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Insights

Oracle Perspective

Tech Trends 2019

Beyond the digital frontier

Trending the trends: A decade of research

2010 2011 2012 2013 2014 2015 2016 2017 2018 2019

EXPERIENCE & DIGITAL REALITY

- Asset intelligence
- User engagement
- Social computing
- User engagement
- Gamification — Social business
- User empowerment
- Gamification goes to work
- Social reengineering by design
- Industrialized crowdsourcing
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- Dimensional marketing
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- Information management
- Applied mobility
- Visualization
- Enterprise mobility unleashed
- Geospatial visualization
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- Cognitive analytics
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- Amplified intelligence
- Machine intelligence
- Intelligent interfaces
- AI-fueled organizations

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- Everything-as-a-service
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- Blockchain: Democratized trust
- Blockchain: Trust economy
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BUSINESS OF TECHNOLOGY

- Exponential technology watch list
- No-collar workforce
- Reengineering technology
- Connectivity of tomorrow
- DevSecOps and the cyber imperative
- *Risk implications*
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- IT unbounded
- Inevitable architecture
- The new core
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- Social impact of exponentials
- Right-speed IT
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- *Risk implications*
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- Software-defined everything
- Core renaissance
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- CIO as chief integration officer
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- Technical debt reversal
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- Business of IT
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- Cyber security
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BUSINESS OF TECHNOLOGY **CORE** **RISK**

Contents

Introduction

L OOKING back a decade to headlines of the day, we are reminded how at that now-distant moment much of the world was still grappling with a cataclysmic recession. In the technology sector, Oracle announced it was acquiring Sun Microsystems.[1] Apple was gearing up to launch the iPad® mobile digital device,[2] and a mean-spirited worm called Stuxnet was changing the rules of cybersecurity.[3]

At this same time, a small number of dedicated tech enthusiasts at Deloitte Consulting were preparing to launch our firm's first annual *Tech Trends* report. Though this freshman effort was only one-third the length of subsequent *Tech Trends* publications, it effectively captured the awe that we and our clients felt about the incredible pace of technology-driven change underway—and the profound impact that change was having on business. This report featured chapters on cloud, cybersecurity, the Internet of Things, mobile's looming impact on the enterprise, and user-centered design—all topics that at the time felt overwhelming and fantastical. Interestingly, many of the things that seemed so incredible 10 years ago are now foundational.

Looking back, we can see the value these emerging innovations offered; in the moment, their promise seemed less clear. It is, therefore, remarkable how quickly organizations across industries and regions navigated the *so what?* and *now what?* for these trends and went on to successfully traverse the new digital landscape.

This journey from uncertainty to digital transformation informs our latest offering, *Tech Trends for Oracle* report. A persistent theme of every *Tech Trends* report has been the increasing, often mind-bending, velocity of change. A decade ago, many companies could achieve competitive advantage by embracing innovations and trends that were already underway. Today, this kind of reactive approach is no longer enough. To stay ahead of the game, companies must work methodically to sense new innovations and possibilities, define their ambitions for tomorrow, and journey beyond the digital frontier.

But the question remains: How can we sense and act upon a future that remains unclear? The good news is that much of the tech-driven disruption each of us experiences today—and will likely experience going forward—is understandable and knowable. Today, the most promising technology trends are grounded in simple yet powerful macro forces that form the backbone of technology innovation, past and present. In this version of *Tech Trends for Oracle* report, we examine how once-disruptive trends such as cloud, analytics, and digital experiences have been embraced to become foundational components of business and IT strategy. We also discuss how reengineering technology's full life cycle, reimagining core systems, and elevating cyber to a strategic function are now critical elements of digital transformation. And finally, we examine the latest trends that are poised to become macro forces in their own right. Those feeling overwhelmed by change may take some comfort in the fact that all of these trends are grounded in the nine macro forces. As in chaos theory, patterns and structures eventually emerge from perceived disorder..

So here's to the next decade of opportunity, whatever it may be. Along the way, embrace that queasy feeling of uncertainty. Be excited about it. Because what you are actually feeling is tremendous, unimaginable

opportunity. Today, when every company is a technology company and everyone is a technologist, there could not be a more exciting or opportune time to leave your mark on your company, your industry, and on an entire world of possibility that awaits just beyond the digital frontier.

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1. Andrew Clark, "Oracle's takeover of Sun Microsystems comes as surprise to software industry," *Guardian*, April 20, 2009.

2. *Tech Trends 2019* is an independent publication and has not been authorized, sponsored, or otherwise approved by Apple Inc. iPad is a registered trademark of Apple Inc.

3. Kim Zetter, "How digital detectives deciphered Stuxnet, the most menacing malware in history," *Wired*, June 7, 2011.

Macro technology forces at work

Technology trends past, present, and future

O VER THE LAST 10 YEARS, CLOUD, ANALYTICS, AND TECHNOLOGIES empowering digital experiences have steadily disrupted IT operations, business models, and markets. Though these now-familiar forces may no longer qualify as "trends," their impacts cannot be overstated, and their storylines continue to evolve. Recently three new technologies—blockchain, cognitive, and digital reality (AR, VR, IoT, and others)—have taken up the "disruptor" mantle. Today, each is poised to become a distinct macro force in its own right. Meanwhile, three foundational forces make it possible for organizations to harness innovation while maintaining operational integrity: modernizing legacy core systems, transforming the business of technology, and evolving cyber risk strategies beyond security and privacy. These nine formative forces are the backbone of technology innovation past and present. Their individual futures are advancing at a rapid pace, while the controlled collision between them compounds their overall impact to drive purposeful, transformational change.

Digital experiences. Analytics. Cloud. In the previous nine issues of *Tech Trends*, we examined these powerful forces as they evolved from promising innovations and novel approaches into full-fledged trends. We recognized their disruptive potential and looked to the horizon to find innumerable strategic opportunities they could—and eventually would—present. Indeed, each proved to be far more than a trend; over time they evolved and expanded across industries and today are considered foundational components not only of enterprise IT but of corporate strategy.

In the context of emerging technology trends, then, is there anything left to say about digital, analytics, and cloud? Yes: Despite their ubiquity and proven value, these technologies' full potential remains largely untapped. Investments in them are often departmental and limited in scope. Likewise, in some companies, initiatives driving analytics, cloud, and digital are disjointed, even competing efforts. And even this old guard of emerging technol-

ogies continues to evolve at an astounding pace—in capabilities, in business models, and across broader marketplace dynamics.

Meanwhile, three newer trends—digital reality, cognitive technologies, and blockchain—are growing rapidly in importance. In the last several issues of *Tech Trends*, we discussed how virtual reality and augmented reality are redefining the fundamental ways humans interact with their surroundings, with data, and with each other. We tracked blockchain's meteoric rise from bitcoin enabler to purveyor of trust. And as cognitive technologies such as machine learning (ML), robotic process automation, natural language processing, neural nets, and AI moved from fledgling siloed capabilities to tenets of strategy, we have explored their profound potential for business and society. These three trends, though still emerging, are poised to become as familiar and impactful as cloud, analytics, and digital experience are today.

Of course, any pursuit of tomorrow's promise should start from the technical realities of today.

With macro forces, it's the controlled collision that leads beyond the digital frontier.

Three formative macro forces have proven essential in the pursuit of digital transformation past, present, and future: modernizing core systems, guiding how (and if) existing assets can serve as a foundation for innovation and growth; elevating cyber and the broader risk domain from a compliance-based activity to an embedded, strategic function; and, in a world where the only constant is constant change, reengineering an organization's technology function to quickly and impactfully deliver against the promise of technologies emerging and existing. Previous editions of *Tech Trends* have discussed

how the business of technology, core modernization, and cyber became trends in their own rights. CIOs and business leaders recognize that in a marketplace being disrupted by rapid-fire innovation, IT must also fundamentally disrupt itself and make strategic decisions about its underlying assets or risk failing at its mission.

Taken together, these nine trends are the macro technology forces that matter. When we talk about technology trends, it is tempting to dismiss broader, more lasting truths and pursue the latest shiny objects. True, today there is nothing about these nine areas that screams "stop the presses!" But just because they are no longer particularly novel doesn't mean they are not vitally important. In fact, one of the most pressing challenges that technology and business leaders face is how to excavate and harness the value these macro forces can deliver *collectively*.

For example, the factory of the future needs to bring together next-gen ERP, machine learning, embedded sensors across the production floor, augmented reality training, mobile visualization and predictive flow scheduling, secure networks, and cloud-based tools for managing workflow across the supply chain. Not to mention the need to retool workers and cross-pollinate between traditional information and operational technology (IT and OT) roles and skills.

Through their collision and the innovation unleashed, these forces will likely dominate enterprise IT, business, and markets to an even greater extent than they have as individual technologies.

With macro forces, it's the controlled collision that leads beyond the digital frontier.

Exploring the forces at work

IN THE BEGINNING . . .

First, there was digital experience, analytics, and cloud. Of the nine macro forces, these three have consistently captured the most mindshare (and investment dollars) over the last decade, and with good reason. Today they are the pillars upon which

many ambitions for the future are built. And we're far from done.

Digital experience

When the term *digital* entered the business-technology lexicon roughly seven years ago, it was used as shorthand for customer-facing sales and marketing with an emphasis on a specific channel, be it social, mobile, or web. Today, *digital* is increasingly used in tandem with *experience*, to describe all the ways organizations, customers, employees, and constituents engage and carry out transactions within digital environments. It's not only for the front office but for the entire enterprise. Think, for example, of how health plans are deploying new tools to simplify the preauthorization of claims. Behind the scenes, cognitive algorithms, robotic process automation, and predictive analytics tools are approving more of the simple and rote use cases that used to dominate many employees' workdays. Instead, workers can spend more of their time on nuanced, complex cases with an opportunity to more directly affect the health and wellness of their member population. Or how leading fast food and convenience restaurants are adopting mobile apps for remote ordering, not only transforming the customer experience but redesigning retail, preparation, and delivery operations. Human-centered design and user engagement have become center-pieces of business strategy—emphasizing how work gets done, how business gets conducted, and how meaningful memories and experiences are made.

Analytics

Data and its underlying complexities have been an enterprise narrative since the earliest days of technology investment. The promise of analytics has been its close and even more tantalizing spiritual successor—taking advantage of that data to generate insights about customers, citizens, markets, operations, and virtually every facet of how an enterprise runs. Most analytics efforts have struggled to deliver on the simplest version of that potential: the rearview mirror describing what has already

happened—or, for the advanced few, presenting real-time views into what is currently happening. In the science of analytics, this is valuable but insufficient. Today companies need the ability to *predict* (I have a good idea what will happen next) and *prescribe* (I can recommend a response). But this is no simple undertaking. Though analytics engines, algorithms, and supporting infrastructure have grown more powerful, the amount of data available for analysis has grown exponentially. Organizations should consider information beyond the well-formed data that lives within traditional IT systems. How can a company leverage machine logs and sensor data, still images, video, audio, biometric information, government research, and sentiment from social feeds? And how does it tap into data across its own boundaries, as well as data sources that live outside of its four walls? For many companies, remaining competitive in the marketplace depends on their ability to answer those questions. And to move core data management and data architecture capabilities from flights of fancy to foundational forces.

We are already shifting our focus from what has already happened to what will happen in the future. Through a collision with cognitive, analytics may soon tell us how to act on our insights—and better yet, automate those actions.

Cloud

One could argue that during the last decade, no single technology trend has so dominated the arena of enterprise IT as *cloud*. During this time, it emerged from modest discussions of, "What is cloud and why does it matter?" to the next phase, which emphasized, "Where and when do we use cloud to lower costs?" to cloud's status today: "Why *not* cloud?" Cloud moved from low-level technology cost arbitrage lever to a means for delivery model optimization to a driver of business transformation. Simply put, cloud is increasingly the foundation upon which innovation is built.

As macro forces go, cloud is unparalleled in importance and likely will remain so for some time. And despite its ubiquity, cloud too has yet to

reveal its full potential. Too many companies still think of cloud as a means for lifting and shifting workloads, or as simply the extension of data center or infrastructure strategy. But this is changing as some begin to ask more complex, future-focused questions: Can we use cloud native services to build our products faster? How do we use the massive compute capacity to process more data and create new products? Could a new cloud back office create an engine for M&A agility? Are there advantageous tax implications of using cloud up, down, and across the stack?

Trends that only recently grabbed headlines as emerging topics have now assumed the mantle of macro force.

In the coming years, expect to see major cloud service providers emphasize their offerings' potential value as platforms and patterns for achieving long-term growth and developing new innovation. Whereas their customers may have embraced cloud for, say, IaaS or SaaS features and functions, they may now turn to cloud for access to AI, blockchain, digital reality, quantum computing, and more. Cloud will likely continue to be a competitive differentiator.

RAPIDLY APPROACHING

Over the next five years, digital reality, blockchain, and cognitive will likely become as important as digital experiences, analytics, and cloud are today. Yet even though their stories are still being written, their novelty is already beginning to wear off. Each is garnering more investment and seeing adoption across industries. Trends that only recently grabbed headlines as emerging topics have now assumed the mantle of macro force. Organizations that delay embracing the cloud may find themselves missing opportunities for innovation.

Digital reality

Digital reality—an umbrella term for augmented reality (AR), virtual reality (VR), mixed reality (MR), the Internet of Things (IoT), and immersive/spatial technologies—is currently redefining how humans interact with data, technology, and each other. Though breakthroughs in wearables, "smart" objects, and sensors sometimes dominate mindshare, the point is not the device itself—the hero of the story should be the interactions and experiences unlocked that would otherwise be impossible.

In the digital age, we have had to force engagement through glass screens in unnatural ways. Digital reality transcends keyboard and touchscreens, offering something that is more lifelike, intimate, and natural, unlocking new and compelling engagement patterns. The underlying capabilities required to deliver these experiences are progressing, with advances in conversational interfaces, computer vision, and auditory technologies turning the dream of entirely new ways for humans to interact with the digital world into a reality. Enterprise investment is outpacing consumer adoption, even as products and offerings in media, gaming, and entertainment continue to advance.[1] That's good news for the ecosystem at large, as existing capabilities mature, new ones emerge, and tools, patterns, and skill sets evolve to support digital reality's full potential.

Blockchain

Blockchain technology continues down the path toward broad adoption as organizations gain deeper understanding of its transformational value, within and across their industries. IDC projects that annual global spending on blockchain solutions will reach US$9.7 billion by 2021.[2] This technology's success in capturing both mindshare and investment is remarkable considering that a few years ago the word *blockchain* was known only through its relationship to cryptocurrencies. Today, blockchain is to trust what the web was to communication: a

profoundly disruptive technology that transforms not only business but the way humans transact and engage. And large enterprises and consortia are deploying enterprise-grade blockchain solutions, avoiding complexities in traversing multiple disparate databases. With technical hurdles and policy limitations being resolved, we will likely see breakthroughs in gateways, integration layers, and common standards in the next few years. Concerns around scalability and cost-performance of transaction processing are being addressed as proof of stake becomes a viable alternative to proof of work consensus, and enterprise tools have emerged to manage and maintain high-performance blockchain stacks. When further breakthroughs occur, expect blockchain to become even more ubiquitous. The door will be open for cross-organizational business process reengineering, an arena that encompasses massive transformation and possibilities across industries, functions, and geographies.

Cognitive technologies

Cognitive is shorthand for technologies such as machine learning (ML), neural networks, robotic process automation (RPA), bots, natural language processing (NLP), and the broader domain of artificial intelligence (AI). Cognitive technologies can help make sense of ever-growing data, handling both the volume and complexity that human minds and traditional analysis techniques cannot fathom. Algorithms replace queries, increasingly unsupervised and self-learning (through reinforcement learning, generative adversarial networks, and other techniques), which makes it possible for machines to explore potential connections and discover patterns and relationships that conventional wisdom would have never considered. And far from just visualizing findings, cognitive toolsets both augment human response and potentially automate the appropriate action. Where conventional analytics focused on finding and answering known crunchy questions, cognitive looks to both spark new questions and short-circuit the handling of the finding.

But similar to the story in analytics, foundational data is a crucial dependency for cognitive. Algorithms and advanced models are dependent on trusted, accurate input. New approaches to data management and data architecture provide more dynamic approaches to ingesting, classifying, and correlating data, using the very machine learning, natural language, and RPA capabilities upon which cognitive is built. But most organizations remain in the early days of the journey. Just as important is the broader culture and organizational dynamic. Becoming data-driven and analytically curious is hard enough; there is an extra leap of faith to allow machines to decision and actuate core business capabilities.

GETTING TO TOMORROW FROM THE REALITIES OF TODAY

Among the nine macro forces, the business of technology, core modernization, and cyber have long been overshadowed by digital, analytics, and cloud. And maybe they don't offer the same kind of headline-grabbing appeal as digital reality, cognitive, and blockchain. But they continue to be essential to the emergence of all the other macro trends, both established and emerging. Simply put, the business of technology, cyber, and core modernization enable technology transformation. When we say we need to imagine tomorrow and get there from today, these three macro forces put in place the foundation needed to make it happen.

The business of technology

For the last decade, CIO, CTOs, and other technology leaders have grappled with a persistent challenge: In a climate of rapid-fire innovation and technology-driven disruption, how can we reorganize and retool the IT organization to deliver fundamental capabilities the enterprise needs? Well-intended initiatives designed to address this challenge often capture inordinate amounts of IT budget. Yet in many cases, they miss the mark because the challenge, as some technology leaders are realizing, is formidable.

A major theme of our annual *Tech Trends* reports is that every company is now a tech company and every employee is a technologist. This theme is particularly relevant as the line between the business and the technology organization continues to blur. There is an increasingly critical need to reorient technology teams around product and business outcomes, shifting effort and resources away from rote, repetitive, low-value activities that dominate energies in many IT organizations. In

Business and technology teams can work together to deliver outcomes faster without sacrificing those essential enterprise *-ilities* (scalability, reliability, security, maintainability, etc.).

this new model, business and technology teams can work together to deliver outcomes faster without sacrificing those essential enterprise *-ilities* (scalability, reliability, security, maintainability, etc.), shape ambitions beyond conventional approaches and technologies, and look beyond IT boundaries. In the end, the business of technology is the broader story of how companies integrate technology into their strategy and reengineer their IT organization to cost effectively thrive in this new world of technology. It requires much more than a CIO or CTO making changes to her own team. Indeed, this is a CEO and board-level discussion that helps the company understand, prioritize, and execute against everything that disruptive technology represents.

Core modernization

Core modernization seeks to solve the riddle of how companies with significant investments in legacy systems can extract more value from these systems by making them a foundation for new disruptive innovations. That, in itself, is a tall

order, given the complexity of many legacy environments and the magnitude of technical debt that these landscapes have incurred. Organizations start to show increased capability to reinvigorate their legacy core by exposing micro services to their technologists and the business. Beyond just replatforming legacy systems, core modernization involves creating a road map for building a next-generation ERP core that incorporates—rather than merely enabling—digital, cloud, and other macro forces.

Those who lead in this transformation see the opportunity to convert technical debt into technical equity. Core modernization can also provide an opportunity to chart an entirely new course for IT. CIOs can choose from several modernization strategies: replatform, revitalize, remediate, replace, and retrench.[3] Some may choose to upgrade and reuse legacy assets; others may replace them altogether with cloud-based technologies. Determining which combination of the five Rs can help you achieve your goals means knowing which core components meet your company's business objectives and which do not, and what the market and your customers are demanding. Identify the useful life of each legacy asset in your IT portfolio. Consider which assets address things about which the business cares deeply, such as the ability to respond to market conditions and address evolving customer needs. Then layer in technology concerns—reliability, security, and scalability. The answers you uncover can serve as a lever that helps you prioritize where and how to invest to modernize.

Cyber risk

For the past few years, as cyber risk threat vectors evolve and attacks become increasingly sophisticated, deliberate, and unrelenting in nature, we've discussed the implications on emerging technology trends for the CIO and CTO. But it's

much bigger: The convergence of multiple macro technology trends and continually evolving digital transformation agendas that affect multiple stakeholders within an organization outside of the IT function—marketing, sales and customer relations, regulatory and legal, finance and human resources—underscores the need for cybersecurity to be the purview of the entire enterprise.

It is critical that cyber risk strategy be built and managed from the ground up, embedded in the business mindset, strategy, and policies, not only within the IT architecture and systems design. IT and business leaders must collaborate to determine a comprehensive cyber risk strategy, encompassing security, privacy, integrity, and confidentiality. This requires considering the organization's risk toler-

ance, identifying the most vulnerable gaps as well as the most valuable data and systems, then devising plans for mitigation and recovery. A defined and comprehensive strategy could potentially drive an organization's market position, even positioning it with a competitive advantage.

This represents a fundamentally broader understanding of cyber risk—it is not simply a compliance-centric process that one undertakes at the end of a project. Rather, companies are pushing the boundaries of the security function and shaping their risk appetite before development begins. Going forward, cyber will undergird every component of the macro platform, and will be integrated into all aspects of an organization's digital transformation agenda.

ORACLE PERSPECTIVE
MACRO TECHNOLOGY FORCES POWER THE FUTURE ERP

The ERP of the future will likely serve as the focal point through which the macro technology forces converge and intertwine, enabling innovations and process improvements. These improvements range from gaining process efficiencies to revamping business models. The controlled collision of macro forces is already visible in the marketplace, with several companies pursuing digital offshoot initiatives after moving to Oracle ERP Cloud.

The potential benefits of the controlled collision of multiple digital technologies include growing new revenue streams, bringing new products and services to market, gaining process efficiencies, and ultimately, attaining a leadership position. Although it is relatively straightforward to target any one of these value levers with a stand-alone digital initiative, the real challenge is to identify the interconnected opportunities that arise from implementing several solutions at once.

