDENTED expansion of technology-driven innovation fuels a high-stakes game of competitive whack-a-mole, an organization's ability to exploit technology to its advantage will determine its survival. Leaders across sectors now routinely elevate technology to a strategic business priority.

Emerging technology trends stir competing emotions and narratives, often pushing us beyond our comfort zones. We're inseparable from our mobile devices, but they constantly interrupt us with an overwhelming flow of information. Cognitive assistants are helpful time-savers, but most of us find them a little creepy. Investors are bullish on flying taxis, but savvy consumers are distrustful of empty media hype and promises that exceed reality. And a painful tension exists between the possibilities of exciting novel technologies and the responsible exploration of technology domains at the forefront of an organization's 18-to-24-month investment road map.

Eleven years of research and deep engagement with global business and technology executives have helped bring clarity to this ongoing drama—and a simpler way to think about significant technology developments. Last year's *Tech Trends* report¹ explored nine macro technology forces that have been—and continue to be—the backbone of business innovation and transformation: digital experience, analytics, cloud, digital reality, cognitive technologies, blockchain, the business of technology, risk, and core modernization. For a decade, we've been tracking their emergence and eventual ascent, exploring how organizations are using them to innovate and drive purposeful, transformational change.

Digital experience, analytics, and cloud are enabling technologies that have proven their value—and then some—over the past decade. They are the basis of numerous successful corporate strategies and new business models.

This decade's disruptors are **digital reality, cognitive technologies, and blockchain**. Adoption is on the uptake, with business cases multiplying across industries. We expect these disruptors to spark surprises throughout the 2020s.

The **business of technology, risk, and core modernization** are foundational technologies. To carry the weight of technology-driven transformation and innovation initiatives, they need to be stable, strong, and sustainable.

These macro forces help drive meaningful conversations about emerging technologies not only with the CIO, CTO, and tech shop but with the CEO and the broader C-suite, board members, and line-of-business presidents. Discussing emerging technologies in the context of this framework can help simplify the tsunami of tech advances and ground in reality the investments and innovations coming from labs, startups, and R&D centers around the world. Smaller trends can be plotted on the evolutionary trajectory of these macro forces.

This year's update takes a fresh look at enterprise adoption of these macro forces and reviews how they're shaping the tech trends predicted to disrupt businesses over the next 18 to 24 months. We also peek beyond the horizon and unveil three macro forces—ambient experience, exponential intelligence, and quantum—that we expect to shape enterprise and technology strategies into the 2030s and beyond.

Enablers

When we first began exploring digital experience, analytics, and cloud a decade ago, we understood the possibilities but weren't quite sure how significant their impact would be. Since then, these now-familiar enabling forces have powered the disruption of businesses, operating models, and markets. They continue to evolve at an astounding pace.

<p>Digital experience</p>	<p>Digital experience continues to be a critical driver of enterprise transformation—in fact, 64 percent of participants in Deloitte's 2018 global CIO survey say digital technologies will affect their businesses in the next three years.² Since we examined this trend last year in <i>Beyond marketing: Experience reimagined</i>,³ organizations are dispensing with the traditional notion of customer acquisition-focused marketing, focusing instead on creating more human-centric interactions—including with their own employees and business partners.</p> <p>This year, in <i>human experience platforms</i>, we discuss how leading organizations are creating customized, emotionally intelligent digital experiences based on individuals' behaviors, preferences, and emotions using an integrated array of AI capabilities such as voice stress analysis and microexpression detection tools. Consider, for example, the use of EEG- and machine learning-enabled headsets that shed light on situations that distract or create stress for employees, enabling businesses to design better workflows and work environments.</p>
<p>Analytics</p>	<p>Analytics includes foundational capabilities and tools that generate powerful insights. Data management, data governance, and supporting architecture are age-old problems that not only are critical building blocks for AI programs but are tactical concerns as organizations work in a dynamic and complex regulatory environment with mandates on data residency, privacy, and usage.</p> <p>CIOs understand what's at stake: 60 percent of them say that data and analytics will affect their businesses in the next three years.⁴ But the issue is becoming only more challenging. The tried-and-true concepts of "data at rest" and "data in use" are joined by "data in motion," which is supported by tools for data streaming, ingestion, classification, storage, and access. The good news? Cloud, core modernization, cognitive, and other technologies are bringing fresh solutions to an exceptionally complicated challenge.</p> <p>Developments in data analytics have helped advance many of this year's trends. For example, the ability to efficiently and cost-effectively process and integrate large amounts of data has spurred the creation of more advanced digital twin technology—but it has also created a deficit of trust, leading to our focus on <i>ethical technology and trust</i>.</p>
<p>Cloud</p>	<p>Cloud's takeover of the enterprise is nearly complete. Ninety percent of organizations use cloud-based services⁵ and they aren't putting on the brakes. In fact, cloud investments are expected to double as a percentage of IT budget over the next three years.⁶ As we predicted in 2017, the use of cloud, extending beyond infrastructure, has given rise to everything-as-a-service, enabling any IT function to become a cloud-based service for enterprise consumption.⁷ Hyperscalers—the handful of massive companies that dominate the public cloud and cloud services industries⁸—have shifted investments higher up the stack, providing platforms for advanced innovation in the other macro forces, including analytics, cloud, blockchain, digital reality, and in the future, quantum.</p> <p>Cloud has also forced the reimagining of some tried-and-true roles. For example, as we discuss in <i>architecture awakens</i>, giving architects the ability to take full advantage of modern cloud-based offerings plays a critical role in developing complex IT systems and applications in a hybrid world.</p>