▶ **What can Oracle ERP customers look forward to?**

Many Oracle ERP customers have already adopted two or more macro forces to transform their organizations. Major themes emerging from our conversations with CIOs and CTOs include:

- **A need** to minimize how much time and effort teams spend on maintenance.
- **Concerns** that an ERP system could be obsolete by the time an implementation is completed.
- **Challenges** handling continuous business requests to upgrade and enhance the current feature set.
- **Desire** to minimize the investment required when it is time to integrate disruptive technologies with existing ERP.
- **Preference** for a single platform in the pivot to digital instead of a mixed bag of platforms.

Prior to selecting a platform, the macro forces need to be carefully examined based on the organization's strategy and priorities. A solid understanding of each macro force and the value it delivers, either individually or in concert with the others, is essential in defining an effective roadmap for revitalizing current IT platforms.

There is no magic bullet or one-size-fits-all approach for adopting the macro forces. But, in many cases, the following steps are critical: getting the core systems set up well in cloud; putting the foundational data in place; and ensuring that the infrastructure is nimble and scalable. The data that can be obtained through alternate sources such as IoT, digital channels, and social media can then be harnessed (in combination with foundational data) utilizing ML, AI, and other cognitive tools to power predictive analytics and automation in processes, transactions, and decisions.

Oracle and other modern ERP platforms drive core modernization, on top of which other macro forces can be layered. This will help enterprises to build an IT ecosystem that is scalable, secure, nimble, and feature-rich.

THE FORCES IN ACTION AT A LOGISTICS SERVICES ORGANIZATION

A large global transportation and logistics provider has centered its innovation approach upon a controlled collision of macro technology forces. The organization has embarked on a journey to modernize its core systems in an effort to attain greater efficiency, speed, and adaptability within its core business functions of sales, purchasing, pricing, order promising, delivery fulfilment, inventory management, and receivables and payables management. A big step in this journey involved its recent transition to Oracle ERP Cloud. To take full advantage of the core modernization, the organization has pursued several additional initiatives to harness the synergies among macro forces. It has also used robotic process automation to augment the capabilities of its employees with a new "digital workforce." The bots automate rote operational tasks as well as feed data and analytics to Oracle ERP systems to support more informed decision making. The company has also deployed chatbots to deliver a next-generation customer experience.

In the latest chapter of its innovation story, the company is transforming itself into a global, digital and insight-driven organization by combining macro technology forces once again. More specifically, the company evaluates the potential uses and benefits of these colliding forces through its digital foundry, where it generates ideas, prioritizes, prototypes, and scales its innovations. The digital foundry, which is itself an example of the business of technology macro force, involves cross-functional and global teams that often partner with other players in the ecosystem. These interactions enable participants to:

- Generate a continuous stream of new ideas
- Rapidly validate the value of new capabilities
- Adopt new ideas via an Agile methodology
- Evolve features and functionalities over time
- Design for agility as well as efficiency

Overall, the organization has embraced the macro forces and is reaping the benefits of their controlled collision.

THE FORCES IN ACTION AT A MAJOR COMPUTER TECHNOLOGY COMPANY

A leading computer technology organization is harnessing three macro forces—core modernization, business of technology, and digital experience—to transform its supply network. The modernization effort will be enabled by migrating various business groups onto a core Oracle ERP SCM platform and utilizing digital technologies (or example, RPA, ML, user centric visualizations, and orchestrated collaboration). This will enable the organization's distributed, mobile workforce to proactively monitor and resolve issues in supply network processes with real-time and automated decision making. Ultimately, the organization seeks to use the convergence of the macro forces to:

- Make the right commitment — Via global collaboration and digitization of supply network planning
- Ensure parts supply — Through global supply visibility and digital-reporting enhancements

- Harmonize and visualize — Via data acquisition and harmonization and interactive digital visualizations
- Keep the customer informed – Through continuous fulfillment updates throughout the entire supply network

Another set of macro forces (that is predictive analytics and cognitive) is shaping the future state of the organization's supply network, with digitization across four processes: plan, source, make, and deliver. Through analytics and cognitive, the organization can examine operational and historical data, gain insights to support better decision making, and more readily respond to demand fluctuations and supply distributions.

THE FORCES IN ACTION AT A LEADING TIRE MANUFACTURER

USE CASE One of the world's largest producers of off-road tires, wheels, and undercarriages for agricultural, construction, and forestry equipment is using the macro forces of digital reality (IoT), cloud, and core modernization in its digital transformation journey.

At its wheel manufacturing facility, the company faced a process challenge: Shop-Floor operators had to pull products off fast-moving, automated paint lines to feed data into the ERP system. Consequently, it was difficult to keep up with the conveyor movement while recording products that were physically ready for shipment, causing paint-line delays and inaccuracies regarding how much product was available to meet demand.

To overcome this challenge, the company is using Oracle IoT Cloud platform, integrated with programmable logic controllers (PLCs) and Oracle ERP Cloud, to capture work-order completion information in real time as products move through the paint lines. Thus, when a product is physically ready, it automatically appears as being shippable in Oracle ERP Cloud. This relieves the burden upon shop-floor operators, makes the lines run more smoothly, and reduces shipping delays.

Building upon the success of this controlled collision of macro forces, the organization has plans to expand the integrated solution to other parts of the business where operations are highly automated.

BOTTOM LINE

The nine macro forces are the enduring technology trends that will continue to shape strategies and dominate investment priorities. But importantly, the forces are not independent, isolated entities. And they're only partially compelling as stand-alone concerns. The calling of our time is to unlock what combination matters for any given line of business, function, agency, or country; to confidently chart a path beyond convention and organizational inertia; and to elevate the narrative from the *what* of the enabling technology into the *so what* of their combined effects—moving beyond trends, and beyond the digital frontier.

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ORACLE PERSPECTIVE

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Endnotes

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AI-fueled organizations
Reaching AI's full potential in the enterprise

FOR SOME ORGANIZATIONS, HARNESSING ARTIFICIAL INTELLIGENCE'S full potential begins tentatively with explorations of select enterprise opportunities and a few potential use cases. While testing the waters this way may deliver valuable insights, it likely won't be enough to make your company a market maker (rather than a fast follower). To become a true AI-fueled organization, a company may need to fundamentally rethink the way humans and machines interact within working environments. Executives should also consider deploying machine learning and other cognitive tools systematically across every core business process and enterprise operation to support data-driven decision-making. Likewise, AI could drive new offerings and business models. These are not minor steps, but as AI technologies standardize rapidly across industries, becoming an AI-fueled organization will likely be more than a strategy for success—it could be table stakes for survival.

In his new book *The AI Advantage*, Deloitte Analytics senior adviser Thomas H. Davenport describes three stages in the journey that companies can take toward achieving full utilization of artificial intelligence.[1]

In the first stage, which Davenport calls *assisted intelligence*, companies harness large-scale data programs, the power of the cloud, and science-based approaches to make data-driven business decisions.

Today, companies at the vanguard of the AI revolution are already working toward the next stage—*augmented intelligence*—in which machine learning (ML) capabilities layered on top of existing information management systems work to augment human analytical competencies.

According to Davenport, in the coming years, more companies will progress toward *autonomous intelligence*, the third AI utilization stage, in which processes are digitized and automated to a degree whereby machines, bots, and systems can directly act upon intelligence derived from them.

The journey from the assisted to augmented intelligence stages, and then on to fully autonomous intelligence, is part of a growing trend in
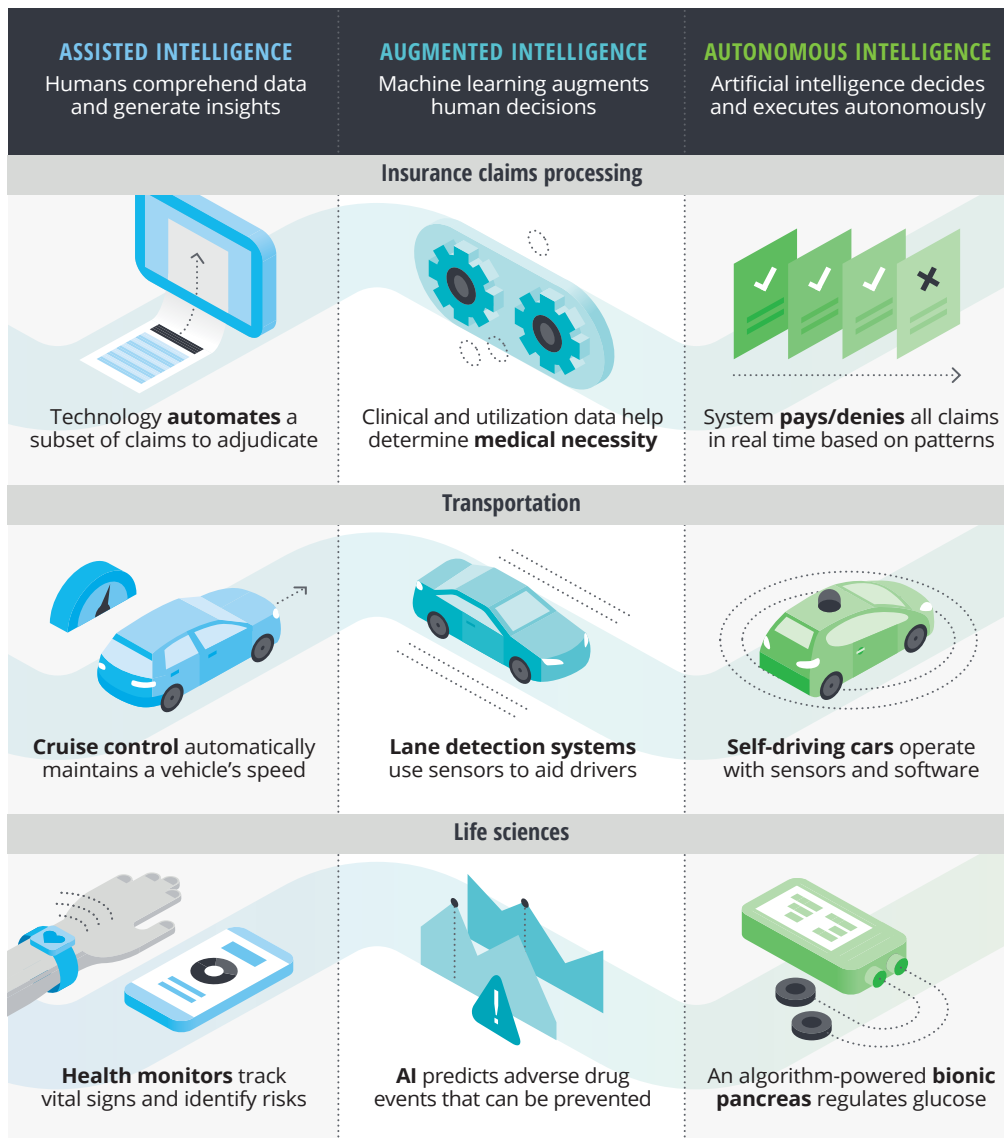
which companies transform themselves into "AI-fueled organizations." This trend is also about a sustained commitment to redesigning core systems, processes, and business strategies around AI and its possibilities. Its end goal: an AI-fueled organization in which humans and machines work together

within designed digital systems to harness data-driven insights.

Over the last decade, *Tech Trends* has chronicled the emergence of AI and other cognitive technologies, and their growing disruptive potential. The *AI-fueled organization* trend, as we recognize it today, found its footing during the last several

FIGURE 1

Bringing the evolution of artificial intelligence to life

ASSISTED INTELLIGENCE Humans comprehend data and generate insights	AUGMENTED INTELLIGENCE Machine learning augments human decisions	AUTONOMOUS INTELLIGENCE Artificial intelligence decides and executes autonomously
Insurance claims processing		
Technology **automates** a subset of claims to adjudicate	Clinical and utilization data help determine **medical necessity**	System **pays/denies** all claims in real time based on patterns
Transportation		
Cruise control automatically maintains a vehicle's speed	**Lane detection systems** use sensors to aid drivers	**Self-driving cars** operate with sensors and software
Life sciences		
Health monitors track vital signs and identify risks	**AI** predicts adverse drug events that can be prevented	An algorithm-powered **bionic pancreas** regulates glucose

Source: Thomas H. Davenport, *The AI Advantage*. Deloitte analysis.

years when a few pioneering companies began experimenting with bots and other cognitive technologies to better understand their potential impact on productivity.[2] We now see companies representing all industries and regions embarking on their own AI-fueled journeys. For example, the German retailer Otto is currently using AI and ML to make operational decisions autonomously at a scale that humans cannot match.[3] In the financial services industry, Zurich Insurance Group is using intelligent bots to process personal injury claims.[4]

Meanwhile, companies even further along in their AI journeys are looking beyond discrete initiatives and beginning to approach AI as an integral component of corporate strategy. A recent survey by the *MIT Sloan Management Review* and Boston Consulting Group of more than 3,000 business executives found that pioneering companies such as Chevron, Allianz, and Daimler are deepening their commitments by prioritizing revenue-generating AI applications over cost-saving ones. They are scaling AI throughout their enterprise operations and are involving high-level management in AI initiatives. Notably, of the surveyed executives from pioneering companies, 90 percent report already having AI strategies in place.[5]

The number of companies following in the footsteps of AI pioneers will likely increase in the next 18 to 24 months as companies identify ways to use cognitive technologies to achieve strategic goals. This process is already underway. In two consecutive global surveys (2016–17 and 2018), Deloitte has asked CIOs to identify the emerging technology in which they plan to invest. Cognitive technologies/AI has consistently topped the list.[6]

Though these CIOs—much like society at large—may be fascinated by cognitive technologies' sci-fi-like possibilities, their AI ambitions are likely grounded in more practical (and achievable) benefits:Pursued strategically across cognitive's three stages, AI can increase productivity, strengthen regulatory compliance through automation, and help organizations derive meaning from ever-larger data sets.[7]

Enterprise tech leaders, start your engines. The time to launch your company's AI-fueled journey is now.

AI, AI—oh!

The AI-fueled organization trend is the latest in a series of technology-driven transformations that have delivered quantum leaps in productivity. In the early 20th century, new tabulating machines helped workers organize data and perform calculations. The 1950s saw the emergence of programmable systems—early antecedents of today's computing and internet technologies. And at the dawn of the new millennium, cognitive technologies such as AI, ML, and robotics began augmenting and amplifying human intelligence, a transformation that continues to disrupt operational models and illuminate new opportunities.[8]

FIGURE 2

The top five benefits of AI

Percentage of survey respondents who rated each benefit in the top three for their company

Enhance current products

44%

Optimize internal operations

42%

Make better decisions

35%

Optimize external operations

31%

Free workers to be more creative

31%

Source: Deloitte Consulting LLP, *State of AI in the Enterprise*, 2nd Edition, October 22, 2018.

Today, the possibility of achieving the next quantum leap in productivity propels our march toward autonomous intelligence.[9] The human brain can decipher and derive meaning from large volumes of data, but this unique ability is limited by the amount of data our brains can absorb at any moment. Unlike the human brain, AI has no such limitation, which has the net effect of turning a trickle of business insights into a raging river of strategic possibilities. More and better insights delivered autonomously can lead to increased productivity, greater efficiency, and lower operational costs. Yet in the context of AI, these three may prove to be low-hanging fruit. Consider how autonomous AI could fuel other opportunities, including:

- **Enhanced regulatory compliance.** Despite companies' best efforts, regulatory compliance remains a moving target, due largely to the pervasive nature of human bias. While subjective opinions and differing worldviews make for interesting conversation, they also make it challenging for any two (or more) people to interpret laws and regulations the same way. This is why we have judges. Algorithms, by contrast, do not have fluid thought processes: They always interpret and execute according to the literal letter of the laws with which they're set up. By intelligently automating compliance functions in IT systems, companies can leave human cognitive maneuverability to machine-based robotic execution, which is, ideally, free of subjectivity, bias, and mood.[10]

- **"Mass personalization" of products and services.** Today content, products, and services are largely designed for mass consumption. In the near future, they will likely be customized based on individual users' personas, needs, wishes, and traits—an approach known as *mass personalization*. What's more, this degree of personalization will take place both statically and dynamically. Some companies are already working toward this goal. In the media sector, for example, Netflix is developing an AI plat-

form that creates personalized movie trailers based on the streaming histories of individual viewers. This is one element in the company's larger content strategy for using data to inform creative decision-making around genre, casting, and plot development.[11] (Learn more about mass personalization and the technologies that make it possible in the *Beyond marketing: Experience reimagined* chapter of *Tech Trends*.)

- **Asset intelligence.** Today, companies rely heavily upon human intelligence to interpret, anticipate, and intuit information in ways that machines cannot. That's about to change. In the future, the intelligence generated by data intelligence generated from company assets—infrastructure, IT systems, and inventory, for example—may surpass human insights as organizations' most mission-critical business intelligence. Sensors embedded in vast IoT networks, computer vision, and machine learning will feed data into analytics systems in real time. AI tools, acting autonomously on the resulting insights, can reconfigure dynamic pricing on store shelves, recalculate warehouse staffing projections, calibrate manufacturing machines, and optimize supply chains.

AI's next top model

Indeed, organizations are using AI in innovative ways, but as the *AI-fueled* trend progresses, more companies will evolve, moving from using the technology in isolated pilots to deploying larger AI systems. But which systems? Three system models are currently in play:

- **Cloud-native model.** Given AI's ascendance in the enterprise technology arena, it is conceivable that an AI-as-a-service platform could be the next big operating system. This may or may not happen, but even the possibility has set off a gold rush of sorts among major (and minor) tech players to build AI-based platforms. AWS, Microsoft, and Google Cloud Platform

are investing heavily in big data, ML, and AI capabilities, while Chinese vendors Alibaba and Baidu are developing a host of cloud-based AI solutions. None of these deep-pocketed tech giants has yet seized a first-mover advantage, but competition—and potential rewards—are steadily increasing.[12] Deloitte Global predicts that in 2019, companies will accelerate their usage of cloud-based AI software and services. Among companies that adopt AI technology, 70 percent will obtain AI capabilities through cloud-based enterprise software, and 65 percent will create AI applications using cloud-based development services.[13] Stay tuned.

- **Package-adjunct model.** In an alternative approach to the cloud-native model, several vendors are putting existing general-purpose AI platforms in the cloud. For example, IBM is now making Watson's AI and ML capabilities available to cloud customers.[14] Salesforce is taking a slightly different tack with its Einstein platform: The company is acquiring AI capabilities to add to its cloud services portfolio.[15] Similarly, SAP and Oracle continue to embed AI capabilities into their existing product suites.[16]

- **Open-algorithm model.** Established vendors with deep pockets are not the only companies to recognize a big opportunity in AI, and it is not a given that a single cloud-based or vendor model will come to dominate the market. For this reason, numerous startups and boutique software shops are developing AI solutions to meet specific business needs, use cases, and vertical-

ized issues. Until market consolidation gains momentum and standards begin to emerge, expect more highly innovative startups to enter the AI fray—and for some of their early efforts to result in scalable deployments.[17]

Intelligence: Artificial and human

An AI-fueled organization places AI, ML, and other cognitive technologies at the very center of business and IT operations. While this may sound like a straightforward proposition, its disruptive ramifications will likely ripple across the enterprise, with particular impacts in the following areas:

- **Data management.** To realize the benefits of becoming an AI-fueled organization, you'll need to put in place more dynamic data governance, storage, and architecture. Advanced data management fuels an enterprise AI engine and is a core building block for deriving autonomous insights from your vast data stores. Data needs to be tagged properly before being fed to AI, and your team should be prepared to provide the business context for that information. To become an AI-fueled organization, you will need access to the right data sets, the ability to train algorithms on that data, and professionals who can interpret the information.

    While AI offers an opportunity to process, analyze, and act on data at phenomenal speeds,

Deloitte Global predicts that in 2019, among companies that adopt AI technology, 70 percent will obtain AI capabilities through cloud-based enterprise software, and 65 percent will create AI applications using cloud-based development services.

quality data is necessary to stand up AI in the first place. Unfortunately, preparing data for AI deployments—and then creating the dynamic capabilities you will need to manage it—can prove challenging. Of the roughly 1,100 IT and business executives interviewed for Deloitte's second annual *State of AI in the Enterprise* survey, 39 percent identified "data issues" as being among the top three greatest challenges they face with AI initiatives.[18]

- **Training machine learning**. To function, AI technologies rely on ML algorithms operating within neural networks that must be "trained" on massive volumes of data. In the context of the global AI gold rush, China—which takes a different approach to data privacy from those of many other nations—currently has an advantage. As they train their neural networks, Chinese developers enjoy ready access to enormous data sets owned by firms such as Alibaba and Baidu, all of which are ultimately controlled to a greater degree.[19] In Western economies, companies lack comparable access to vast, controlled data stores, which puts them—at least for now—at a competitive disadvantage.

39%

of Deloitte's second annual *State of AI in the Enterprise* survey respondents identified data issues as among the top three greatest challenges they face with AI initiatives.

Yet there is an alternative technology-based means for training AI that may help companies overcome this data access challenge. DeepMind, a UK-based company owned by Google, has developed a system for training neural networks on simulations rather than on real data. In other words, DeepMind's AI solution trains itself. It's too early to tell whether simulation-based AI training can fully match the benefits of training with traditional data, but it does offer an alternative approach that could put AI training and full deployment within the reach of millions of companies around the world—including startups without years of data sets already in hand.[20]

- **Ethical AI**. The current debate surrounding the ethical ramifications of using AI and its potential impact on society isn't ending anytime soon.[21] In the absence of ethical consensus on so many aspects of cognitive technologies, individual companies on AI journeys should factor ethical considerations—as well as their organization's values—into the development of their own AI solutions. Though a few organizations operating at the vanguard of cognitive exploration are using machines to write code, by and large humans continue to write it. As such, all their biases, assumptions, and perceptions may find their way into the algorithms being developed.[22] As you build your AI-fueled organization, ask yourself: What does ethical AI mean? How do governance and ethics overlap? Do the algorithms we are creating align with our values and those of society in general? How can you build transparency into AI decision-making? How can you calibrate algorithm models more consistently to remove the unconscious bias that may exist in underlying data or in the surrounding environment?

- **Talent**. Only the biggest companies with the deepest pockets likely have the resources to keep industry-leading AI talent on the payroll on a permanent basis. Moreover, as more organizations become AI-fueled, competition for expertise will only increase. How will you secure the talent and skills you need to compete in

As we move into the AI-fueled model, workers will have to adapt to a more advanced end state in which humans and machines interact and collaborate in ways that, until recently, existed only in the realm of science fiction.

this climate? The first step is to jettison the old-school idea that employees are, and must always be, full-time workers. As discussed in Deloitte's *2018 Global Human Capital Trends* report, "the traditional employer-employee relationship is being replaced by the emergence of a diverse workforce ecosystem—a varied portfolio of workers, talent networks, gig workers, and service providers that offers employers flexibility, capabilities, and the potential for exploring different economic models in sourcing talent."[23] This does not mean that full-time workers will no longer have a role to play in IT. It does mean, however, that as cognitive technologies and automation transform IT roles and skill sets, the definition of talent will evolve to include:

- full-time employees you can attract and hire

- contracted freelancers working in the gig economy

- crowdsourced activities, such as the creation of algorithms

- bots that automate some business processes and act as digital full-time employees

This last talent category—bots—is important. In the future, humans and machines will likely complement each other's efforts effectively, with intelligent bots assuming many of the tasks that full-time employees perform today. This will free humans from low-value, repetitive drudgery to focus on tasks and initiatives that create value. This hybrid talent model lies at the heart of what we foresee as the "future of work."[24] It is also a foundational component in the AI-fueled organization.

- **Organizational and culture changes**. Among the most prized IT skills today are those in the areas of data analysis, data modeling, and applications development. As AI adoption grows, companies will increasingly value expertise in data science, algorithm development, and AI system design—with special emphasis on the human-centered design skills required to develop personalized user experiences. For CIOs, this presents a challenge: What do you do with existing talent whose expertise lies in legacy systems? You can retrain, reskill, and retool your workers, or change your workforce altogether. Some CIOs may find that the best way to meet their needs is by pursuing both options, to the extent possible.

  Yet retraining and acclimating legacy talent to the world of AI may present its own challenges. It's not about just learning a new skill—it requires adapting to a new culture. AI-fueled organizations work in unorthodox ways. Anecdotally, we have seen companies struggle to get their people to accept using analytics to perform traditional tasks. As we move into the AI-fueled model, workers will have to adapt to a more advanced end state in which humans and machines interact and collaborate in ways that, until recently, existed only in the realm of science fiction. What will an organizational culture shift of this magnitude mean for AI adoption, buy-in, support, and sponsorship?

- **Insights, not information**. Traditionally, CIOs have spent much of their workdays (and careers) maintaining legacy systems and

"keeping the lights on." As AI, ML, and other cognitive tools drive automation across the IT ecosystem, CIOs and their teams may spend less time on maintenance and more time helping the enterprise with informed decision-making about how they use and what they expect from technology. CIOs have unique insights, directly affecting business strategy and tactics, to address key questions:

– What are the data assets within an organization?
– How could one monetize those assets?
– What insights could be generated from those assets?

– How do you interpret those insights?
– How do you use these insights to generate meaningful outcomes?
– Consequently, how do you make informed decisions on new products and services for your customers while at the same time increasing the engagement with those customers?

Ultimately, the AI-fueled journey presents CIOs with an opportunity to redefine their own role, from chief information officer to "chief insight officer"—the organizational leader who serves as custodian, facilitator, and catalyst for informed decision-making at the corporate level.[25]

ARE YOU READY?

No two companies will adopt a technology trend in the same way. Every organization has its own goals, strengths, and weaknesses to ponder before it embarks on its own transformation journey. If you are unclear on what the AI-fueled trend offers—or requires of—your organization, ask yourself the following questions:

▶ **What business objective(s) can our organization achieve by deploying artificial intelligence?**

Artificial intelligence may offer a wealth of benefits to your organization, but only when viewed through a strategic business lens rather than as an IT project, and only when brand rhetoric gives way to measurable results. Collaborate across functions to identify the enterprise's main objectives, then align the AI strategy alongside to achieve those outcomes. You may choose to pursue solutions that reduce costs, facilitate a leap in productivity, monitor compliance, reduce risk scenarios, or derive greater meaning from more data. The first step of the AI journey should be setting end goals, which will enable you to draw a much more detailed, actionable road map with clearly marked milestones.

▶ **How can I use AI to achieve a competitive advantage?**

AI is a broad category that includes natural language processing, computer vision, machine learning, and more, all of which can augment back-office, intra-office, and customer-facing systems. If you're not sure where to start, look to your organization's vertical industry for guidance and inspiration. Proceeding with an eye on your industry's trends can ensure that you'll both meet customers' needs and remain competitive. For example, in the financial services industry, developers are creating highly personalized products and services; a financial firm may want to initiate its AI pilots by creating a robo-adviser or chatbot that can offer customers one-on-one investment advice. Deriving your initial AI pilots and use cases from your industry's trajectory—which you can understand better by talking to customers, vendors, and industry analysts—helps ensure that your resources are utilized to meet business goals.

———————————————

▶ **Is my technology adequate for an AI-fueled organization? If not, how do I find the right partners to build my AI ecosystem?**

To move forward, your organization's existing technology and talent pool may be inadequate to meet the needs of standing up an AI system. You might look to bring in next-gen IP, products, and solutions to broaden your ecosystem. Once you've determined where AI fits into your business processes, you can evaluate your existing technology, talent, and expertise to determine where there are gaps. You may decide to augment your existing resources by investing in startups that are further along in their AI journeys, or you may identify vendors and other industry partners with whom to collaborate and potentially co-invest in building market-ready applications with shared resources.

▶ **I'm sensing "cognitive fatigue" in my IT organization. What should I do?**

There are companies that dove headfirst into cognitive only to realize that they had taken on too much, too soon. Underwhelming results from early cognitive initiatives can dampen enthusiasm for further exploration. If you find yourself in this situation, consider starting a "lessons learned" dialogue with stakeholders and IT talent to review what went wrong and what can be done differently in future initiatives. And discuss AI approaches that other companies in your industry have taken that delivered desired outcomes.

▶ **Do I think big and start small—or go all-in?**

More important than going big or starting small is moving purposefully. CIOs and business leaders appear to recognize the value of creating a long-term AI strategy to guide their efforts. Stay focused on the desired outcome and employ design thinking, and the right plan will fall into place. Begin by identifying opportunities for AI within your organization, such as transactional, time-consuming tasks or data-heavy processes that require a bit of "tribal" knowledge. Carry out a cost-benefit analysis to determine whether an AI solution is feasible for that process, taking into consideration both existing resources and those you will need to acquire. Next, structure a pilot program around one of those transactions to run four to eight weeks. If those results are positive, you're ready to determine how you can move forward to scale to production and, eventually, expand to other products and service lines.

ORACLE PERSPECTIVE
OPERATIONALIZING AI

No longer a nascent technology, AI has established itself as an important component within the enterprise technology stack. In order to meet the increasing demand for AI-powered software, technology providers have launched a myriad of options. The growing trend is to embed AI into existing platforms in a way that is both intuitive for users and impactful for both IT and the business. Client demand has been particularly strong in the following areas:

- **AI-powered analytics** – Infuse AI into business processes and existing platforms to solve critical business problems
- **Cognitive IoT insight engine** – Operationalize data science to optimize business processes
- **Simplifying IT operations** – Reduce burden on IT to administer and maintain data warehouses

In each of these areas, business users are asking for ways to improve the quality and speed of decision-making while at the same time reducing the burden on IT. By embedding AI into modern software, businesses can capitalize on the wealth of information residing in their organizations in ways that are both intuitive and immediately impactful. For example, having a procurement module within a cloud ERP platform that automates entry, classification, and approval processes goes a long way toward streamlining business operations.

Data scientists often work in a vacuum, which is why organizations frequently face significant challenges in deploying solutions created by these experts. While languages such as Python and R provide the flexibility to write AI models capable of solving complex business issues, it is often difficult to integrate these models with the analytical tools that enable business users to derive valuable insights and take action. Companies that claim to be truly AI fueled succeed not only at creating algorithms to solve business problems but also at driving user adoption and making AI a core element of their business processes.

▶ AI-powered analytics

In the past, reporting and analytics typically fell within the purview of IT. Business users had to make requests, and subsequently tie up technical resources, when generating reports, curating data, and creating advanced analytics calculations. An important part of Oracle's approach to self-service analytics is to make these tasks more accessible to individual lines of business. As detailed in the following sections, AI-enabled analytics platforms can help business users in a number of ways.

- **Autonomous data prep** — Modern analytics platforms come with AI-driven, data-prep capabilities that automatically scan new data sources for enrichment opportunities prior to ingestion into an enterprise data warehouse. For example, it is possible for some to perform fuzzy logic calculations (for example, guessing the genders of people based on names).
- **Conversing with your data** — AI assistants have now firmly established themselves as an integral part of our lives, either on our phones or through smart speakers. Modern analytics platforms integrate with such assistants and have built-in natural language recognition. Through this integration, a user can make a request such as "show me sales by product and quarter" and immediately receive a line chart in response. Developers can take this one step further by enabling AI assistants to interact with the data, empowering them to respond to questions such as, "Which employees are at risk of leaving?" A number of companies are integrating digital assistants with the Oracle Analytics Cloud platform to enable employees to converse with their data, thus supporting better decision making and increasing process efficiencies.

- **Bringing data scientists to the business** — The focus thus far has been mainly on embedding AI capabilities within applications rather than on providing a platform for developers. Nonetheless, business users increasingly expect to gain insights through the push of a button. Data mining technology that runs in the core kernel of the database is one example of an industrial-strength AI platform that fulfills this expectation. By performing many of the calculations at the database level, companies can reduce the need to employ an army of developers and data scientists. More specifically, it is now possible to bridge the gap between data scientists and the business by providing the ability to ingest Python and R code, develop and score models, and display the results through an analytics platform.

▶ **Cognitive IoT insight engine**

Industrial IoT has quickly become an important battleground for companies competing on the strength of their supply chains. However, professionals in areas such as manufacturing, agriculture, logistics, and healthcare often find it difficult to extract value from these IoT platforms. Technology providers are responding to the market by embedding AI in the heart of IoT solutions, attempting to resolve this challenge through the following approaches:

- **Self-learning, adaptive IoT** — The primary use cases for industrial IoT involve smart devices sifting through large amounts of sensor data in order to learn patterns. These patterns in turn trigger workflows and support decision making related to critical processes, such as optimizing maintenance windows and preventing mechanical breakdowns. The bar has been raised though, and now there is a call for self-learning devices that can automatically adapt to new inputs as well as trigger workflows.
- **Deeper insights into the manufacturing ecosystem** — An effective IoT platform should integrate with existing enterprise software, in addition to coming packaged with analytics functionality for sensor data. Typically the realm of data scientists, this type of functionality gives manufacturing workers the ability to interpret data streams in real time. The insights gleaned further empower them to make continual improvements in the form of process enhancements and better equipment utilization.
- **Automated intelligent workflows** — The ability to respond to real-time data is one of the main benefits of IoT. While using data models to determine optimal maintenance time frames is certainly beneficial, being able to predict a malfunction before it occurs provides another level of value. Today, sensors often indicate when vehicles or machines need maintenance, thus preventing breakdowns and loss of time. Supply chain and manufacturing leaders are now expecting IoT analytics to go a step further: automating workflows and integrating them into business processes in order to immediately respond to changes as they are recorded. This level of automation is quickly becoming a "must have," since much of IoT's potential value is negated if human observation and intervention is still required. That is why triggered alerts, automated service orders, chatbot interaction, and other cognitive-driven responses increasingly need to be part of an effective IoT analytics platform, as is the case with Oracle IoT Cloud.

▶ **Simplifying IT operations**

Until recently, enterprise database administration was wholly the responsibility of IT, with business users lacking a self-service option. Now, modern databases can use AI to solve many problems that have been accumulating over the years, making it possible for these systems to self-patch and self-tune. While it is easy to understand how an autonomous database can reduce both cost and risk, the potential to empower lines of business is largely driving demand.

- **Database management challenges** — Always available, high-performing, and extremely reliable are the watch words of database management. In order to maintain these exacting standards, administrators typically tune the database manually, optimizing table structures and managing rapidly expanding data—all while regularly performing patches and maintenance. These tasks are time-consuming and require substantial expertise. Advances in database technology have helped, but there are capital limitations, especially with larger databases. The cost of database hardware is often prohibitive, particularly when extra IT resources are needed to manage it.
- **Emergence of autonomous data warehouses** — To address these challenges, organizations are increasingly adopting autonomous data warehouses (ADWs). With ADWs, optimizing, tuning, patching, backing up, and troubleshooting—essentially all of the typical database administration tasks are performed by AI. In addition, ADWs, which are cloud scalable, run on the latest hardware, thus eliminating the need to have IT administrators provision or manage the environment. Using deep-learning AI algorithms, it is now possible to incorporate decades of enterprise database experience into a cognitive system that manages the database without any human intervention. Furthermore, the number of steps needed to create such a database has been drastically reduced, allowing business users to spin up and spin down environments when needed.

AI-fueled organizations measure themselves not only on the problems they can solve, but also on how effectively they are able to weave AI into the fabric of the business. As AI adoption grows, more organizations will be faced with the question of how to operationalize AI to generate value. Leveraging platforms that embed AI at their core is often a good starting point for companies wishing to operationalize this new technology.

AI EMPOWERS THE WORKFORCE VALUE CHAIN
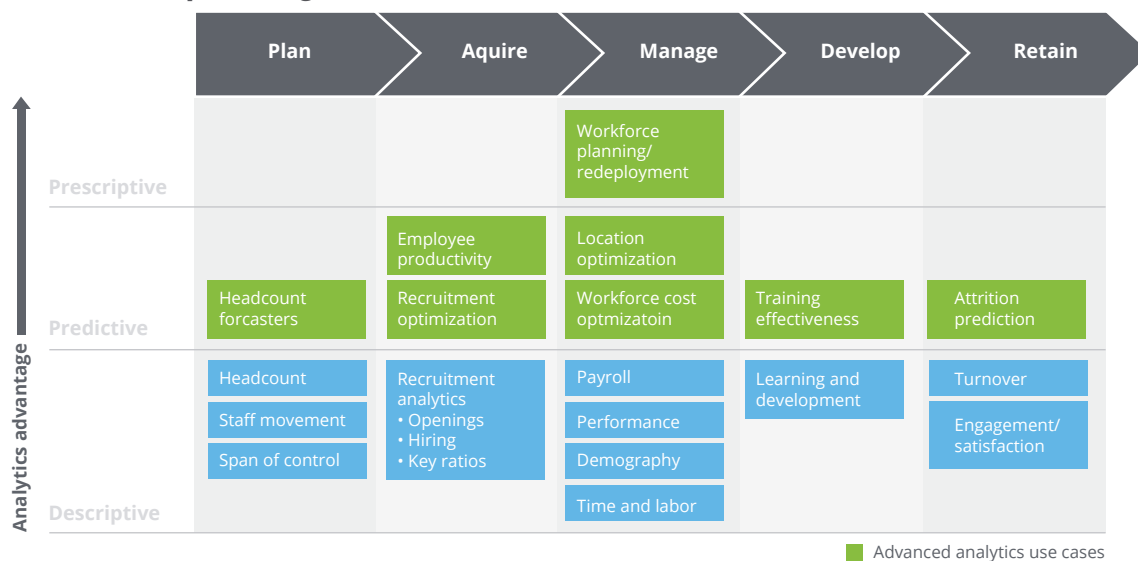
USE CASE

Disruptive technologies such as AI, evolving cultures, shifting demographics, and a tightening labor market are reshaping our workplaces at an enormous pace. A large healthcare conglomerate in the United States was facing an ever-increasing backlog of open nursing positions that its recruitment team was struggling to fill. Moreover, many new hires would leave within the first year. The company invested heavily in training these nurses only to see them leave just as they were becoming productive. Well-publicized AI success stories became a clarion call for using advanced analytics to identify the problem and recommend solutions.

To begin, the company built a core set of analytics to better measure the effectiveness of key HR functions as they touched employees, from planning for open positions through terminating employment. Empowered with these metrics, the organization set out to develop AI use cases that would help uncover new opportunities to improve HR effectiveness in hiring, managing, retaining, and optimizing the workforce. Using Oracle Advanced Analytics, the organization developed AI-powered workflows that assisted HR leaders in better understanding which candidates fit well with the culture of the organization. They also used AI models to identify factors that were affecting employee productivity and to figure how to minimize overtime costs in departments that were experiencing high churn. The organization additionally developed AI-powered workflows that ran periodically on the entire nursing population to identify nurses that were at high risk of attrition and to identify factors that may prompt them to leave. Not only did the solution help HR leaders to take proactive steps to retain high performers, it also helped them to update compensation policies, forecast demand, develop screening questions for hiring, create training content, and plan events and activities to foster better engagement and belonging. Overall, the organization effectively demonstrated that AI can be used to enhance the entire workforce value chain.

FIGURE 3

How AI is empowering the workforce value chain

Analytics advantage	Plan	Aquire	Manage	Develop	Retain
Prescriptive			Workforce planning/ redeployment		
Predictive	Headcount forcasters	Employee productivity / Recruitment optimization	Location optimization / Workforce cost optmizatoin	Training effectiveness	Attrition prediction
Descriptive	Headcount / Staff movement / Span of control	Recruitment analytics • Openings • Hiring • Key ratios	Payroll / Performance / Demography / Time and labor	Learning and development	Turnover / Engagement/ satisfaction

■ Advanced analytics use cases

ENABLING A DATA-POWERED, NEXT-GENERATION UTILITIES COMPANY

USE CASE

Power and utilities companies are being disrupted through technological advancements and the growing need to integrate renewable energy sources, modernize grid infrastructure, support distributed power, and comply with regulations around pricing, security, and operations.

Considering these diverse needs, one power and utilities company took a crawl-walk-run approach to adopting AI-powered analytics. The organization chose customer, metering, and grid analytics for the pilot effort because leadership believed these areas would produce the greatest returns in the shortest amount of time. With data centralized on the Oracle Big Data Appliance, the organization deployed several analytical models to derive insights. More specifically, the data scientists leveraged AI algorithms to monitor networks, derive insights on asset health, explore storm impacts, and discover efficiencies for power consumption. Based on the output of these models, the company is better able to predict outages and adopt preventive maintenance measures to improve grid utilization. It is also better equipped to modernize billing and customer service.

With the success of the pilot, the list of desired capabilities grew, expanding beyond the initial target areas and into other parts of the organization to encompass:

- Fast search
- Exploration and discovery
- Quality and audit
- Reconciliation and governance
- Ingestion, integration, and processing
- Provisioning, metadata, and lineage
- Security and monitoring controls

Having received the desired return on their AI investments, the company is poised to forge ahead with even more AI applications, better preparing it to address ongoing disruption and shifting market demands.

FIGURE 4

Storm impact analytics models combine multiple data types

30

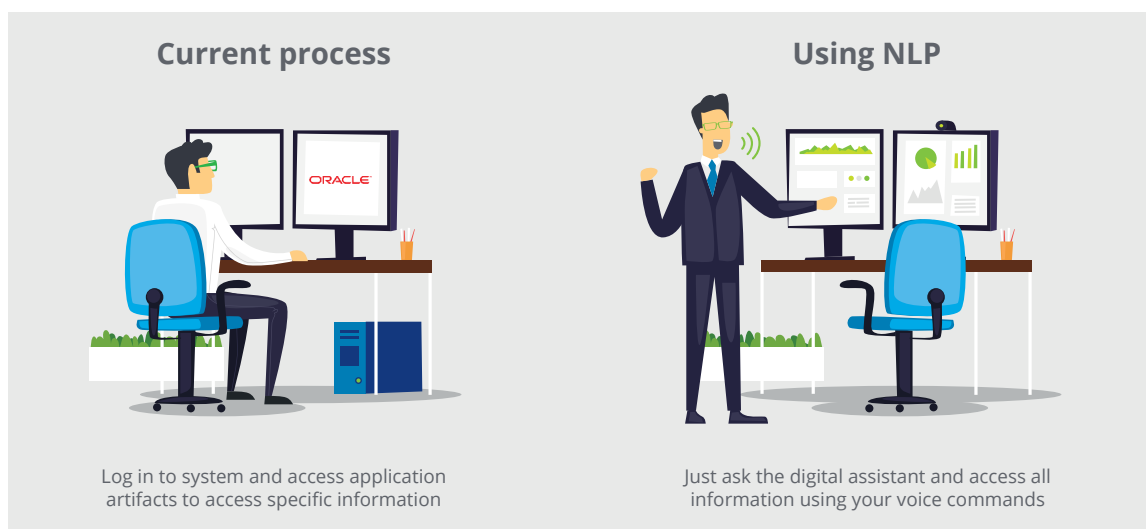# VOICE IS THE NEXT FRONTIER

USE CASE

An American *Fortune 500* manufacturing corporation had a vision: to voice-enable its recruitment functions. Leadership envisioned employees conversing with digital assistants and receiving immediate answers to business questions. To realize this vision, the company developed a solution using the AI capabilities and intuitive, natural language processing interface of Oracle Analytics Cloud. The solution, nicknamed "Ask Workforce," empowers users without requiring them to learn any specific syntax or to understand the structure of the data they are analyzing. It makes it easier for them to find the right candidates, and it saves a great deal of time, since they no longer have to manually search through a multitude of policies and documents to find the answers to their questions.