Disruptors

Today's disruptors—digital reality, cognitive technologies, and blockchain—are the descendants of experience, analytics, and cloud. As the change agents of the coming decade, these newer trends may no longer be considered novel, but they're on the cusp of becoming as familiar and significant as their predecessors.

<p>Digital reality</p>	<p>Digital reality technologies, including AR/VR, mixed reality, voice interfaces, speech recognition, ambient computing, 360° video, and immersive technologies, promote more natural user engagement by seamlessly extending a human-centric experience beyond the confines of keyboards and screens. The goal is natural, intuitive, and potentially imperceptible interactions with underlying technologies.</p> <p>Commercial applications of digital reality are growing.⁹ For example, as discussed in <i>human experience platforms</i>, many companies are using digital reality technologies to deepen emotional connections and empathy among customers and employees. And in <i>digital twins</i>, we see how digital reality can help bring the digital twin to life. Using AR, a manufacturer can provide its workers with a view into 3D content from a digital twin, improving worker productivity.¹⁰</p>
<p>Cognitive</p>	<p>Cognitive technologies, such as machine learning, neural networks, robotic process automation, bots, natural language processing, neural nets, and the broader domain of AI, have the potential to transform nearly every industry. These technologies personalize and contextualize the human-technology interaction, allowing businesses to provide tailored language- and image-based information and services, with minimal or no human involvement.</p> <p>Demand for cognitive technologies is skyrocketing—IDC forecasts spending to reach US\$77.6 billion in 2022¹¹—although their potential benefits are accompanied by significant trust and tech ethics considerations. As we discuss in <i>ethical technology and trust</i>, a company can help build a reputation as a trusted global brand by being transparent about the use of cognitive technologies, evaluating the impact on customer trust, and proactively seeking to understand and mitigate the effects on customers and their data.</p>
<p>Blockchain</p>	<p>Blockchain is a critical technology priority for more than half of those who participated in Deloitte's 2019 Global Blockchain Survey, a 10-point increase from 2018. Eighty-three percent could identify compelling blockchain use cases, a 9-point increase from the previous year. Results suggest that in 2019, the topic of enterprise blockchain discussions shifted from, "Will blockchain work?" to, "How can we make blockchain work for us?"¹²</p> <p>Financial services and fintech companies continue to lead blockchain development, but other sectors—notably, government, life sciences and health care, and technology, media, and telecommunications—are also advancing blockchain initiatives.¹³ Similar to cloud, our <i>architecture awakens</i> trend discusses how blockchain provides architects with an opportunity to do bold new things, disrupting the status quo as they work on multidisciplinary teams to help achieve business outcomes.</p>

Foundation

The business of technology, risk, and core modernization may seem prosaic and dull, but these forces are undeniably the heart of the business. And companies continue to make considerable investments and advances in these well-established domains. Combined, they provide a reliable, scalable foundation for digital transformation, innovation, and growth, and are a requirement for successful investments in analytics, cognitive, blockchain, and other disruptive technologies.