Originally designed for HR, the solution has quickly been expanded to other functions. Operational data inquiries can now be made by sales, service, and marketing personnel, as well as human resources staff, with little to no formal training. Entire departments can now make data-driven decisions that enhance the customer experience, increase revenue, and optimize the workforce.

FIGURE 5

Current process

Log in to system and access application artifacts to access specific information

Using NLP

Just ask the digital assistant and access all information using your voice commands

BOTTOM LINE

AI's role in the enterprise is growing as cognitive tools and tactics are standardized across IT environments. While it is true that in coming years, AI will likely be deployed not only to augment human performance but to automate some operational and business processes altogether, proactively printing pink slips is an ineffective means of planning for the next cognitive stage. Now is the time to fundamentally rethink the way humans and machines interact within working environments and what they can achieve together in the AI-fueled organization of the future.

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NoOps in a serverless world

Shift IT's focus from operations to outcomes

W E HAVE REACHED THE NEXT STAGE IN THE EVOLUTION OF cloud computing in which technical resources can now be completely abstracted from the underlying system infrastructure and enabling tooling. Cloud providers are continuing to climb the stack; rather than simply providing everything from the "hypervisor on down," they are now—through their own focus on hyper-automation—taking on many core systems administration tasks including patching, backup, and database management, among others. Together, these capabilities create a NoOps environment where software and software-defined hardware are provisioned dynamically. Going further, with serverless computing, traditional infrastructure and security management tasks can be fully automated, either by cloud providers or solution development teams. Freed from server management responsibilities, operations talent can transition into new roles as computing farm engineers who help drive business outcomes.

Traditionally, the CIO's responsibility of keeping business-critical technology systems running has absorbed up to 70 percent of IT's budget as well as considerable amounts of labor bandwidth. Cheaper storage, cloud, and outsourcing have lowered this budgetary outlay by 20 percent or more. Yet in an era of perpetually tight IT budgets, finding ways to redirect financial and human assets from operations to innovation remains a top CIO goal.[1]

In previous issues of *Tech Trends*, we have examined how CIOs are pursuing this goal by transforming their technology ecosystems from collections of working parts into high-performance engines that deliver speed, impact, and value. From the bottom of the IT stack up, they are building infrastructure that is scalable and dynamic, and architecture that is open and extendable. From the top down, CIOs are rethinking the way their IT shops organize, staff, budget, and deliver services.[2]

In many reengineering initiatives, automation is the keystone that makes meaningful efficiency and cost reduction achievable. With more of IT

becoming expressible as code—from underlying infrastructure to IT department tasks—organizations are applying new architecture patterns and disciplines in ways that remove dependencies between business outcomes and underlying solutions. They are applying those patterns as well as engineering techniques to redeploy IT talent from rote, low-value work to the higher-order capabilities.

Now, as part of a growing trend, CIOs are taking their automation efforts to the next level with serverless computing. In this model, cloud vendors dynamically and automatically allocate the compute, storage, and memory based on the request for a higher-order service (such as a database or a function of code). In traditional cloud service models, organizations had to design and provision such allocations manually. The end goal: to create a NoOps IT environment that is automated and abstracted from underlying infrastructure to an extent that only very small teams are needed to manage it. CIOs can then invest the surplus human capacity in developing new, value-add capabilities that can enhance operational speed and efficiency.

Serverless' value proposition is driving considerable interest in the serverless market.[3] A recent Cloud Foundry global survey of 600 IT decision-makers found that 19 percent of respondents were already using serverless computing, with another 42 percent planning to evaluate it within the next 24 months.[4] Moreover, MarketsandMarkets, a B2B competitive research firm, projects that the value of the serverless architecture market will reach US$14.93 billion by 2023, up from US$4.25 billion in 2018.[5]

Thus far, a number of large companies including Netflix,[6] Coca-Cola,[7] and the New York Times Co.[8] have been at the vanguard of the serverless trend. In the next 24 months, expect more organizations to begin following their lead, exploring ways to use serverless to scale their DevOps practices and to build greenfield applications. The goal of achieving pure NoOps environments may take several years

to achieve, but across industries, the transition, however preliminary, is underway.

Enough already with the "care and feeding"

For the purposes of discussing this trend, the terms *NoOps* and *serverless* are not interchangeable. "Ops" comprises any number of operational areas—think networking, security, management, and monitoring. In the marketplace and in the context of this technology trend, the term serverless basically describes server administration. To further muddy the definitional waters, both terms are misnomers: With the serverless model, there are still servers, but their functions are automated; likewise, in NoOps environments, traditional operations such as the code deployment and patching schedules remain internal responsibilities—they are simply automated to the extreme.

Both terms can trace their roots to the first as-

Serverless computing is an umbrella term for a spectrum of cloud-based options available to organizations wishing to get out of the business of managing servers.

a-service offerings and the dream that one day IT organizations would be able to hand onerous care-and-feeding responsibilities of enterprise systems to someone else. Today, *serverless computing* is an umbrella term for a spectrum of cloud-based options available to organizations wishing to get out of the business of managing servers. At one end of this spectrum is the platform-as-a-service model in which customers buy always-on access to a database. At the other end is the function-as-a-service model, which offers a fine-grain pricing model, substantiating and running code only when a customer needs
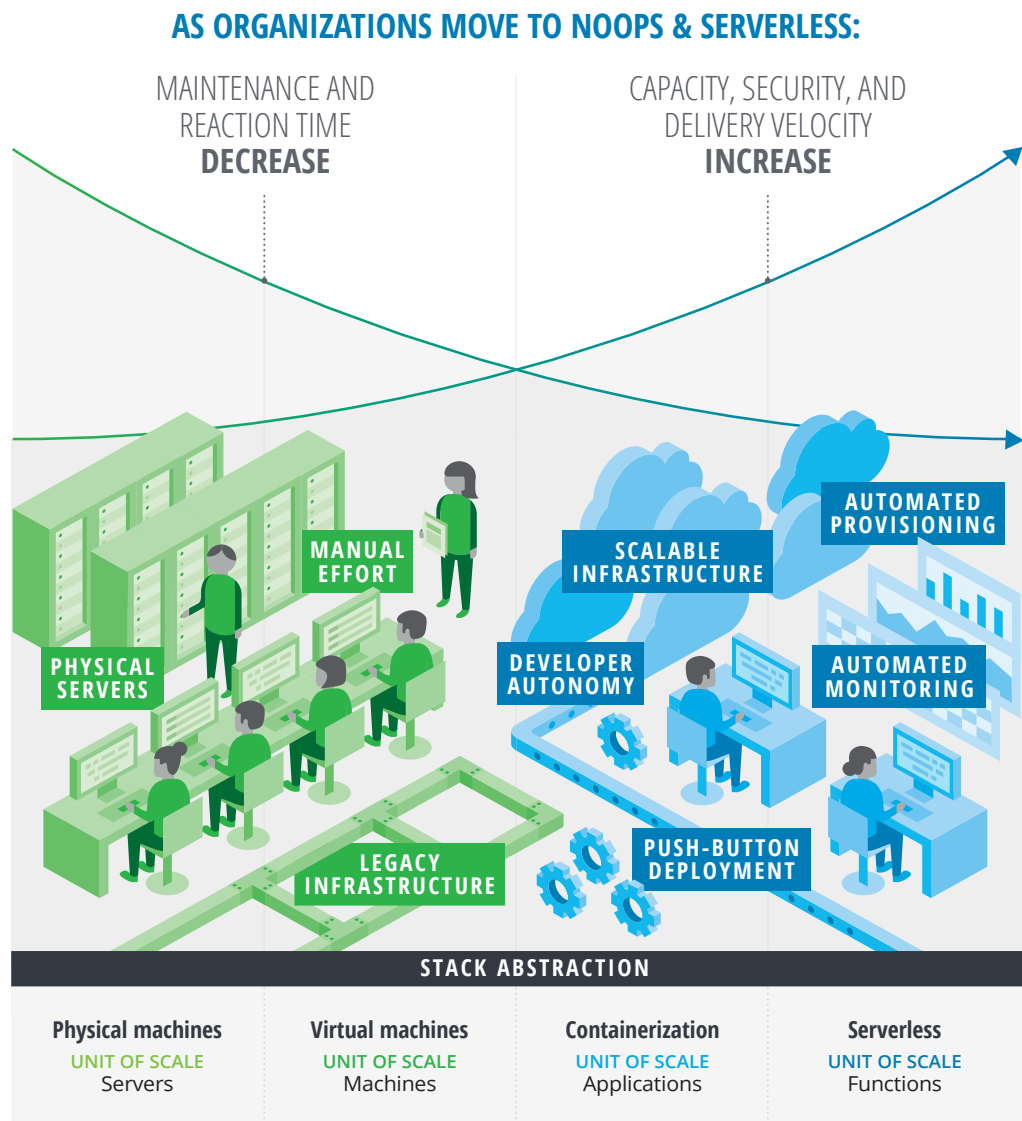
it. As such, customers pay for only the requests they make.

Serverless computing offers CIOs a toolkit for transforming their IT operations. Its potential benefits include:

- **Infinite scalability and high availability.** Functions scale horizontally and elastically depending on user traffic.
- **NoOps (or at least less ops).** Though operational tasks such as debugging typically remain in-house, infrastructure management is fully outsourced.

FIGURE 1

The digitalization of IT

AS ORGANIZATIONS MOVE TO NOOPS & SERVERLESS:

MAINTENANCE AND REACTION TIME **DECREASE**

CAPACITY, SECURITY, AND DELIVERY VELOCITY **INCREASE**

MANUAL EFFORT

PHYSICAL SERVERS

LEGACY INFRASTRUCTURE

SCALABLE INFRASTRUCTURE

DEVELOPER AUTONOMY

AUTOMATED PROVISIONING

AUTOMATED MONITORING

PUSH-BUTTON DEPLOYMENT

STACK ABSTRACTION

Physical machines	**Virtual machines**	**Containerization**	**Serverless**
UNIT OF SCALE	UNIT OF SCALE	UNIT OF SCALE	UNIT OF SCALE
Servers	Machines	Applications	Functions

Source: Deloitte analysis.

- **No idle time costs.** In a serverless computing model, consumers pay for only the duration of execution of a function and the number of functions executed. When a function is not executed, no charge is levied—thus eliminating any idle time. In terms of cost, this represents an improvement over legacy cloud computing models in which users are charged on an hourly basis for running virtual machines.

In many companies today, cloud strategies remain works in progress, as do efforts around virtualization and containers. Likewise, serverless computing, with its promise of a NoOps future, does not suddenly render these efforts redundant, but it does offer a vision of a highly automated end state to which CIOs can aspire.

And aspire they do. In Deloitte's _2018 global CIO survey_, 69 percent of respondents identified "process automation and transformation" as the primary focus of their digital agendas.[9] In the coming years, serverless will likely be a key technology that many CIOs use to automate the deployment, scale, maintenance, and monitoring of applications. Today, cloud vendors are steadily adding new capabilities such as databases and natural language processing interfaces to their portfolios of serverless offerings. It is now possible to build greenfield applications without deploying a physical or virtual machine. By understanding the investments that companies are making today in serverless computing and by embracing the broader _NoOps in a serverless world_ trend, they can make this transition foundational to their short- and long-term digital transformation agendas.

Chasing the elusive NoOps dream

The NoOps trend is gaining traction in part because it offers a new way of looking at an age-old problem: How can we make resources go further? For budget-strapped CIOs whose enterprise fief-

69%

of Deloitte's _2018 global CIO survey_ respondents identified process automation and transformation as the primary focus of their digital agendas.

doms generate no revenue directly, this question remains largely unanswered. But one thing is clear—there is not a lot of business value to be found in maintaining servers and data centers. Keeping on the payroll people whose expertise lies solely in patching servers has traditionally been just another cost of doing business.

The NoOps trend offers CIOs an opportunity to shift these employees' focus from patching, monitoring, and measuring to higher-value engineering and development tasks. More broadly, this trend makes it possible to manage IT operations more efficiently using automation and orchestration capabilities that others pioneered and have proven.[10] Much of what we think of when we talk about _NoOps_ and _serverless_ are infrastructure components that Amazon, Google, and Microsoft developed to support their as-a-service offerings. These vendors realized that these same components could benefit their as-a-service customers too, particularly in the area of software development.[11] In a _NoOps_ model, developers no longer have to coordinate with other teams to execute minor tasks involving underlying infrastructure, operating systems, middleware, or language runtime.

Transitions from traditional to serverless environments do not happen overnight, a fact that helps to mitigate the fears that some in IT may have about

job security. During these transitions, operations talent may still have to do some routine database tasks and make sure that core systems are tuned and maintained. But they will now have the bandwidth to upskill and redefine their roles; perhaps more importantly, they can begin approaching operations tasks less from a plumber's perspective than from an engineer's. Many may find this a much better place to be professionally: Writing software that monitors and heals certainly seems preferable to getting an urgent 2 a.m. text that a critical system is down. More broadly, think of this as transitioning operations talent from being reactive to proactive, and finding new opportunities to leverage automation. In the NoOps world, IT talent engineers variability out of operations, thus making things routine, repeatable, efficient, and effective.

Working with serverless platform vendors

At present, several major cloud providers are offering serverless platforms that can help users move ever closer to a NoOps state. Amazon, Google, and Microsoft dominate today's serverless market. Alibaba, IBM, Oracle, and a number of smaller vendors are bringing their own serverless platforms and enabling technologies to market.[12] Meanwhile, open-source projects such as OpenFaas and Kubeless are attempting to bring serverless technologies from the cloud to on-premises.[13]

The serverless model offers several advantages, particularly over the IaaS and SaaS models for which customers often pay a fixed monthly or yearly price whether or not they use the entire capacity provided. By contrast, serverless models charge customers for only the resources consumed for the life of the function that is called. It's a fine-grain, pay-as-you-go model, with significant projected cost savings over other cloud models for many workloads. For example, as competition in the serverless space heats up, it is not unreasonable for users to get up to a million free compute requests per month,

which provides a large amount of computing power without huge upfront costs.[14]

As you explore serverless offerings, be aware that the serverless computing model is still evolving—it should not be construed as a cure-all for development and operations problems. For example, the production tooling that provides visibility in serverless development environments is currently limited. Recently, cloud infrastructure provider DigitalOcean surveyed 5,000 development professionals about the challenges they have encountered when using serverless. Their responses varied, but respondents identified the following major areas:[15]

- **Monitoring and debugging.** Unsurprisingly, 27 percent of survey respondents cited monitoring and debugging in a serverless environment challenging, which is perhaps unsurprising given the ephemeral nature of serverless computing. Capturing the information needed to monitor and debug is more challenging with a serverless model because there is no machine to log onto. In some situations, developers working to debug tricky problems may be forced to log manually into a data store. The good news is that a new generation of debugging tools and applications that make it possible to run serverless functions locally are emerging.
- **Vendor lock-in.** Concern over vendor lock-in emerges often in the early stages of disruptive technology waves. Until industry standards are set and a single model becomes a market leader, early-stage customers are often concerned that they will pick the wrong horse. What if you are locked in an agreement with a vendor whose products eventually become nonstandard? If you want to switch vendors, you could face significant costs to retool and redesign your architecture. DigitalOcean found that 25 percent of respondents were concerned about getting locked into an agreement with their serverless vendor. In many cases, a suitable architecture can minimize your ties to a particular vendor. With function-as-a-service, for example, it is

possible to abstract your business logic from the serverless "handler" to make porting easier. With other serverless features, consider weighing their benefits against the potential costs of getting locked into an agreement you may neither want nor need.

- **Migration.** Roughly 16 percent of survey respondents cited migration as challenging. Indeed, for large companies, migrating at scale is no small task. For example, it can involve re-architecting one or more of your applications (as in the case of function-as-a-service) or at least swapping major system components such as databases. For this reason, some companies may view full-scale migration of their application portfolios to serverless as overly costly and disruptive. They may opt instead for migrating select existing applications or those that are a part of greenfield development initiatives.

ARE YOU READY?

Like the macro cloud journey that many companies are currently on, any pursuit of NoOps or serverless can unfold in manageable stages. But where—and how—to begin? As you explore the NoOps in a serverless world trend's potential for your organization, consider the following questions:

▶ **Is the trend right for me?**

At their core, the NoOps and serverless trends are grounded in two fundamental use cases: Infrastructure engineers can drive automation to new levels, and application developers can lessen their dependency on infrastructure engineers. It's also important to remember that while serverless won't be a good fit for every app in your stack, there's little downside to embracing automation and self-service to run and manage some of your solutions. Additionally, when done right, serverless architecture may yield faster time-to-market, more flexibility, a reduction in human error, and lower infrastructure and maintenance costs, all of which make good sense for the right workloads.

▶ **How do I go from doing this in small pockets to driving it across my organization? How do I make movement at a tactical level?**

From a technical perspective, a serverless environment allows for faster and continuous scaling through automation, so the technology enables faster deployment across the enterprise. As the application load increases and more functions are executed, the cloud provider is responsible for scaling the underlying infrastructure. This may allow established organizations with monolithic legacy systems to stand up new capabilities as quickly as small startups. From an operational perspective, however, a NoOps environment requires a cultural shift in your organization. You must be willing to break down silos, assign new roles, and reorganize your roster to gain the necessary traction to deploy at scale. Much like efforts to migrate to the cloud, a steering committee that establishes and enforces standards and lays out the road map—which at first glance may seem to counter the spirit of DevOps as well as NoOps—can keep the transformation on course.

_____

▶ **What if I need to start from scratch? I'm not very far along with automation or DevOps.**

Serverless architectures may be your fastest way to embrace NoOps. With a serverless environment, software applications can be broken down into individual functions (that is, a microservices-based architecture) that are portable, cost-efficient, and, most importantly, not bound to a legacy infrastructure footprint. The separation of application functionality from supporting infrastructure provides the greatest opportunity for application modernization.

▶ **What sort of workloads will be appropriate for serverless environments?**

A serverless approach is not one-size-fits-all but is often a good fit for applications that rely on microservices or APIs, such as Web applications, mobile backend, IoT backend, and real-time analytics and data processing. Applications well suited for serverless environments are ephemeral and stateless and don't require access to file-level systems. On the other hand, functions with high read-and-write volumes and those that require sustained computing power may be poor candidates. Longer-running, more complex computational tasks—such as data migration to NoSQL, applications requiring significant disk space or RAM, or those that require server-level operational access—may be better suited to a hybrid solution that employs servers and serverless capabilities.

▶ **Where do I start? Every company has several core, heart-and-lungs systems—do I begin there? Do I tackle it on the periphery first?**

Some companies are focusing their serverless efforts in areas where they have already made some progress on the digital front, such as customer-facing e-commerce applications and microservices. These areas are often ripe for the move to serverless because digital teams have probably begun the cultural shift (as well as some of the retraining and upskilling that may be necessary) that is an essential part of a NoOps transformation. As companies anchor their efforts in their digital foundations, they can simultaneously begin the NoOps and serverless transformation from both a top-down and bottom-up progression.

▶ **From an infrastructure perspective, what do I need to adopt? Do I have to go full cloud, or can I remain on-premises?**

You certainly can reap some benefits of DevOps practices on-premises, but unless you have a truly robust private cloud, your automation capabilities will likely be limited. And while you could deploy a hybrid solution of serverless and server-based components, you may realize only select serverless benefits. Even with just one on-premises server to manage, you will still perform anti-virus and vulnerability scanning and patching. To reach NoOps nirvana, you will likely need to go all in.

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AUTONOMOUS INFRASTRUCTURE AND CLOUD SERVICES BUILD FOUNDATION FOR CLOUD TRANSFORMATION

The evolution of cloud computing and the movement to where operational functions are automated thereby creating a NoOps environment, which can be achieved with enterprise technologies such as the autonomous self-driving cloud services. This is just one example how the evolution of technology is moving to support a NoOps environment.

Simply moving workloads to cloud infrastructure only solves part of the problem, and it can require additional skill sets and more, not less, IT effort. To get the full benefit of a NoOps environment, tooling and automation are required to shift limited resources to higher-value tasks.

While organizations are largely aware that they need tooling and automation platforms, many are still in the initial stages of design or development. Accordingly, they do not have a clear vision of how these tools will scale to meet increasing demands or if they will be able to support the hundreds, if not thousands, of applications in their portfolios that will ultimately need to reside in the cloud. With so many questions left unanswered, they are often immobilized, or they push forward hesitantly in the face of numerous unknowns.

- *Will our automation tools work with legacy ERP products and an increasingly multi-cloud landscape?*
- *How can we avoid introducing more and more tools and skill sets into the landscape?*
- *Will all this effort be wasted if we choose to partner with another cloud service provider?*

▶ Multi-cloud reality

Not every cloud platform is well-suited to run and operate every type of workload. Enterprise applications, enterprise databases, commercial off-the-shelf (COTS) applications, and developed cloud-native applications are not equal in terms of their running and operating requirements. Thus, single-cloud versus multi-cloud strategies must be considered.

As organizations select and deploy automation and cloud-management tooling, a landscape comprising of cloud-native applications can be a good place to start. From there, future possibilities can be more readily considered. Several tools are on the market for support in an increasingly multi-cloud landscape. However, in order to protect one's cloud investment, there needs to be a balance between market-leading functionality and breadth of support.

▶ Consider the application landscape

Cloud-native applications and simple workloads are often the first to be moved from on-premises to cloud. However, most organizations have a complex application inventory that includes SaaS, custom, COTS, and enterprise applications. The technical platforms need to be considered across cloud, non-cloud, and multi-cloud domains, including cloud-native development and on-premises in a hybrid technology model.

Even though certain automation tools for infrastructure and DevOps may have a strong business case, IT leaders should consider if they will work across the various operating systems, databases, middleware, and applications in the enterprise. Judicious selection of tools that can be used for most of the application landscape will generally reduce IT effort while overuse of specialty tools can have the opposite effect. The same level of automation may not be feasible for all applications, but opting for consistency as much as possible goes a long way toward reducing effort and improving quality.

▶ Open-source tooling

Many organizations heavily depend upon open-source tools. Some of these tools have been updated to support multiple cloud providers, but not every tool will be certified on every provider. Nonetheless, open-source tools rely on cloud APIs. This fact, plus the competitive landscape of features across cloud providers, means that many open-source tools can be easily adapted for the desired APIs, even if they haven't been certified as such.

▶ Serverless

Serverless cloud functions can lessen reliance on automation for custom development and for modification of applications based in Software as a Service (SaaS), Platform as a Service (PaaS), or Infrastructure as a Service (IaaS). While some cloud providers have Serverless Function as a Service (FaaS) offerings, they typically have a proprietary syntax and are not portable from one provider to another.

Container-native serverless platforms provide rapid scaling, offer high availability, and support many programming languages. It helps organizations to shift the focus from server architecture and infrastructure to business value. Furthermore, because it is based on open-source container architecture, it is portable across multiple on-premises and cloud providers.

Focus on a serverless platform that allows developers to write and deploy code without having to provision or manage compute and network infrastructure. By providers managing the underlying infrastructure, it eliminates the need to stand up servers or pay for idle compute time. Instead, many FaaS offerings employ a pay-for-use pricing model where customers are charged for the resources they consume.

▶ Infrastructure build and change automation

Leveraging automation tools while designing and building cloud architecture can improve quality as well as provide documentation, deployment controls, and versioning. For instance, an infrastructure-as-code tool allows blueprints to be deployed as available infrastructure. These blueprints can be re-used for cloning multiple environments or for deploying changes across a broad landscape of servers in an orchestrated process. Capable of supporting deployments in multi-cloud environments, Terraform provides an example of an infrastructure-as-code tool that can be used on Oracle Cloud. Open-source and cloud-agnostic, it supports HashiCorp configuration language (HCL), as well as JavaScript Object Notation (JSON). Similarly, the open-source automation platform, Ansible, supports YAML Ain't Markup Language, an open-source, human-readable data serialization standard for all programming languages. Using tools that support common automation languages can increase portability across cloud providers.

▶ Autonomous cloud services

The growing trend toward a serverless environment applies the concepts of machine learning, self-healing, and self-tuning to cloud services. Today, autonomous cloud services shift high-value resources from routine tasks such as patching, tuning, and debugging to value-added tasks such as designing and implementing. They do this by using machine learning to identify, predict, and prevent issues from occurring while optimizing configurations and tuning based on the data and workloads deployed. Autonomous cloud services also leverage machine learning in conjunction with robotic process automation (RPA) to recommend integration mappings and provide analytics. Automating maintenance and patching tasks in this manner virtually eliminates planned and unplanned downtime, making services more reliable and, more often than not, cost-effective.

Today, autonomous cloud services collectively deliver more of the anticipated benefits of PaaS than previous offerings. With these services, operators and database administrators (DBA) have fewer maintenance responsibilities, allowing them to support more value-added activities.

LEVERAGING AUTONOMOUS DATABASE FOR CLOUD MIGRATION

USE CASE

A leading multinational company wanted to move a large custom application, which had been built on multiple middleware products, to the cloud. The main objectives were to decrease managing and hosting costs and to lighten the load on IT. The application needed to perform well for a large user base and be securely deployed.

In considering the target database architecture for the cloud migration, IT leadership was concerned about several challenges related to the status quo. In the organization's current state, the DBA team had to constantly patch and upgrade multiple independent databases and identify and resolve performance issues. In addition, IT leadership saw an opportunity to improve security in moving to the cloud. A traditional PaaS deployment with database consolidation would likely improve the situation, but leadership explored other options, including Oracle Autonomous Database.

With this solution the database drives itself, so it does not require typical care and feeding. Over the last couple of decades, much automation has been built into modern databases to make things easier for DBAs. Today, DBAs in general are more focused on managing the resources provided to the database and are less concerned with micromanaging how those resources are allocated. Furthermore, modern databases provide clearer details about performance and available tuning options, thus allowing DBAs to focus on evaluating the recommendations rather than on writing highly optimized queries. However, the self-driving capabilities of autonomous databases take these improvements to the next level.

With autonomous databases, machine learning and RPA allocate resources to the database, select and implement performance improvements, and handle patching, thus collectively eliminating many routine tasks. Autonomous databases are also self-securing, protecting themselves from external cyberattacks while automatically encrypting data at rest and in transit. In addition, security patches are automatically applied. By using machine learning to identify and address symptoms and failures, issues can be resolved without human intervention, long before the DBA even becomes aware of the problem.

LEVERAGING SERVERLESS FOR SaaS EXTENSION AND CUSTOMIZATION

USE CASE

Recent acquisitions had left a large enterprise with multiple ERP platforms and inconsistent business processes, which posed a complex consolidation challenge. Leadership determined that a next-generation, cloud-based application platform was needed to carry the organization into the future. Guiding principles for this large-scale SaaS deployment of a financial management system included standardized business processes aligned with leading industry practices, and an adapt-and-adopt approach over customization.

Like most ERP implementations, there were a few development requirements where out-of-the-box functionality would not suffice. Since one of the guiding principles for the project was to minimize

customizations, there was little justification for standing up a development-and-server platform to host customizations. When high-availability considerations were taken into account, this option simply did not make sense. Instead, a serverless platform better fit these requirements due to the following characteristics:

- Built-in high availability
- Horizontal scaling based on user load
- Function-based design, thus avoiding the need to architect and re-architect the development-and-server platform to accommodate new use cases

Leveraging a Docker-based architecture and an open-source serverless platform, the organization was able to shift to a highly available, autoscaling platform designed to perform simple tasks efficiently. Consequently, the IT team can now focus on implementing new functionality rather than re-architecting and manually scaling the platform as the business continues to grow through acquisitions.

BOTTOM LINE

For years, basic care-and-feeding of critical systems claimed large portions of IT's budget and labor capacity. Today, the *NoOps in a serverless world* trend offers CIOs a way to redirect these precious resources away from operations and toward outcomes. It also offers development teams opportunities to learn new skills and work more independently. The journey from legacy internal servers to cloud-based compute, storage, and memory will not happen overnight. Nor will it be without unique challenges. But as more and more CIOs are realizing, an opportunity to fundamentally transform IT from being reactive to proactive is just too good to ignore.

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ORACLE PERSPECTIVE

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Connectivity of tomorrow

The spectrum and potential of advanced networking

ADVANCED NETWORKING IS THE UNSUNG HERO OF OUR DIGITAL future, offering a continuum of connectivity that can drive the development of new products and services or transform inefficient operating models. Increasingly, digital transformation through data- and networking-dependent technologies such as cognitive, IoT, blockchain, and advanced analytics are fueling adoption of connectivity advances. Next-generation technologies and techniques such as 5G, low Earth orbit satellites, mesh networks, edge computing, and ultra-broadband solutions promise order-of-magnitude improvements that will support reliable, high-performance communication capabilities; software-defined networking and network function virtualization help companies manage evolving connectivity options. In the coming months, expect to see companies across sectors and geographies take advantage of advanced connectivity to configure and operate tomorrow's enterprise networks.

Traditionally, networking has lived in the shadow of high-profile disruptive enterprise technologies such as digital experiences, cognitive, and cloud that capture imaginations and headlines. Networking, though mission critical, is not particularly sexy.

This is about to change. Increasingly, technology forces dependent on networking are transforming enterprise architecture. For example, proliferating mobile devices, sensors, serverless computing, exploding volumes of shared data, and automation all require advanced connectivity and differentiated networking. Indeed, advanced connectivity is fast becoming a linchpin of digital business.

In *TechTarget's* most recent IT Priorities Survey, 44 percent of respondents cited upgrading their networking foundations as a top priority for the coming year.[1] Similarly, a 2018 survey of IT leaders by Interop ITX and *InformationWeek* found that companies are increasingly focused on adding bandwidth, exploring ways to modernize their networks with software, and expanding their networking capabilities.[2]

Going forward, one of the CIO's primary responsibilities will be getting data from where it is collected, to where it is analyzed, to where it is needed to drive real-time decisions and automated

operations—at scale and at speed, in a data center, in the cloud, or, increasingly, on the edge at the point where business occurs and missions are realized. As such, building and maintaining the networking capabilities required to meet this responsibility is a growing CIO priority. As part of the growing *connectivity of tomorrow* trend, CIOs have begun developing connectivity strategies that support their broader digital agendas. They are exploring opportunities to use software-defined networking (SDN), network function virtualization (NFV), and network slicing to build controllable, secure, distributed networks that feature different kinds of devices and have the ability to utilize distributed computing power. Likewise, they are defining the roles that evolving access mechanisms such as 5G and low Earth orbit (LEO) satellites will play in their connectivity strategies. And importantly, CIOs are learning ways to maintain control over these networking components without increasing the cost of ownership.

Networking models featuring some or all of these components can transform an organization's agility, efficiency, and competitiveness—but only to the extent that they can reliably deliver connectivity, security, and performance seamlessly to end users and applications. Often, the expectation behind every digital experience is the infinite availability and omnipresence of seamless network connectivity. And when that expectation cannot be met, the experience—and the strategy behind it—fail.

The orders-of-magnitude performance boost that 5G promises doesn't happen very often.

The orders-of-magnitude performance boost that 5G promises doesn't happen very often. Very soon, LEO satellite-based connectivity and mesh networks will deliver 5G capabilities to locations that currently have only limited coverage. During

the next 18 to 24 months, expect to see more companies embrace the *connectivity of tomorrow* trend by exploring how a host of advanced networking capabilities can be used to enhance products, services, and enterprise architectures.

From a strategy perspective if you are in an industry that can benefit from greater bandwidth and more digital technology capabilities in your stores, warehouses, field operations, or across your global networks, what does this trend mean for your company's future? How will you build your connectivity of tomorrow?

Connectivity building blocks

Advanced connectivity raises the bar on network flexibility, making it possible to configure networks to fit different types of performance and availability requirements. Network management frameworks are increasingly allowing companies to dynamically configure and control network resources through software. As they develop advanced networking strategies, CIOs should start by examining how the following core capabilities may be able to advance their digital transformation agendas.

The latest advanced connectivity building blocks include:

- **5G.** The fifth generation of cellular wireless technology represents a sweeping change, far beyond being just another new wireless interface for smartphones. It offers greater speed, lower latency, and—importantly—the ability to connect massive numbers of sensors and smart devices within a network.[3] How? By breaking technology constraints. With 5G, many networking protocols can coexist to meet device and application specific requirements, and can be managed seamlessly. In *connectivity of tomorrow*, billions of connected devices will be communicating directly as machine-to-machine, and addition or subtraction of connected devices will be possible at unprecedented scale. In this environment, the ability to manage

large volumes of connected devices and the information being exchanged between them will be critical. 5G acts as a unifying technology, bringing together all the networking capabilities needed to manage the information flow and density at scale. The protocol also lowers power requirements for base communication, extending sensor battery life and viability of many IoT potential use cases.

The 5G revolution is well underway with telecom operators. Deloitte predicts that 2019 will be the year in which 5G networks arrive in scale. There were 72 operators testing 5G in 2018,[4] and by the end of 2019 we expect 25 operators will have launched 5G service in at least part of their territory (usually cities). An additional 26 operators could launch in 2020, more than doubling the total.[5]

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operators will have launched 5G services in at least part of their territory by the end of 2020, according to predictions by Deloitte Global.

In addition, with regulatory approval for spectrum use, enterprises can deploy private local area networks with 5G technology. In some industrial settings such as factory floors, 5G can replace local area networking over Wi-Fi, significantly increasing the network's reliability, performance, and predictability. This 5G capability could be used to untether robots from fixed locations or to enable remote control of robots,

thereby providing higher levels of flexibility in operations.

- **Low Earth orbit satellites.** Companies have long used large, high-altitude, geostationary satellites to connect remote areas to the outside world. These satellites have served a purpose, but they lag fiber and cable-based internet in terms of reliability and responsiveness and have potentially high cost profiles. In what some have characterized as a "new space race," SpaceX, OneWeb, and other organizations are developing small, low Earth orbit satellites that, deployed in clusters, may be able to deliver high-performance broadband anywhere on Earth. In addition to providing access to rural or isolated communities, low-orbit satellites could become essential networking infrastructure tools for industries operating in remote areas such as energy, mining, transportation, and even finance.[6]

To monitor and manage evolving connectivity options that are increasingly varied, CIOs are virtualizing parts of the connectivity stack using the following network management techniques:

- **Software-defined networking.** SDN is a software layer that sits atop a physical network composed of networking appliances such as switches and routers. Long restricted primarily to use within the data center, the technology is now being extended for wide area networking (SD-WAN) to connect data centers, branch banks, stores, or other multilocation applications. These physical appliances still forward data packets, but SDN software controls where these packets get forwarded. In the SDN model, software can centrally program and manage a network, potentially boosting flexibility.[7]
- **Network function virtualization.** NFV replaces network functions such as routing, switching, encryption, firewalling, WAN acceleration, and load balancing provided by dedicated physical network appliances with virtualized software. These virtual network functions appear and behave like their physical

FIGURE 1

Considerations for connectivity technology selection

When designing end-to-end solutions, start by thinking about connectivity building blocks

	Technology parameter	Evaluation
THE BASICS 1	RANGE	Does the technology cover the correct **distance** for the use case?
	THROUGHPUT	Does the technology have the right **capacity** for the use case?
FEATURES 2	PERFORMANCE	Does the technology meet **latency**, **resilience**, and **flexibility** needs?
	SECURITY	Does the technology support **authentication** and strong **encryption**?
ECOSYSTEM 3	STRENGTH	Is the technology widely supported by **core players** across industries?
	MATURITY	Is the technology **stable,** with multiple device options?

END-TO-END SOLUTIONS 4

Use case: Driverless vehicles

A 5G network connects vehicles and physical infrastructure and transmits mapping and navigation data. 5G, LPWAN, and mesh networks enable seamless interoperability.

Use case: Health care

4G, 5G, and NB-IoT optimize ambulance routing, while Wi-Fi, 5G, NFC, and Bluetooth support transfer of patient data.

Source: Deloitte analysis.

counterparts without the need for dedicated, specialized hardware. NFV deployments typically use commodity servers. Through virtualization, these network services can scale horizontally or vertically on demand.[8] With NFV, services such as multimedia voice, evolved packet core routing, and radio access networking can now be operated completely in a cloud environment using low-cost, general-purpose computing platforms as network infrastructure.

SDN and NFV are complementary. SDN controls network functions centrally; it doesn't matter whether the network functions are provided by dedicated hardware appliances or virtualized network functions.

What does this mean for IT?

CIOs can use these advanced connectivity building blocks together with existing local area networking technologies like Ethernet, and Wi-Fi, and wide-area capabilities such as Gigabit broadband and 4G LTE to create configurable networks that can be tailored to fit a variety of enterprise needs (see Figure 1). Similar to how enterprises utilize elastic cloud computing infrastructure, with SDN and NFV they will be able to spin up, tear down, and optimize network capabilities on demand to fit specific application or end-user requirements.

As you begin developing your *connectivity of tomorrow* strategy, consider the following demand and supply factors:

- **Growing demand for real-time computation and low latency at the end device.** Applications such as industrial automation, virtual reality, and autonomous decision-making will require high computation capabilities with very low latency (round-trip time from the device to the cloud and back). In these situations,

data processing can be partitioned with a portion executed in a "mini cloud" as close as possible to the device. The remaining data-processing functions can be distributed among cloud service providers or corporate data centers. This mini cloud is also known as *edge computing*— a useful model in situations where low latency connectivity to the end device is an essential component. For IoT networks that generate and move massive amounts of data, edge computing is a game-changer. It makes it possible for these IoT devices—many with minimal computing power and low-speed connectivity—to process data at the edge. This model increases efficiencies for both the telecom operator and the enterprise by reducing network backhaul traffic to central repositories.[9]

- **Proliferation of connected devices to monitor and manage.** Enabled by 5G, both the volume and variety of connected device types are expected to dramatically increase within an enterprise. These devices are likely to have a range of operating systems, computing, storage, and networking capabilities. For CIOs and their IT teams, new end-point security requirements and challenges are likely to emerge, including prevention of unauthorized devices on the corporate network, security policy management at the device level, and avoiding potential for network storms by rogue devices.

- **IT talent models evolve.** As examined in the *Reengineering technology* chapter of *Tech Trends 2018*, talent models will need to evolve as IT talent upskills and retrains to address the new normal. In the context of advanced connectivity, SDN and NFV expertise is not widely available in all regional and industry talent pools. Likewise, enterprise architects will need to address partitioning of applications between the edge and the cloud/enterprise data centers, while ensuring that data is transported efficiently and securely.

ARE YOU READY?

As the *connectivity of tomorrow* trend gains momentum, new capabilities to support differentiated, fit-for-purpose networking for devices and applications will become available around the world. What steps can you take to lay the groundwork for new networking models in your enterprise? Step one could involve scenario planning, in which you create models that consider your business and advanced connectivity together. You can then use these models to develop strategic options within a connectivity road map aligned with your company's business strategy.

As part of this planning effort, consider the following questions:

▶ **In the context of our business strategy, where and how can advanced connectivity create a material impact?**

These capabilities could be a catalyst within an enterprise to accelerate both information technology and operational technology. Knowledge of these capabilities and potential timing should serve as a key input to shape customer- and internal-facing digital transformation initiatives. Viewed through an alternate lens, digital transformation, enterprise agility, mobility, and cloud technology features such as serverless computing are all dependent on advanced connectivity. However, with advanced capabilities comes higher network complexity in the form of multiple networking protocols, proliferation of devices and device types, and edge computing. Moreover, these capabilities will likely become available and evolve at different speeds across geographies. Taking into consideration your enterprise's business and technology strategy, consider building capabilities that could be transformative to your enterprise, assess potential availability and timing, and develop strategic options and a three-year *connectivity of tomorrow* adoption road map.

▶ **What impact could advanced networking systems have on my enterprise architecture?**

As capabilities such as 5G, LEO satellites, SDN, and NFV are advancing, so are compute and storage, significantly affecting enterprise compute infrastructure and data architecture. For example, sensors in the field and telemetry in applications and on mobile devices will generate increasing volumes of data to be stored, analyzed, and acted upon. Enterprise architecture must consider the impact of distributed computing—between devices, edge, cloud, and data centers and where, how, and when advanced connectivity will be deployed.

As you develop strategies for connectivity and cloud, both should align with the strategic goals set forth in your digital transformation agenda. How will cloud and connectivity help your enterprise operate more efficiently? How can the ability to deliver and process enormous volumes of data where and when they are needed help your enterprise to more effectively engage customers, business partners, or your global operations? Which specific networking and cloud capabilities, deployed in tandem and managed similarly, might support new product and service offerings?

▶ **How will this trend affect my budget?**

As the trend gains momentum, user expectations of networking capabilities and performance will rise. Vendors will want to recoup their significant capital investments in new products and services. Competition will likely put downward pressure on prices as technologies become more widely available. As a result, enterprise customers may have to make decisions about the capability/value requirements for advanced connectivity. Prices may be dynamic for some time, requiring enterprises to continually balance user and

system demand for advanced connectivity with cost and business value. The likelihood is that CIOs will need to factor ongoing change into their networking strategy for the next several years.

▶ **How could the trend affect my IT/networking function?**

Advanced connectivity can significantly raise the bar on automation. As automation levels increase, IT's primary responsibility will shift more heavily to engineering and driving the convergence of IT and operational technology. Depending on how far along you are on this path, you may need to make organizational changes to support new operational realities. Likewise, as you adopt configurable networks deployed with SDN and NFV, your connectivity service provider landscape may take on a different profile. Of course, this will depend on which capabilities you source, from where you source them, and how you integrate them into your infrastructure.

ORACLE PERSPECTIVE
DATA IS EVERYTHING

Information technology leaders have long understood that making data available at the right place and the right time is just as important, if not more so, than collecting the data itself. Greater adoption of advanced technologies, such as digital assistants, augmented reality, sensors, and analytics, is driving the need for "always on" capabilities, that is, continuously connected applications that can share volumes of data securely and reliably. Instant data-sharing among people, which enables new levels of collaboration, is also growing in importance. Almost everywhere you look, dynamic, integrated networks characterized by a continuous flow of information and analytics are becoming more commonplace. This expectation for robust connectivity shines a whole new light on the underlying infrastructure that connects the digital components of the enterprise.

Many companies today have cloud initiatives underway, and cloud is increasingly becoming the new standard. But cloud applications, just like on-premises ones, generate huge amounts of data.