<p>The business of technology</p>	<p>The business of technology—how IT operates—is evolving as technology and business strategies converge. As companies increasingly look to reengineer IT not only to deliver operational excellence but to partner with business functions to drive value creation, many IT teams are shifting their focus from project delivery to product and business outcomes and adopting collaboration-enabling development methodologies such as Agile and DevOps.</p> <p>The supercharged technology function can then help enterprises become more agile in their response to technology-driven market and business changes. In <i>finance and the future of IT</i>, we take a closer look at how new approaches to technology finance are helping fuel business agility. And in <i>architecture awakens</i>, we examine how organizations are redefining the architect’s role to cultivate responsiveness to overarching business needs and encourage collaboration with business and end customers.</p>
<p>Risk</p>	<p>Risks facing enterprises in an innovation-driven era extend far beyond traditional cyber, regulatory, operational, and financial threats. Participants in the <i>2019 CEO and board risk management survey</i>¹⁴ said the top threats to their companies were those related to new disruptive technologies and innovations, ecosystem partners, brand and reputation, and organizational cultures—even as they acknowledged they hadn’t prepared for or invested appropriately to manage these risks.</p> <p>Beyond the essentials of compliance and security, organizations are approaching the broader issue of trust as a corporate strategy driven by the potential risks that emerging technologies could have on products, services, and business goals. <i>Ethical technology and trust</i> examines the broad implications of trust—including ethics and responsibility, privacy and control, transparency and accountability, and security and reliability—on an organization’s people, processes, and technology.</p>
<p>Core modernization</p>	<p>Core modernization reflects the ongoing pressures that digital transformation, user expectations, and data-intensive algorithms put on core systems in the front, mid, and back office. Whether it’s digital finance, a real-time supply chain, or a customer relationship management system, core systems support key business processes. Many CIOs recognize that their legacy systems lack the agility to innovate and scale, with 64 percent of CIO survey participants currently rolling out next-generation ERP or modernizing legacy platforms.¹⁵</p> <p>In an era of instantaneous, always-on, tailored interactions, organizations need to lower their overall technical debt. Thoughtful approaches to modernizing the core—reengineering existing legacy systems, refreshing ERP systems, and rewriting systems—are more important than ever. <i>Architecture awakens</i> discusses how technology architects are building on future-forward architectures that leverage new platforms to get the benefits of agility, automation, security, and scalability.</p>

Emerging forces on the horizon

As the three disruptor forces are gaining ground and are poised to make significant business contributions in the coming decade, three technology developments and innovations—the horizon next—are waiting in the wings. We will begin to feel their impact toward the end of the 2020s.

Ambient experience

Ambient experience envisions a future in which technology is simply part of the environment. Computing devices continue to increase in power and shrink in size. These ever-smaller devices are evolving our input from unnatural (pointing, clicking, and swiping) to natural (speaking, gesturing, and thinking) and their interactions from reactive (answering questions) to proactive (making unanticipated suggestions).

As devices become seamless and ubiquitous, they and we are becoming increasingly inseparable. Imagine a future world where tiny, connected, context-aware devices are embedded throughout the office, home, and beyond, functioning as part of the background. Or neurofeedback technology that today enables game-playing through brainwave analysis¹⁶ could serve as the foundation for direct brain and neural interaction, allowing us to think a question or request and have an appropriate response or action delivered to our ambient experience. For example, thinking, “I need to leave for the airport in an hour” could trigger a cascade of background activity, including arrangements for automated flight check-in, a virtual boarding pass for biometric screening, a self-driving car programmed to activate at the correct terminal, setting your home smart system to “away,” and halting deliveries for the duration of the trip.

Exponential intelligence

Exponential intelligence will build on today’s cognitive capabilities. Today, machine intelligence can find patterns in data but can’t interpret whether those patterns have inherent sense. It lacks the ability to recognize and respond to the nuances of human interaction and emotion. And it is also very narrow—it can defeat a human chess grandmaster but can’t understand the need to flee from a room on fire.

The future promises more. With semantic and symbolic understanding, machines will be able to tease out actual causality from spurious correlation. With a combination of technologies from *human experience platforms*, our virtual assistants will increasingly be able to recognize—and adapt to—our moods. And as researchers make progress at creating broad, not just narrow, expertise, exponential intelligence will be able to move beyond the statistical and computational. It will ultimately lead to more capable AI with, dare we say, personality.

Quantum

Quantum harnesses the counterintuitive properties of subatomic particles to process information and perform new types of computation, communicate “unhackably,” miniaturize tech, and more. For quantum computing, the special properties of these quantum bits, or qubits, have the potential to create exponential change. By manipulating individual particles, quantum computers will be able to solve certain highly complex problems that are too big and messy for current supercomputers—from data science to material science.