Companies have historically managed the "four Vs" of data (that is, volatility, volume, velocity, and visibility) as they attempted to achieve multiple objectives, which more often than not included total cost, service, quality, and support for innovation. These traditional priorities are not likely to change, but going forward, decision makers should also be able to achieve higher levels of performance by developing cross-functional capabilities with new digital technologies. Additionally, companies may be able to find new sources of revenue by using digital technologies to produce smart products and to gain faster access to new markets.

▶ **Connectivity of tomorrow is happening today**

🔍	**End-to-end transparency**	The ability to see across the network	Sensors New data sets Visualizations
💡	**"Always-on" Agility**	The ability to proactively operate across the network	**Capability elements** Predictive alerts Advanced analytcs Edge computing
👥	**Connected environment**	The ability to extend into your suppliers and customers	**Capability elements** Third-party data sets Real-time collaboration and live data sharing
📈	**Resource optimization**	The ability to identify and utilize the right worker, human, or machine, for work	**Capability elements** Artificial intelligence Optimization algorithms Unstructured data
🌐	**Holistic decision making**	The ability to continuously learn and make optimal network decisions	**Capability elements** Machine learning Voice and thought interaction

Foundational elements

Cybersecurity	Data integrity	Safety	Talent

For the most part, businesses running on large-scale enterprise applications, such as Oracle platforms, have mastered common operational activities. IT leaders of these organizations, many of whom are also adopting cloud applications, are now exploring ways to utilize the existing back-office install base while modernizing the front office. In other words, can the back office be used as the new front office? The answer is often "yes," if a faster, better, "always-on" connection between front-office and back-office applications can be achieved. This implies a new level of data sharing to support:

- **Customer experience:** Consumers using a commerce platform should be able to buy anything, any-time, anywhere.
- **Operational excellence:** When working remotely, factory managers should be able to receive real-time updates on critical equipment failures.
- **Supply efficiency:** Operations managers should be able to have real-time visibility into supply levels, so they can make informed decisions and act immediately.
- **Superior service:** Services system engineers should be able to view the digital twin of a physical asset or piece of equipment, such as an underwater turbine.
- **Instant support:** Equipment operators should be able to access real-time video streams and aug-mented reality instructions through headgear.

▶ Supporting "always-on"

Achieving super data sharing across applications can be complicated, especially when an organization's system landscape has multiple applications serving business units around the world. A single call between applications can be affected by a multitude of factors, such as the time needed to authenticate the interaction, package the data, and send it across. However, infrastructure platforms, such as Oracle, are addressing ways to help alleviate latency issues and connectivity concerns.

GETTING AND STAYING CONNECTED

USE CASE

Workers rightfully expect that mission-critical information will be available when they need it. Organizations should not only have the capabilities to provide this information instantaneously upon request, but also to detect needs as they arise.
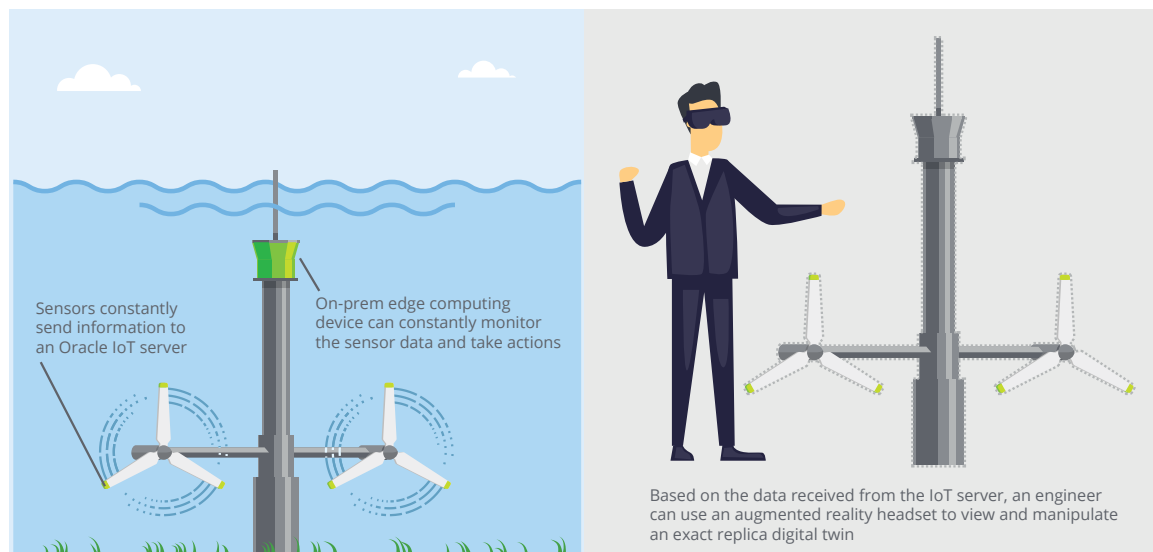
For example, an underwater marine turbine manufacturer must be able to monitor its installations for issues and provide instant support. The product engineering team should be able to view the digital twin of the actual product on an augmented reality headset. This means that the data received from the IoT application cloud would need to be incorporated into the digital twin and projected onto to the engineer's screen in real time. The engineer should then be able to run simulations on the twin and perform remedial actions, which would be instantly transmitted back to the physical turbine—thus completing one cycle of the physical-to-digital-to-physical loop. There would be constant communication throughout the loop not only to resolve a particular issue but also to continuously monitor the situation moving ahead.

Cloud can provide the raw computing power needed to drive both the physical components and the information-processing and analytical capabilities of the physical-to-digital-to-physical loop. But, collecting the sensor information, processing it in the cloud, generating and projecting images of the digital twin, and taking action all add a lot of latency. This may be solvable by creating a dedicated private connection with higher bandwidth options, along with an IoT server that can reliably and securely collect data. There may also be a need for edge services, which can help reduce network latency between the physical device and the IoT server.

FIGURE 2

Digital Twin: the physical-to-digital-to-physical loop

Sensors constantly send information to an Oracle IoT server

On-prem edge computing device can constantly monitor the sensor data and take actions

Based on the data received from the IoT server, an engineer can use an augmented reality headset to view and manipulate an exact replica digital twin

DIGITAL SUPPLY NETWORK

USE CASE

Advancements in digital technologies and capabilities, such as sensors, artificial intelligence, machine learning, and cognitive computing go beyond providing the foundation for analytics: They are fueling convergence between the physical and the digital worlds. This convergence is transforming traditional, linear supply chains into connected, intelligent, scalable, customizable, and nimble supply networks.

Connectivity plays a crucial role in driving digital supply chain. In typical day-to-day supply chain scenarios, connectivity gets disadvantaged due to ineffective networks, which are slow in data transmitting, analyzing, and relaying important information b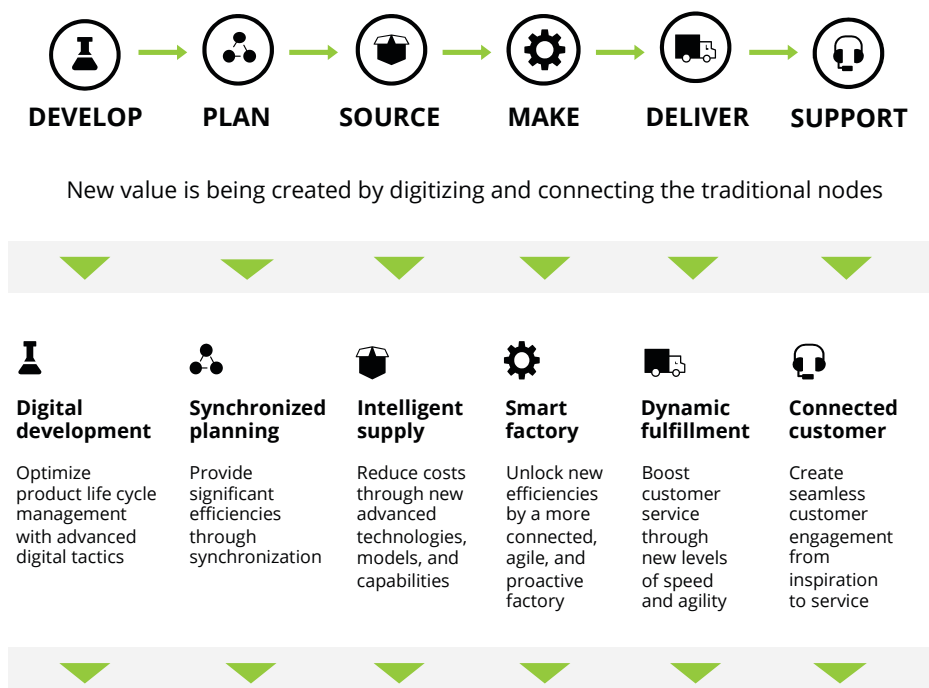ack to the sites. Particularly so if these sites are at far-flung or remote locations and the existing networking infrastructure has latencies, lower bandwidth, and/or is not secure enough for mission-critical operations. Combining edge computing and 5G technologies can result into deriving full potential of the organization's existing systems in place.

Application of such a framework can be weighed in a circumstance, as an example, where an organization has Oracle EBS on-premises, but is moving toward modern cloud applications. One path forward would be to host an Oracle EBS application on the IaaS platform while connecting to other cloud applications through Oracle Cloud Infrastructure solutions. Networking and data transmitting at remote locations can be driven through 5G and

FIGURE 3

The collapse of the linear supply chain

New technologies and tools have allowed the traditionally linear supply chain to collapse into an agile interconnected network that unlocks new value across the digitized nodes

DEVELOP → PLAN → SOURCE → MAKE → DELIVER → SUPPORT

New value is being created by digitizing and connecting the traditional nodes

Digital development	Synchronized planning	Intelligent supply	Smart factory	Dynamic fulfillment	Connected customer
Optimize product life cycle management with advanced digital tactics	Provide significant efficiencies through synchronization	Reduce costs through new advanced technologies, models, and capabilities	Unlock new efficiencies by a more connected, agile, and proactive factory	Boost customer service through new levels of speed and agility	Create seamless customer engagement from inspiration to service

The birth of the Digital Supply Network (DSN)

Innovative and disruptive technologies can enable supply chains to transform into Digital Supply Networks, which can serve as a powerful competitive weapon

FIGURE 4
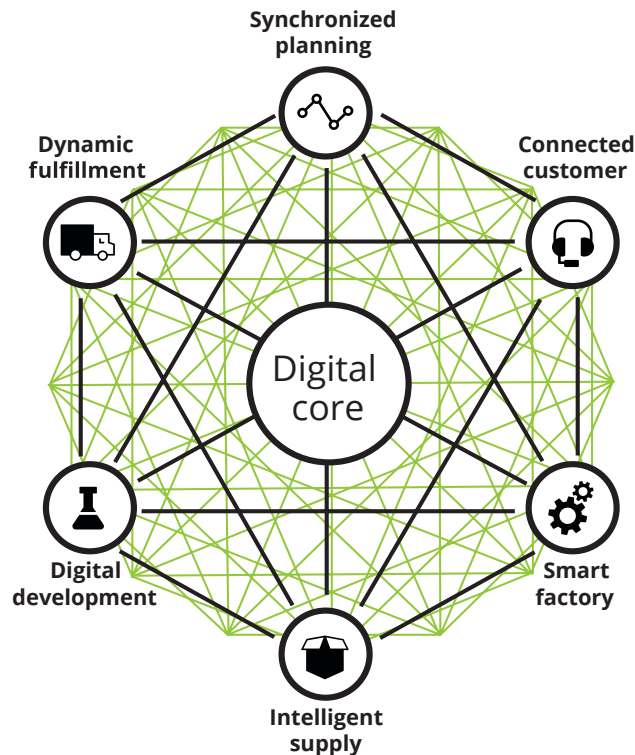
comprehensive smart edge technologies. The edge will optimize the mission-critical data that need to be always at the ready on-premises, so analytics and actionable inputs can be immediately realized and acted upon. As the system can harvest data, analyze, and respond in real time and can realize full potential of networking infrastructure driven gains as communication between cloud and the edge would be driven by high speed 5G capabilities.

Some scenarios where a similar approach may be applicable:

– IoT-enabled fleet can continuously monitor vehicle halt times and relay the information to a near edge analytics system. All vehicles in the fleet would be enabled

with 5G networking capabilities so the relay times of IoT data are minimized. The edge can gather data from the Oracle Cloud Transportation Management System on other details related to this specific shipment such as ship to location (how remote the location is), priority of the shipment (if the goods are critical to manufacturing or distribution line), or criticality of reaching on time (whether the goods are perishable if not delivered in a certain amount of time). This is where the superiority of smart networking would be truly beneficial as data from IoT are instantly gathered along with the data

from cloud into a distributed source of analytics, which is promptly available depending on the location of the vehicle.

– Combined with the cache maintained on the edge and the analytics capabilities, the system can then predict in real time the delay that may be caused and immediately prompt the driver with

updated delivery routes. At the same time, facility operators would also be notified in case the delays are unavoidable so that capacity planning or distribution planning (depending on the usage of the plant) can be managed and would not be hampered due to unavailability of the material.

BOTTOM LINE

The *connectivity of tomorrow* trend represents a necessary and much-anticipated transformation in the way organizations move business-critical data from where it is generated to where it is needed. Across industries, this transformation will only accelerate as the total number of networked devices grows exponentially. Increasingly, technology and business leaders are recognizing that when deployed as part of a well-planned connectivity strategy, building blocks such as 5G, satellites, SDN, and NFV can deliver an order-of-magnitude boost in network flexibility, efficiency, and velocity. What will your strategy be for harnessing the connectivity of tomorrow?

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Intelligent interfaces
Reimagining the way humans, machines,
and data interact

TODAY, PEOPLE INTERACT WITH TECHNOLOGY THROUGH EVER MORE intelligent interfaces, moving from traditional keyboards to touchscreens, voice commands, and beyond. And even these engagement patterns are giving way to new and more seamless and natural methods of interaction. For example, images and video feeds can be used to track assets, authenticate individual identities, and understand context from surrounding environments. Advanced voice capabilities allow interaction with complex systems in natural, nuanced conversations. Moreover, by intuiting human gestures, head movements, and gazes, AI-based systems can respond to nonverbal user commands. Intelligent interfaces combine the latest in human-centered design techniques with leading-edge technologies such as computer vision, conversational voice, auditory analytics, and advanced augmented reality and virtual reality. Working in concert, these techniques and capabilities are transforming the way we engage with machines, data, and each other.

At a dinner party, your spouse, across the table, raises an eyebrow ever so slightly. The gesture is so subtle that no one else notices, but you received the message loud and clear: "I'm bored. Can we leave yet?"

Most people recognize this kind of intuitive communication as a shared language that develops over time among people in intimate relationships. We accept it as perfectly natural—but only between humans. It seems a bit farfetched—or, at least, premature—that machines might also be able to recognize the intent behind a subtly raised eyebrow and respond in contextually appropriate ways.

Yet in an emerging technology trend that could redraw—or even erase—boundaries between humans and computers, a new breed of intelligent interfaces is turning the farfetched into reality. These interfaces are actually a sophisticated array of data-gathering, processing, and deploying capabilities that, individually or in concert, provide a powerful alternative to traditional modes of human-computer interaction. For example, using cameras, sensors, and computer vision, a retailer can track and analyze shoppers' store movements, gaze, and behavior to identify regular customers and gauge their mood. By cross-analyzing the information with these customers' purchase histories, the retailer can push promotions in real time to shoppers' mobile devices—or, in the not-too-distant future, be able to predict a need based on a customer's subconscious behavior and preemptively place an order on her behalf.

In this example, the deployed technologies become an intelligent interface between users and systems. And this is only the beginning. Thermal imaging technologies can detect changes in shoppers' heart rates. A variety of wearables ranging from today's smartwatches to tomorrow's augmented-reality goggles capture a wearer's biofeedback. Smartphone data captured in real time can alert retailers that customers are checking online to compare prices for a specific product, suggesting dissatisfaction with store pricing, product selection, or layout.[1]

Such potential is fueling a growing demand for a broad range of human-machine interface devices. The global market for speech and voice recognition technologies alone could reach US$22.3 billion by 2024.[2] The market for affective computing—another name for emotion-sensing software—is projected to reach US$41 billion in value by 2022.[3]

During the next two years, more B2C and B2B companies will likely embrace aspects of the growing *intelligent interfaces* trend. As a first step, they can explore how different approaches can support their customer engagement and operational transformation goals. Companies already on such journeys can further develop use cases and prototypes. Though investments of time, labor, and budget may be required before companies can begin reaping benefits, the steps they take during the next 18 to 24 months will be critical to maintaining future competitiveness.

The voice of authority

Intelligent interfaces represent the latest in a series of major technology transformations that began with the transition from mainframes to PCs and continued with the emergence of the web and mobile. At each stage, the ways in which we interface with technology have become more natural, contextual, and ubiquitous—think of the progression from keyboards to mice to touchscreens, to voice and

the consequent changes in the way we manipulate onscreen data.

Today, voice-user interfaces such as those found in popular mass-market products such as Amazon's Alexa, Google Assistant, Apple's Siri® voice recognition software, and Microsoft's Cortana are the most widely deployed type of intelligent interface. The ongoing competition among these tech giants to dominate the voice systems space is standardizing

At each stage, the ways in which we interface with technology have become more natural, contextual, and ubiquitous.

natural language processing and AI technologies across the interface market—and fueling innovation.[4] Amazon offered a US$1 million prize through its annual Alexa competition to any team of computer-science graduate students building a bot capable of conversing "coherently and engagingly with humans on popular topics for 20 minutes."[5]

Voice use cases are proliferating in warehouse, customer service, and, notably, in field operation deployments where technicians armed with a variety of voice-enabled wearables can interact with company systems and staff without having to hold a phone or printed instructions. Likewise, we are seeing more organizations explore opportunities to incorporate voice dialog systems into their employee training programs. Their goal is to develop new training methodologies that increase the effectiveness of training, while shortening the amount of time employees spend learning new skills.

Though conversational technologies may currently dominate the intelligent interfaces arena, many see a different breed of solutions gaining ground, harnessing the power of advanced sensors, IoT networks, computer vision, analytics, and AI. These solutions feature, among other capabilities, computer vision, gesture control devices, embedded eye-tracking platforms, bioacoustic sensing,

emotion detection/recognition technology, and muscle-computer interfaces. And soon this list also may include emerging capabilities such as brain-controlled interfaces, exoskeleton and gait analysis, volumetric displays, spatial computing, and electro-vibration sensing.

To understand how these capabilities could work in concert in an enterprise setting, picture a widely distributed array of IoT sensors collecting data throughout a manufacturing facility, and streaming it rapidly back to a central neural system. In many cases, these sensors function like a human's senses by visually, haptically, and acoustically monitoring operational environments. For example, micro-phones embedded in assembly-line motors can detect frequency changes. Or computer vision moni-toring those same motors can "see" a malconfigured part. Enter AI algorithms—acting as a logic-based brain—that derive inferences from the data gener-ated by these and other sensors. The brain may infer that a specific assembly-line function is underper-forming, and based on that identification, the brain/AI component of an intelligent suite of interfaces can respond. Moreover, by collecting, for example, manufacturing variances in real time versus in batches, the system can accelerate response times and, ultimately, increase operational throughput.

To be clear, skilled human observation, com-bined with machine data, still delivers the most robust and impactful understanding of manufac-turing processes or retail operations. And with intelligent interfaces, the flow of information be-tween humans and machines runs both ways (see figure 1). As we have examined in previous editions of *Tech Trends*, augmented reality (AR), virtual reality (VR), and mixed reality devices—which act as delivery vehicles for intelligent interfaces—are drawing upon a wide variety of data to provide users information-rich, contextually detailed vir-tual environments.[6] This represents a fundamental reordering of the way that people have traditionally used technology. Rather than being the beginning state of the human-machine interface, we are now the end state.