As researchers overcome current technical limitations, quantum computers will increasingly supplement classical computers. Data scientists will be able to scan ever larger volumes of data for correlations; material scientists can use qubits to simulate atoms in ways that are impracticable on classical computers; and fascinating possibilities exist in many other areas including communications, logistics, security and cryptography, energy, and more.

MY TAKE



JOHNSON & JOHNSON HELPS people live longer, healthier lives by creating innovative medicines, life-altering medical devices, and trusted consumer products. While there's no denying that technology touches every aspect of our business, what matters most to our patients and customers is how our products help improve their lives. Technology absolutely plays an important role in getting us there, but it is a means to achieving our greater purpose of improving human health.



JOAQUIN DUATO
VICE CHAIRMAN OF THE
EXECUTIVE COMMITTEE,
JOHNSON & JOHNSON

Within this context, technology's potential has always been front and center in some areas of our business, such as R&D. What has changed in the last few years is that now everyone appreciates that technology is an enabler, everywhere in the organization, across lines of business, functions, and our talent pool. Today, the convergence of multiple disruptive technologies is helping us generate more value for our stakeholders by making better decisions and working more productively.

First, we're making better business decisions thanks to data science. Given J&J's reach, there is tremendous potential in connecting our data and embedding higher-quality, more efficient, and increasingly predictive decision-making tools across the organization. To do this, we are working cross-functionally to build our data science foundation by understanding what types of data are available, cleaning and engineering it so it can be analyzed more easily, and defining our next-generation data standards and architecture. The results are already impressive. For example, supply chain leaders are using advanced analytics to plan and improve process controls. In addition, R&D depends on data science to advance clinical trials and screen new medicine candidates faster than ever before so we can deliver safe and effective new medicines to patients in need.

We're also using data science to help doctors make better patient health care decisions. For a hypertension study, J&J scientists collaborated with the Observational Health Data Sciences and Informatics network to perform research on hundreds of millions of patient records within the network's international database.¹⁷ The study included insurance claims data and patient records from 4.9 million patients, making it the most comprehensive study ever on first-line drugs used to reduce hypertension. Rather than conducting single pairwise comparisons of two medicines for a given outcome, as most studies do, data science technologies enabled the team to evaluate 22,000 pairwise comparisons at once. By accelerating the research process, advanced analytics and cognitive technologies can help doctors deliver better patient care.

Second, we're using intelligent automation—automation technologies combined with artificial intelligence—to give our employees the gift of time. Intelligent automation reduces repetitive and routine work while generating insights that employees can use to improve compliance, quality, and speed. For example, our finance collections team automates routine tasks, giving members more time to engage with customers to resolve disputes. This has led to improved cash flow, increased productivity, greater efficiency, and enhanced job satisfaction.

Over the past 18 months, we've automated nearly 30 global processes affecting 300,000 transactions. We've improved business outcomes and quality, while giving back more than 15,000 hours to our teams. And we've merely scratched the surface of what's possible—we intend to scale these solutions across our enterprise.

These overarching initiatives are underpinned by investments in cloud, core modernization, comprehensive cyber risk strategies, and more. Our employees are just like consumers in that they want to have a frictionless experience with technology in their day-to-day lives, so we're focusing on improving their digital experience wherever we can. We're simplifying workflow, making processes less complicated, and shifting to modern user-centric designs powered by data science and intelligent automation.

All of this requires an evolved technology organization that works as a strategic partner and not just a service provider. Our technology team's role is to ensure we apply disruptive technologies in concert to help the organization deliver stronger outcomes, and we're introducing ways to measure the connection between the function's performance and the outcomes the business cares about. For example, how can we use metrics to show that R&D is making better decisions because our technology function is delivering cleaner data?

In the same way that the technology organization needs to understand the business outcomes it supports, our executives need to recognize how technology can help them achieve the outcomes they desire. We don't expect our executives to become programmers, but they should be able to identify how, when, and where technology can help them drive better results. And we want them to develop a dose of healthy skepticism so they can distinguish between hype and technologies likely to deliver lasting outcomes.

We look at technology as an enabler that helps our people progress in their careers, become proactive change agents, and deliver better outcomes. We take a simple view of new and emerging technologies: They are valuable because they help us achieve business results that are meaningful to our patients and customers—and because they help us create a better, healthier world.