Knowing me, knowing you

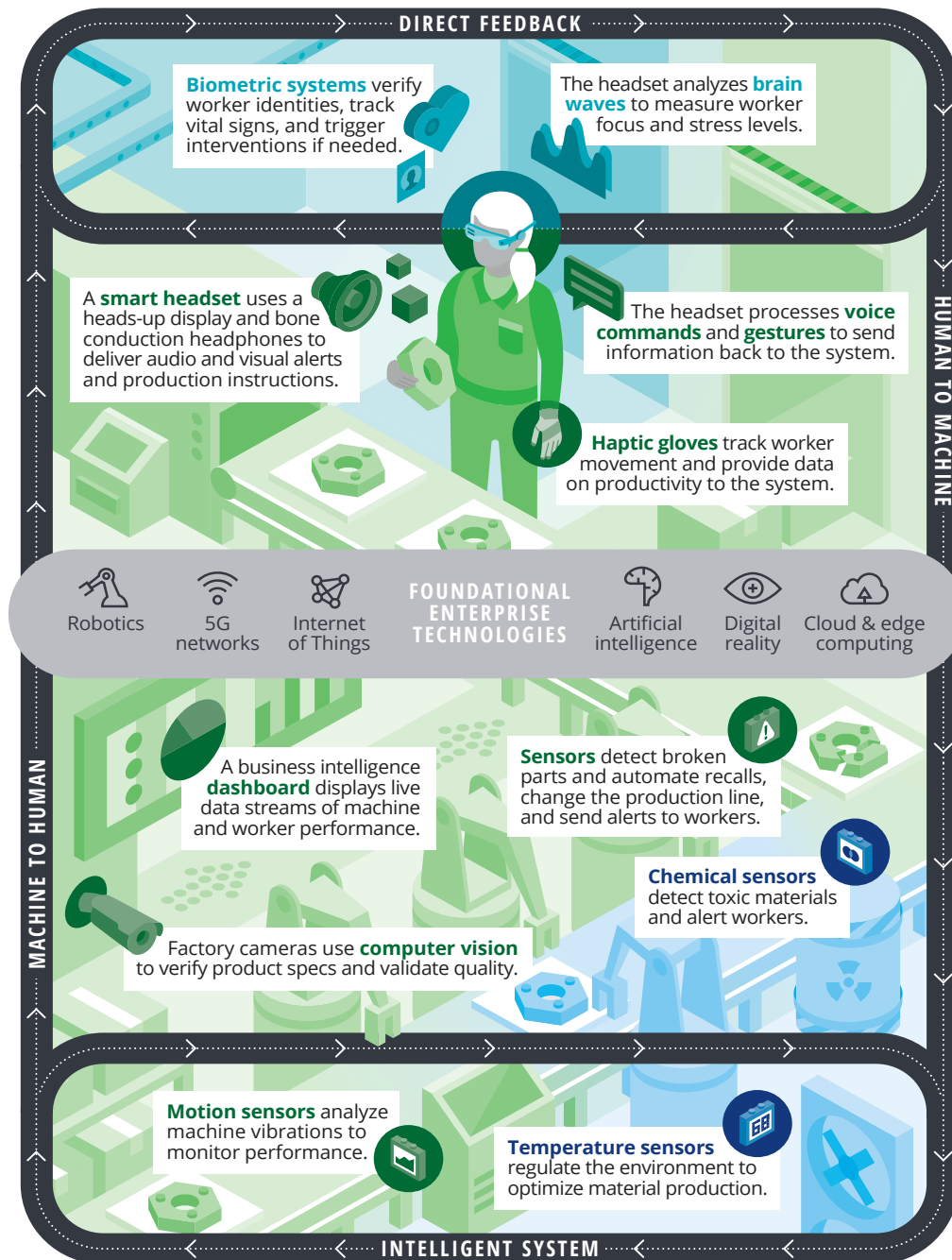Intelligent interfaces offer B2C and B2B oppor-tunities in several areas:

- **Tracking customers' offline habits.** Just as search engines and social media companies can track their customers' digital habits, some intelligent interface capabilities already make it possible to track physical behavior. Mobile phones are the most ubiquitous intelligent interface today: You may not have your phone turned on, but thanks to tracking functionality, service providers can tell whether, for instance, you are repeatedly visiting a certain restaurant or spending a lot of time at the beach. They can then push offers to you for discounted beverages or sunscreen. As smartglasses and digital reality become more widely accepted, those same offers could appear in your field of vision at the very moment you enter that establishment or arrive at the beach. As the *intelligent interfaces* trend progresses, expect companies to learn more about us—our habits, routines, tastes, experi-ences—than we could have ever thought possible.

- **New products and solution sets.** Under-standing customers at a personal, detailed level will make it possible to "micro-personalize" products and services. For example, emotion sensors can detect when humans are experi-encing stress. Perhaps they are being confronted, are stuck in traffic, or are engaged in an online political debate; their blood pressure rises, and their breathing becomes shallow. An enter-prising health services provider could take this information and build an application that helps users manage their emotions during stressful episodes. If the user is online, perhaps the app creates a distraction to help delay an immediate—and ill-considered—email response. In another setting, it might create another kind of digital distraction to help the user remove herself from the immediate situation. With intelligent inter-faces, opportunities for micro-personalization

FIGURE 1

Intelligent interfaces create real-time, context-aware, automated feedback loops

Intelligent interfaces have applications across industries—from life sciences and health care to energy, automotive, public sector, and more. Here's one scenario from the factory floor.

Information ■ Sensory ■ Physical ■ Biological

DIRECT FEEDBACK

HUMAN TO MACHINE

Biometric systems verify worker identities, track vital signs, and trigger interventions if needed.

The headset analyzes **brain waves** to measure worker focus and stress levels.

A **smart headset** uses a heads-up display and bone conduction headphones to deliver audio and visual alerts and production instructions.

The headset processes **voice commands** and **gestures** to send information back to the system.

Haptic gloves track worker movement and provide data on productivity to the system.

Robotics | 5G networks | Internet of Things | **FOUNDATIONAL ENTERPRISE TECHNOLOGIES** | Artificial intelligence | Digital reality | Cloud & edge computing

MACHINE TO HUMAN

A business intelligence **dashboard** displays live data streams of machine and worker performance.

Sensors detect broken parts and automate recalls, change the production line, and send alerts to workers.

Chemical sensors detect toxic materials and alert workers.

Factory cameras use **computer vision** to verify product specs and validate quality.

Motion sensors analyze machine vibrations to monitor performance.

Temperature sensors regulate the environment to optimize material production.

INTELLIGENT SYSTEM

Source: Deloitte analysis.

become infinite—and we have yet to scratch the surface in this area.

- **Efficiency.** Today, companies are exploring opportunities to use VR, AR, mixed reality, 360-degree, AI, and sensor technologies to enhance operational efficiency and individual productivity. For example, Amazon is experimenting with ways to use AR to track to the microsecond the behaviors of its warehouse workers in order to help them work more effectively.[7] As organizations begin integrating intelligent interfaces into their operations, they will likely face an increasingly common challenge: how to increase efficiency without micromanaging workers through sensors and real-time feedback. No doubt many workers are troubled by the prospect of wearing employer-mandated AR goggles or other forms of mechanical augmentation to perform their jobs. Yet their discomfort may be short-lived. Today, earbuds and some wearable technologies are as ubiquitous as watches and jewelry. Resistance to smartglasses and monitored work environments will likely wane as employees acclimate to new modes of human-machine interaction and see how mechanical augmentation can help them work more efficiently.

What does this mean for IT?

Any intelligent interface initiative involves underlying technology capabilities to bring it to life. As the fidelity and complexity of these experiences evolve, those foundational elements become even more critical. If you are collaborating with a colleague in a virtual environment via a head-mounted display, a 50-millisecond delay in a spoken conversation is annoying; if you find yourself waiting a full 10 seconds for a shared visual to load, you will probably lose confidence in the system altogether. Developing the supporting infrastructure necessary to harvest, analyze, and disseminate infinitely more data from more input sources will make or break experiences. There are also data syndication, capture, storage, compression, and delivery considerations, and this is where having an IT strategy for managing

the backbone elements of intelligent interfaces will be crucial.

An effective strategy for prioritizing data, breaking it apart, processing it, and then disseminating to systems and network devices should include the following considerations:

- **Bandwidth.** In the *Connectivity of tomorrow* chapter in this year's *Tech Trends* report, we examine how in this data-hungry world advanced networking may hold the key to our digital futures. A primary networking component is 5G, the next generation of mobile connectivity technology that is poised to dramatically increase the speed and capacity of wireless networks. For their intelligent interface networks to traffic data within and between systems without a lag, companies will need the kind of bandwidth that 5G offers.

- **Cloud and edge computing.** If they hope to get their AI-driven interfaces to function in real time, companies can no longer channel all data through centralized servers in San Jose. During the 15 milliseconds of lag time, intelligent interface users will have grown impatient waiting for an AI response, and will have moved on. *Real time* means real time, with no discernible delay. For this reason, moving data and AI-driven decision-making to the edge of the organization and dynamically prioritizing what is processed will be a necessary step.

- **IoT.** Contextual computing capabilities require data inputs from vast networks of sensors in a user's surrounding environment that feed contextual information into the AI systems. This includes everything from temperature to humidity to air quality that could help the system understand the context in which a human gesture is made, or in an enterprise setting, when a machine vibrates unnaturally. If data is the lifeblood pulsing through an intelligent interface environment, IoT is the vascular system. As the *intelligent interfaces* trend progresses, building, maintaining and expanding IoT capabilities should be near the top of every CIO's priority list.

ARE YOU READY?

The *intelligent interfaces* trend represents an opportunity to use converging exponential technologies to understand customers more deeply, enhance operational efficiency, and create highly personalized products and services. But as every CIO knows, the devil is in the details. Some industries, such as retail and manufacturing, are currently at the vanguard of intelligence interfaces adoption. Other industries? Time will tell. As you explore the opportunities and potential pitfalls of intelligent interfaces, consider the following questions:

▶ **My budget is limited. How can I show a return on this kind of investment sooner rather than later?**

Intelligent interface initiatives will almost certainly require investing in hardware such as sensors, head-mounted displays, and microphones. These are not as-a-service plays—they are hard costs. And while an individual sensor is inexpensive, adding up the number of sensors needed to monitor a manufacturing facility may suggest a very different level of investment. While this may give you pause, you should avoid falling into the common trap of viewing IT solely as a cost center. CIOs often view initiative costs linearly: *Investments in emerging technologies will deliver specific outcomes within certain time periods.* Perhaps a more effective—and accurate—approach might be to look more broadly at how investment costs could amortize across operations and returns. In today's interfaces marketplace, there is a gap between what these nascent technologies truly do and how their costs are justified. As you explore opportunities in your company, think critically about what you want to achieve, how this trend may help you achieve it, and about the level of commitment you are willing to make.

▶ **What skill sets will I need?**

With intelligent interfaces, human bodies become the instruments for creating commands, with users wearing devices on their bodies that constantly track movements, voices, and gazes. For this reason, human-centered design skills will likely be more important than ever to IT organizations. For example, people with medical backgrounds understand the way bodies function and process stimuli. Linguists might offer insight into what constitutes an effective voice conversation for humans, and what humans would respond to in terms of a computer-generated response. Physical therapists could bring specialized expertise to the development and use of haptic technologies.

In addition to those with human-centered skills, technology generalists or "connectors" will also play an important role going forward. These are people who deeply understand all intelligent interface technologies and, more broadly, how they interact and interface with each other. They will be able to understand how to deploy these technologies in combinations to fuel the levels of growth that the trend promises.

▶ **At a fundamental level, the intelligent interfaces trend involves understanding the behaviors of customers and employees in much greater detail than ever before. Should I be concerned about privacy issues?**

Yes. In terms of privacy, tracking users' online behaviors is one thing. Tracking both online *and offline* is a fundamentally different proposition—one that many users may find invasive and unacceptable. How this will play out in terms of regulation remains to be seen. But for now, companies can take steps to make sure all interfaces—particularly those, such as AR or VR gear, that are designed primarily for the consumer market—are deployed consistently with enterprise standards of privacy and security. For example, when using headsets in the workplace, you don't want to capture coworkers' faces for extended

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periods of time, so users need the ability to activate the headsets only when necessary. This same consideration applies to voice interfaces: How do you determine what conversations should or should not be recorded? Microphones in popular virtual assistants in the consumer market are always on, which may be acceptable in some enterprise deployments but surely less so in retail or home settings. As part of any intelligent interfaces deployment, it will be necessary to put checks in place before data is gathered or processed to help ensure that individual privacy is respected consistently.

▶ **There are so many hardware and software players in this space right now. Should I wait until standards and a few dominant platforms emerge?**

No. The solution space is fragmented, but growing numbers of companies—some of them likely your competitors—are developing use cases and exploring ways that the intelligent interfaces trend might add value. You can follow their lead or develop your own in-house use cases. Either way, your efforts can and should be contained in an innovation portfolio where the costs are understood as research. Your programs can be quick-cycling, seek immediate user feedback, and can be catalogued as impactful or not (and ideally tied to KPIs that can be identified and projected). You can then measure and evaluate these efforts with a go/no-go. Of course, developing use cases and exploring opportunities is only one piece of a larger digital transformation puzzle. Bigger picture, your company needs a coherent innovation strategy that incorporates rapidly evolving, fragmented ecosystems and unproven use cases today and in the future. In the end, nimble innovation makes it possible for companies to try, fail, and learn.

ORACLE PERSPECTIVE
INTELLIGENT INTERFACES AMPLIFY THE VALUE GENERATED ON THE ORACLE ENTERPRISE PLATFORM

While the future may very well bring opportunities for organizations to capture a customer's emotive responses to products and experiences in real time, companies can generate value right now by using current intelligent-interface technologies to augment their core enterprise platforms. Users need friendlier interfaces so they can consume, analyze and act on the massive amounts of data the platform contains. It is not uncommon for companies that are running their business on a core Oracle cloud platform to receive the following requests from their users:

- **Give us real-time help.** Provide support with little or no wait time.
- **Don't make us stop what we're doing to look things up.** Deliver relevant information and instructions in a digital reality environment to efficiently support operations.
- **Help us figure out what customers want.** Acquire customer and product insights directly from customer interactions.

Intelligent interface technologies, such as voice-enabled digital assistants, augmented reality and smart-data aggregation and visualization powered by IoT, can address all of these user requests and more—ultimately helping organizations to get more value from their core enterprise platforms.

▶ **Real-time help from chatbots and intelligent digital assistants**

Chatbots are being used widely in C2B and B2B applications, often bringing greater productivity and efficiency to a wide range of customer interactions. An enterprise digital assistant is a type of internally facing chatbot that can help users within the organization to interact with enterprise applications through voice or chat instead of keyboards and screens. Today, many companies are embracing enterprise digital assistants as a way to reduce repetitive and redundant tasks, thus allowing employees to focus on higher value activities. Enterprise conversational intelligence takes this concept to the next level by learning user behaviors from past interactions and making recommendations, predictions, or taking action on behalf of the user—essentially functioning as a personal assistant.

What makes an enterprise digital assistant smart?

- **Human-like conversational skills.** The digital assistant should be able to understand the real meaning, intention, and context of a conversation. It should be able to provide the user with a personalized experience during every interaction with Oracle Cloud ERP and other enterprise applications.
- **Smart cognizance.** So that it can store knowledge from different events and domains, the digital assistant should be endowed with both long-term and short-term memory. This in-memory knowledge can be further used to augment human intelligence to improve decision making.
- **User behavior intelligence.** The digital assistant needs to understand the behavior patterns, intentions, priorities, and needs of its user. It should intuitively be able to sense when to initiate communication and recommend actions.
- **Interactions across channels.** A user should be able to interact with the digital assistant using various platforms such as touch-screen devices, voice commands, and type-in commands. The digital assistant should be able not only to seamlessly identify its user across multiple channels, but also to converse with her using multiple channels at the same time.

▶ Augmented reality to improve business operations

Nowadays workers are being asked to perform increasingly complex tasks, and they often need detailed analysis in order to complete them. Conventional applications are generally not sufficient for helping modern workers to manage this complexity. Instead, they need an entirely new set of digital tools that can deliver instructions and training to them on the spot, wherever they are. AR presents digital information to workers on the move by overlaying it on their view of the real world.

AR is bringing the physical and digital world closer today, and some AR pioneers in the logistics world are already saving time and reducing error rates by deploying this technology. For example, some companies are using AR in warehousing activities, such as helping employees to find the shortest route for picking and putting away goods through guided navigation. Deployed on mobile devices, they are also using AR to expedite barcode scanning—synchronizing the information collected with enterprise systems in real time.

▶ Data aggregation and visualization through IoT

In order to proactively manage customer satisfaction, understand product quality, and provide outstanding service, companies require real-time data, whether from customers, machines, products, or assets in the field.

In the past, significant integration and mobility barriers impeded remote data access. Enter IoT technologies, which have paved the way for companies to access data in real time from almost anything, anywhere—ranging from car engines to household appliances.

IoT can extend business applications, such as supply chain, such as supply chain and ERP cloud and customer-experience software, into the physical world, forging 24/7 connections with customers and ecosystem partners. IoT also enables companies to generate insights from the vast amount of data they collect to help business leaders make well-informed, timely decisions. Some companies are well along their IoT journeys and are preparing to take the next big step. They are starting to combine IoT with machine learning to create an intelligent interface between humans and data. Through this powerful combination of two digital enablers, IoT and AI, companies can discover previously unattainable insights, resulting in improved operational efficiency, greater productivity, and less unplanned downtime.

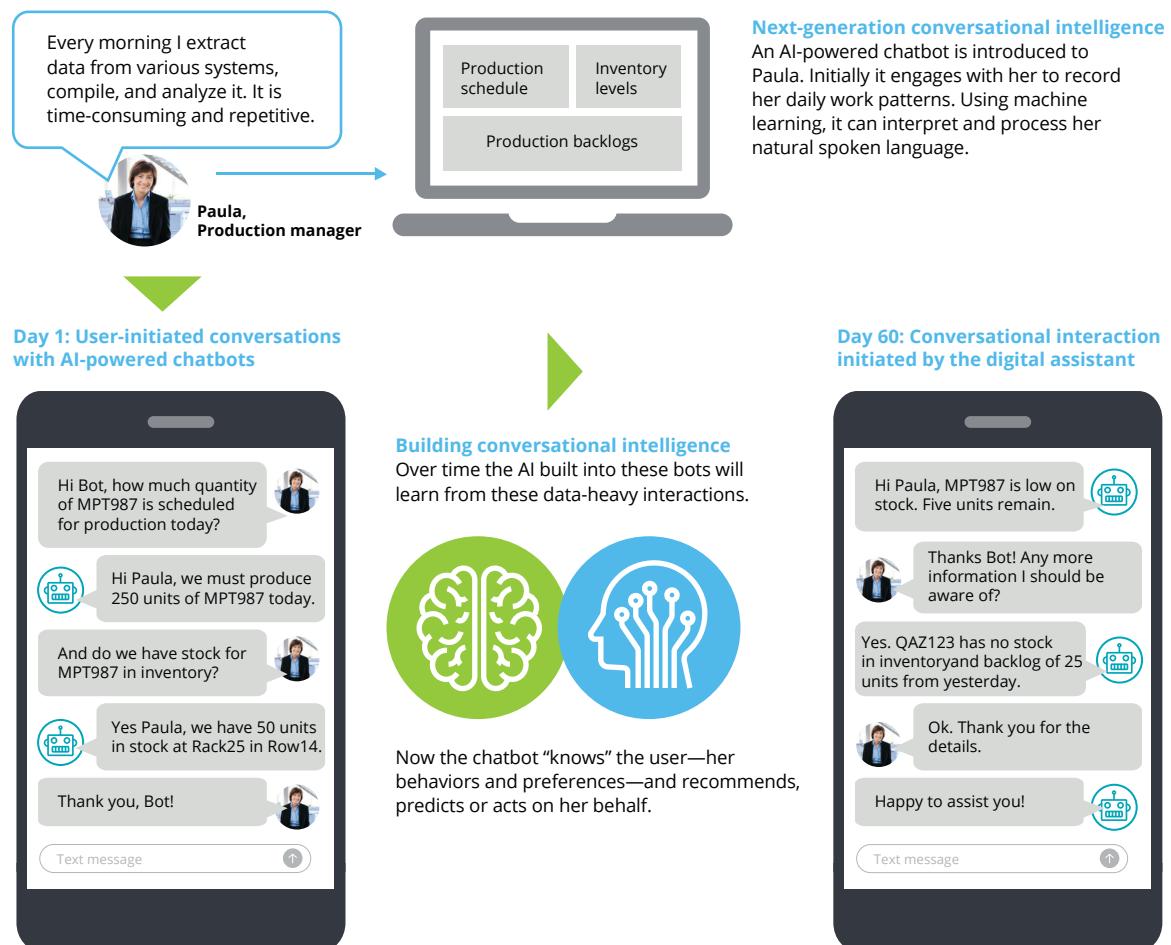# ENTERPRISE DIGITAL ASSISTANTS TO EMPOWER THE WORKFORCE

USE CASE

As a production manager in a manufacturing facility, Paula needs to gather data from various systems, analyze it, and generate insights daily. These are repetitive tasks where machines could lend a hand. Throughout the day, she also needs to check on the overall health of the manufacturing operations, and it's not practical for her to carry a laptop around the facility. Much to

Paula's delight, IT gave her an enterprise digital assistant, powered by AI, that can converse with her in natural language over a smartphone. For the first few months, the digital assistant "gets to know" Paula by recording, tracking, and analyzing their interactions with the help of machine learning algorithms. Over time, the assistant learns Paula's behaviors and preferences so it can recommend, predict, and act on her behalf.

FIGURE 2

A conversational enterprise—Digital assistant in a manufacturing facility

Every morning I extract data from various systems, compile, and analyze it. It is time-consuming and repetitive.

Paula, Production manager

Production schedule | Inventory levels

Production backlogs

Next-generation conversational intelligence
An AI-powered chatbot is introduced to Paula. Initially it engages with her to record her daily work patterns. Using machine learning, it can interpret and process her natural spoken language.

Day 1: User-initiated conversations with AI-powered chatbots

Hi Bot, how much quantity of MPT987 is scheduled for production today?

Hi Paula, we must produce 250 units of MPT987 today.

And do we have stock for MPT987 in inventory?

Yes Paula, we have 50 units in stock at Rack25 in Row14.

Thank you, Bot!

Text message

Building conversational intelligence
Over time the AI built into these bots will learn from these data-heavy interactions.

Now the chatbot "knows" the user—her behaviors and preferences—and recommends, predicts or acts on her behalf.

Day 60: Conversational interaction initiated by the digital assistant

Hi Paula, MPT987 is low on stock. Five units remain.

Thanks Bot! Any more information I should be aware of?

Yes. QAZ123 has no stock in inventoryand backlog of 25 units from yesterday.

Ok. Thank you for the details.

Happy to assist you!