MY TAKE



FOR NEARLY HALF a century, technology has underpinned critical business and logistics operations on which FedEx customers depend. Almost a decade ago, we committed to an expansive technology renewal initiative based on an ongoing vision for cloud and everything-as-a-service. We began a journey to simplify and modernize our monolithic legacy systems by creating a collection of orchestrated microservices.



ROB CARTER
EVP AND CIO, FEDEX

We're wrapping up the primary phase of the IT renewal initiative, and it's nothing less than a complete refactoring of legacy software applications that typically have long development, testing, and deployment cycles. Our new service-oriented, cloud-based model is more value-driven. The technology team orchestrates software functions as interoperable microservices that can be used across multiple platforms. They are smaller, incremental, and modular, with iterative delivery cycles that enable us to rapidly adapt to ever-changing business circumstances and help us remain in alignment with our customers as they adopt API- and service-driven architectures and workflows.

As the Internet of Things, advanced analytics, and blockchain emerged, we were able to leverage them to sustainably develop innovative new products and services for our customers. We've been able to position ourselves ahead of the curve on these and other emerging technologies. For example, we developed and are testing small, embeddable IoT sensors—each about the size of a pack of gum—that provide drop-in connectivity using Bluetooth Low Energy (BLE) wireless networks. This allows us to dramatically expand the amount of shipment data we collect beyond date, time, and location stamps to include temperature, speed, and a host of other measurements. The application of real-time analytics to the sensor-collected data improves visibility into the transportation network, automatically predicts the flow of shipments, and optimizes delivery routes by dynamically routing shipments to bypass network clog points.

When IoT and analytics are combined with blockchain, they have the potential to improve existing chain-of-custody systems and processes. Embedded IoT sensors can automatically transmit data to a blockchain ledger as a shipment moves from point of supply to point of demand, enabling carriers, regulators, and customers to track the provenance of goods, combat illegal and counterfeit products, and simplify the cross-border shipping process. Ultimately, we expect the impact of these technologies to extend beyond product shipments to the end-to-end life cycle of a product as it moves through the supply chain.

To stay ahead of the innovation curve, we must be responsive, which requires an agile framework that allows us to rapidly and iteratively adapt, deploy, and pivot when the market demands it. For instance, our experiments with sensor-based logistics stretch back more than a decade with the launch of our SenseAware device. Initially, we deployed sensors that relied on cell phone networks, migrating to BLE network technology when it proved more efficient. Large and expensive, the original sensors had to be reclaimed and reused. As IoT capabilities matured and became more cost-effective, we were able to roll out smaller, less expensive sensors at scale.

We also embrace risk-taking innovation when the potential reward outweighs the risk. For example, we calculated that the cost of experimenting with blockchain and potentially concluding that it wasn't useful would be a fraction of the cost of not making an early blockchain move at all. Our willingness to take an early risk paid off. As a charter member of the Blockchain Research Institute and current standards chair of the Blockchain in Transport Alliance, we have access to invaluable contacts and resources in the blockchain industry.

We know this is a continuous journey—we can't ever stop transforming. New competitors are agile and technologically savvy, so we plan to continue to evolve our analytics capabilities and to integrate artificial intelligence into the logistics network. And there are a few more legacy systems whose long tentacles haven't been fully pried out yet. But because we can't predict the next innovation or market force, we haven't locked ourselves into processes, investments, or technologies that aren't adaptable to future unknowns. I don't always know what's coming next, but with an adaptable set of services and the ability to be agile and iterative, I know we'll be much faster at delivering value.

EXECUTIVE PERSPECTIVES



STRATEGY

Many of the disruptive opportunities around which organizations are building their business and innovation strategies are grounded in the macro forces discussed in this chapter. To capitalize on changing technology forces and become undisruptable, CEOs need to become “masters of disruptive jujitsu.”¹⁸ They should identify potential disruptions, organize appropriate component responses, and hijack the trends for their own competitive advantage. To do so, CEOs can work with tech executives and their teams who are identifying emerging technology and operating on the front lines of the digital revolution. At the same time, it falls to the CEO—particularly those in incumbent organizations—to strike an ambidextrous balance between “protecting the fortress” and embracing disruptive technology. Stability is important, but given the pace of technology-driven disruption, few can afford to focus solely on the short term. The time to invest in the next generation of macro force innovations is now. As such, CEOs expect CIOs to become insightful strategists and futurists who can help their peers connect the realities of today with the possibilities of tomorrow.¹⁹



FINANCE

Which macro-level technology disruptions could upend one industry and cause value to migrate to another? As CFOs examine technology-driven innovations for opportunities, this question should be top of mind. In the last 20 years, for example, disruptive innovations have driven value away from established advertising and retail players, toward tech startups with dynamic new models, and onward to social media platforms attracting advertising and marketing dollars. It is finance’s job to anticipate how emerging trends could alter where and how companies may make money in the future, and who will own the profit streams. As a result, CFOs and their teams should strive to become more fluent in enterprise technology. With a vision of the future in mind and a deeper understanding of disruptive technologies and their possibilities, CFOs and their teams can then develop strategies for competing in a brave new ecosystem.



RISK

The farther we gaze into the future of the macro forces and the disruption they enable, the more difficult it becomes to recognize, evaluate, and plan for consequent risks. Today’s risk assumptions will quickly dissolve into a fog of ambiguities and unknowns that do not fit neatly into the chief risk officer’s green, yellow, and red stoplight charts. How, then, can companies better understand the technology risks that lie ahead? First, by deploying advanced cognitive risk sensing and predictive risk intelligence tools that continuously scan the digitalized risk landscape for relevant information.²⁰ Similarly, by applying AI capabilities—including data mining, machine learning, and natural language processing—to unstructured data, they can identify risk indicators that humans and traditional analytics often miss.²¹ But these steps alone are not enough to bring the future into focus. Going forward, CIOs should help risk and business leaders develop a more nuanced understanding of the role macro forces play in their company’s future. This will help them think beyond traditional stoplight chart reporting and develop new approaches for identifying and managing only the most relevant risks ahead.

NINE SHIFTS HELP DELIVER ON THE PROMISE OF THE MACRO FORCES

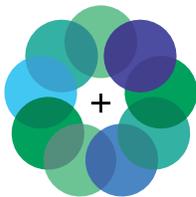
Nine shifts can help businesses organize effectively and upgrade their innovation chops to realize the collective benefits of the macro forces.²² Each of these interconnected shifts influences the others; applying them in concert can help businesses achieve the most effective outcomes.

- **Agility and speed.** Agile capabilities, organizational design, culture, work style, funding, governance, and sourcing can help companies innovate rapidly.
- **Future workforce.** As traditional IT tasks and capabilities disappear, businesses seek talent with new technical skill sets and soft skills.
- **Digital transition.** Every company's transition from digital experience to digital reality will have a different focus, type of leader, and structure.
- **Innovation and ecosystems.** A radar for disruptive technologies, an innovation ecosystem, and a pipeline of ideas can enable continual innovation.
- **Governance and funding.** Leaders can consider making governance and funding changes that support technology innovation and a product-centric focus.
- **Data organization.** Data-focused organizations extend the focus of analytics from operational efficiency and risk management to value creation.
- **Blurred internal boundaries.** Embedding technologists in business functions can extend technology funding and accountability deeper into the business.
- **Leadership and culture.** Leadership skills and a supportive culture can help companies recruit, develop, and inspire the technology workforce.
- **Cloud adoption.** Adopting the cloud typically shrinks the centralized IT organization and promotes value cocreation in addition to operational excellence.

Build wisely: The macro forces in concert

In and of themselves, none of the macro forces is sufficient. But like instruments in a symphony, the macro forces, working in concert, can lead to innovative new business models, new sources

of business value, and transformed business operations.



In our exploration of these macro forces over the last decade, perhaps our most significant finding was that the most effective organizations are combining multiple trends. For each of our 2020 trends, we highlight how multiple

macro forces come together to set the stage for a new disruption. Take, for example, digital twin technology. Over the course of the last decade, advances in cloud, analytics, cognitive technologies, and digital reality have combined with digital design and manufacturing system advancements to make it easier to integrate data from multiple systems, software platforms, applications and hardware. Now organizations across industries can use digital twins to optimize processes, make data-driven decisions in real time, and create new products, services, and business models.

Leading organizations are proactively engineering a controlled collision of these macro technology forces to create a solid foundation for innovation that can propel their business into the future.

ARE YOU READY?



BOTTOM LINE

Nine macro forces will continue to shape future business and technology strategies, IT operations and investments, business models, and markets. Together, they're clearing a path for three new forces that could render our world unrecognizable by the next decade. Our challenge is to organize the enterprise to navigate the macro forces from experience to digital reality, analytics to cognitive, and cloud to blockchain to deliver on the combined promise that these forces hold.

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