Text message

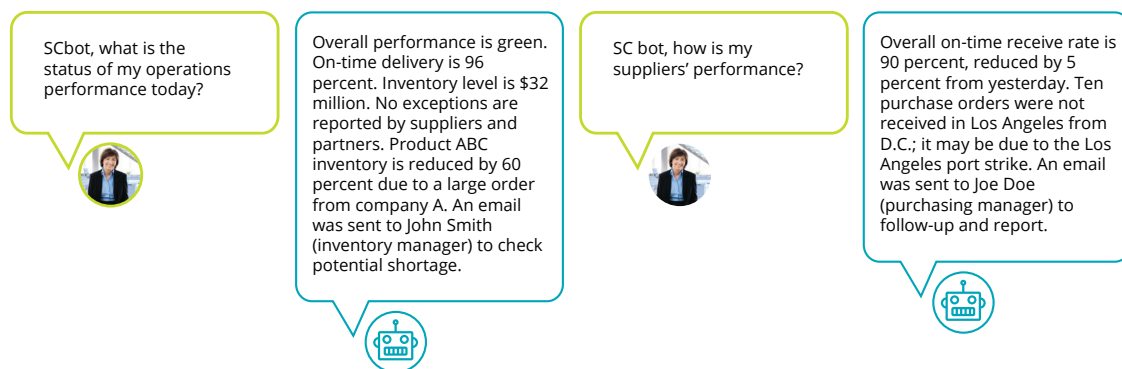## Supply chain digital assistant: Predicting disruption and recommending mitigations

No matter the industry, there is an increased demand for better visibility into supply chain operations. Executives are seeking a comprehensive view of their operational performance, as well as better ways of detecting and responding to potential supply chain disruptions.

An intelligent digital assistant, powered by natural language processing and cognitive computing, can fulfill all of these requirements by providing real-time views of supply chain operations and empowering executives to respond dynamically to disruption. And because it can be configured and trained to learn from past experience, the digital assistant will broaden its scope for detecting disruptions and suggest more accurate ways of mitigating them over time.

▶ For example, a rules-based bot (that is, intelligent digital assistant) can be created in Oracle Cloud ERP. This bot can use machine learning to mimic human actions and judgment to detect potential supply chain disruptions. It can also go a step further and recommend mitigating actions. How does this assistant get so smart? Through machine learning, it ascertains where to look for potential issues, helping executives to stay a step ahead by predicting and preventing potential disruptions.

▶ A typical interaction between an executive and a supply chain (SC) bot within the Oracle Cloud ERP system is described in the accompany chart. It demonstrates how a smart digital assistant can help business users to gain an understanding of the problem and receive either suggested remedies or updates on automated actions already performed.

FIGURE 3

SCbot, what is the status of my operations performance today?

Overall performance is green. On-time delivery is 96 percent. Inventory level is $32 million. No exceptions are reported by suppliers and partners. Product ABC inventory is reduced by 60 percent due to a large order from company A. An email was sent to John Smith (inventory manager) to check potential shortage.

SC bot, how is my suppliers' performance?

Overall on-time receive rate is 90 percent, reduced by 5 percent from yesterday. Ten purchase orders were not received in Los Angeles from D.C.; it may be due to the Los Angeles port strike. An email was sent to Joe Doe (purchasing manager) to follow-up and report.

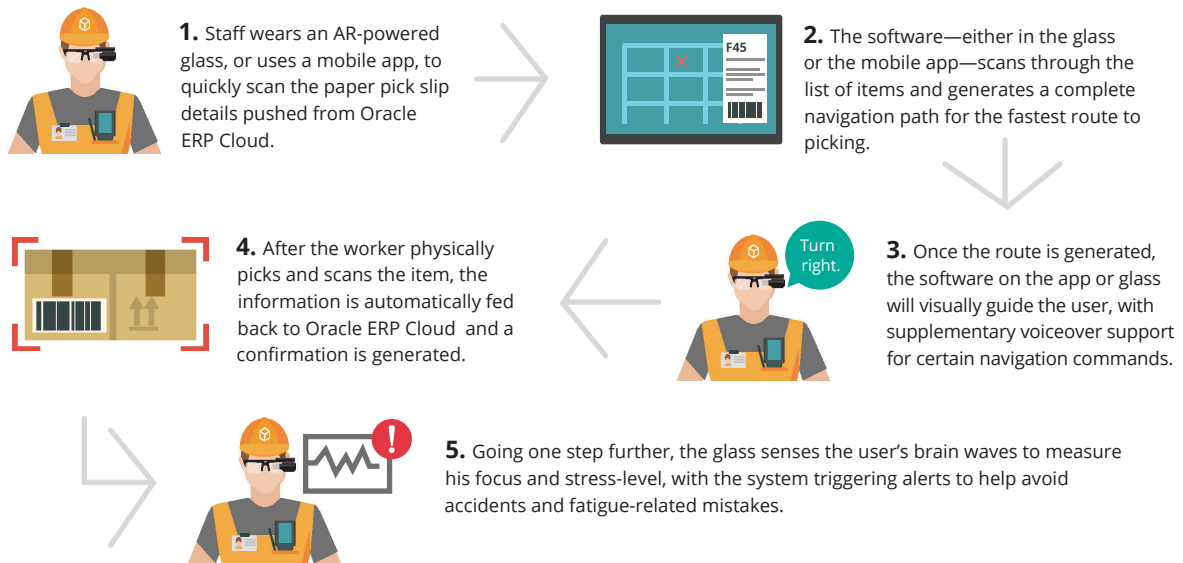# TRANSFORMING WAREHOUSE OPERATIONS WITH DIGITAL REALITY

USE CASE Managing a large warehouse poses a variety of operational challenges, such as a large amount of footage to cover, constant training due to high turnover, complex storage and retrieval systems, and low staff productivity. Digital reality technology can help resolve these complex challenges, ultimately improving overall operational efficiency and boosting productivity.

FIGURE 4

Guided warehouse-selection process made more efficient with augmented reality

1. Staff wears an AR-powered glass, or uses a mobile app, to quickly scan the paper pick slip details pushed from Oracle ERP Cloud.

2. The software—either in the glass or the mobile app—scans through the list of items and generates a complete navigation path for the fastest route to picking.

4. After the worker physically picks and scans the item, the information is automatically fed back to Oracle ERP Cloud and a confirmation is generated.

3. Once the route is generated, the software on the app or glass will visually guide the user, with supplementary voiceover support for certain navigation commands.

5. Going one step further, the glass senses the user's brain waves to measure his focus and stress-level, with the system triggering alerts to help avoid accidents and fatigue-related mistakes.

ENABLING PREDICTIVE MAINTENANCE WITH IoT

USE CASE A global, diagnostic-equipment manufacturer uses Oracle ERP applications for its business operations, including customer service and repair activities. Its existing maintenance processes primarily respond to breakdowns. In addition, some reports generated out of the Oracle ERP system are used to deliver preventive maintenance to customers. Constrained by the reactive nature of its processes, the company sought to implement predictive maintenance capabilities as well as to enable its service group to be more proactive with its customers. It also sought to shorten the overall maintenance cycle from problem identification to resolution.

Implementing IoT-sensing and machine learning technologies, along with an Oracle IoT platform, provided an intelligent and intuitive interface through which the organization can aggregate and analyze data.
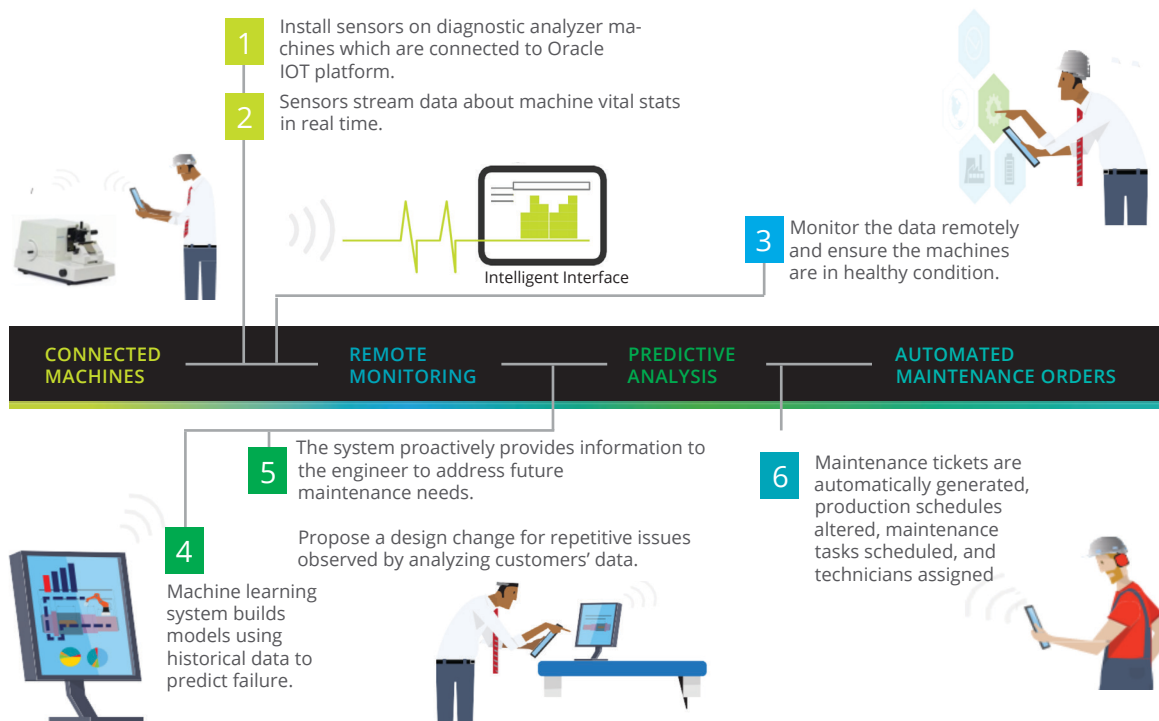
The solution employs predictive analytics to generate insights on customer usage and failure

patterns, which the design and engineering teams then use to enhance the company's products and services. The solution also includes a dashboard to provide the service organization with visibility into locations, usage patterns, failure rates, lead times, and issue status.

The accompanying outline depicts how automating the maintenance process with Oracle IOT in this instance reduced the time required to plan maintenance by 20 percent to 50 percent. In addition, customers experienced a 10 percent to 20 percent increase in equipment uptime and availability and a 5 percent to 10 percent reduction in maintenance costs.

FIGURE 5

1 Install sensors on diagnostic analyzer machines which are connected to Oracle IOT platform.

2 Sensors stream data about machine vital stats in real time.

Intelligent Interface

3 Monitor the data remotely and ensure the machines are in healthy condition.

CONNECTED MACHINES   **REMOTE MONITORING**   **PREDICTIVE ANALYSIS**   **AUTOMATED MAINTENANCE ORDERS**

5 The system proactively provides information to the engineer to address future maintenance needs.

4 Machine learning system builds models using historical data to predict failure.

Propose a design change for repetitive issues observed by analyzing customers' data.

6 Maintenance tickets are automatically generated, production schedules altered, maintenance tasks scheduled, and technicians assigned

BOTTOM LINE

Unlike many technology trends that present new ways to streamline processes or engage customers, the *intelligent interfaces* trend offers something much more personal: an opportunity to fundamentally reimagine the way we, as humans, interact with technology, information, and our surroundings. To say this trend is potentially disruptive would be an understatement—simply put, it represents the next great technology transformation. And this transformation is already underway. If you are not exploring the role that voice, computer vision, and a growing array of other interfaces will play in your company's future, you are already late to the game.

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ORACLE PERSPECTIVE

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Beyond marketing: Experience reimagined

CMOs and CIOs partnering to elevate the human experience

THE NEW WORLD OF MARKETING IS PERSONALIZED, CONTEXTUALIZED, and dynamic. Increasingly, this world is orchestrated not by outside parties but by chief marketing officers partnering with their technology organizations to bring control of the human experience back in-house. Together, CMOs and CIOs are building an arsenal of experience-focused marketing tools that are powered by emerging technology. Their goal is to transform marketing from a customer acquisition-focused activity to one that enables a superb human experience, grounded in data. In experiential marketing, companies treat each customer as an individual by understanding their preferences and behaviors. Analytics and cognitive capabilities illuminate the context of customers' needs and desires, and determine the optimal way to engage with them. Experience-management tools tailor content and identify the best method of delivery across physical and digital touchpoints, bringing us closer to truly unique engagement with each and every human.

Imagine a world in which a brand knows who you are and what you want, and can deliver the product, service, or experience that best suits your needs seamlessly and in real time, across physical or digital channels. This world has arrived.

Marketing technology is undergoing a renaissance. Channel-focused solutions such as websites, social and mobile platforms, content management tools, and search engine optimization are fast becoming yesterday's news. As part of the growing *beyond marketing* trend, organizations are adopting a new generation of martech systems that deliver unprecedented levels of customer intimacy, targeted engagement, and precision impact. By deploying new approaches to data gathering, decisioning, and delivery, companies can now create personalized, contextualized, dynamic end-to-end experiences for individual customers. These experiences, in turn, can help customers create deep emotional connections to products and brands, which drive loyalty and business growth.

With its emphasis on the human experience, the *beyond marketing* trend represents a turning point in marketing strategy and practices. Traditionally,

marketing's broad goal was to bend consumer will in ways that advance a seller's strategy. Going forward, its goal will be to adapt the seller's objectives and methods of engagement to meet specific customer expectations—expectations formed on a deep, sensory level. How deep? Consider this: The human eye is capable of seeing more than seven million colors, our ears can sense when two notes are ever-so-slightly out of tune, and 20 million nerve endings allow us to feel everything. Humans are sensory creatures, our lives lived through experiences. When it comes to companies communicating and connecting with people, logic and system limitations have sometimes trumped emotional intelligence. Reclaiming the human experience and reconnecting with emotion are on the rise. Brands are expected to understand wants, needs, and previous interactions. An optimal brand experience demonstrates emotional sensitivity and sets the bar for all brand expectations moving forward, regardless of category or sector.

To meet these expectations, some companies are looking beyond longstanding relationships with marketing services providers (MSPs) and ad agencies, and are bringing data management and customer engagement processes back in-house. Likewise, CIOs and CMOs have begun collaborating more closely than ever and are aligning their companies' marketing, business, and broader digital strategies. They are trading in "black box" customer marketing solutions for cloud-based, flexible, automated marketing systems that offer greater control of data. Organizations farther along in their *beyond marketing* journeys are exploring opportunities to integrate first-, second-, and third-party data, cognitive analytics, machine learning, and real-time/right-time touchpoint delivery into their data management stacks.

During the next 18 to 24 months, expect more companies to launch their own *beyond marketing* journeys. Established organizations may start by launching pilots in individual brands or by consolidating vast volumes of consumer data that are currently spread across enterprise systems and operational silos. Startups might launch greenfield

efforts by defining what the optimal consumer experience can be, and then working to make it real.

Organizations, large and small, will likely shift their marketing technology exploration and use case development into high gear. Going forward, consumers—not marketers—will be behind the wheel.
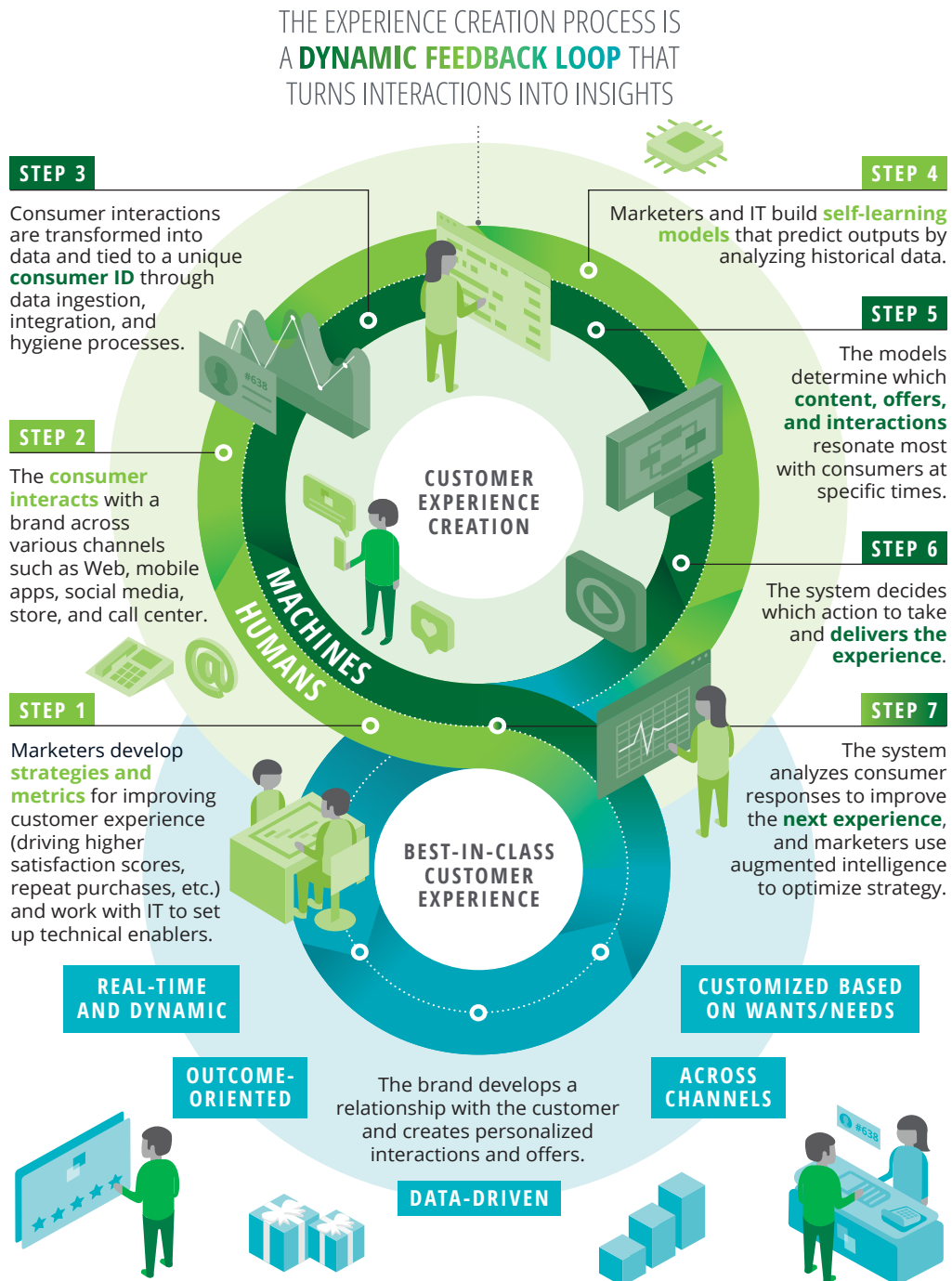
My way or the highway

Constant online access is dramatically changing customer expectations. Customers want personalized experiences and communication, delivered when and how they want it. In a CMO Council/SAP survey, 47 percent of respondents said they would abandon a brand that delivers poor, impersonal, or frustrating experiences.[1] In response, CMOs are allocating nearly a third of their budgets to marketing technology.

Across industries, we are seeing companies use a variety of technologies to enhance their customer experiences. For example, clothing retailer Nordstrom recently debuted a digital shopping experience platform that uses smartphone shopping application features to enhance in-store experiences. Customers might see an article of clothing they like on social media; using the Nordstrom app, they can contact their personal Nordstrom stylist, who will direct them to the closest store that has the item. When the customer arrives at that location, they will find a dressing room with their name on the door, and the item inside, ready to be tried on.[2]

In sports, the Kansas City Chiefs are using a decision cloud rooted in machine learning and artificial intelligence to improve the fan experience. "The platform allowed us to connect multiple levels of fan data to many different offers, promotions, and solicitations," says Tyler Kirby, Chiefs VP of ticket sales. "Ensuring we were delivering our content to only those fans who would be most likely to purchase, and equally as important, not cannibalizing our retail sales. The audiences identified were valuable for all email, paid social, and lead distribution efforts to our sales team."[3]

FIGURE 1

CIOs and CMOs partner to reimagine human experience

THE EXPERIENCE CREATION PROCESS IS
A **DYNAMIC FEEDBACK LOOP** THAT
TURNS INTERACTIONS INTO INSIGHTS

STEP 3
Consumer interactions are transformed into data and tied to a unique **consumer ID** through data ingestion, integration, and hygiene processes.

STEP 2
The **consumer interacts** with a brand across various channels such as Web, mobile apps, social media, store, and call center.

STEP 1
Marketers develop **strategies and metrics** for improving customer experience (driving higher satisfaction scores, repeat purchases, etc.) and work with IT to set up technical enablers.

STEP 4
Marketers and IT build **self-learning models** that predict outputs by analyzing historical data.

STEP 5
The models determine which **content, offers, and interactions** resonate most with consumers at specific times.

STEP 6
The system decides which action to take and **delivers the experience**.

STEP 7
The system analyzes consumer responses to improve the **next experience**, and marketers use augmented intelligence to optimize strategy.

CUSTOMER EXPERIENCE CREATION

MACHINES
HUMANS

BEST-IN-CLASS CUSTOMER EXPERIENCE

REAL-TIME AND DYNAMIC

CUSTOMIZED BASED ON WANTS/NEEDS

OUTCOME-ORIENTED

ACROSS CHANNELS

The brand develops a relationship with the customer and creates personalized interactions and offers.

DATA-DRIVEN

Source: Deloitte analysis.

Tech-enabled CX initiatives like these are becoming common as a couple of factors push the *beyond marketing* trend forward. First, traditional ad agencies and other MSPs are struggling to deliver integrated experiences across sales, marketing, and data. In some cases, legacy data management systems cannot support real-time access and decisioning; in others, siloed organizational functions prove inefficient in the digital age. The problem of silos is exacerbated in larger organizations, as MSPs can't easily look across product lines, business units, functions, and geographies. As a result, more companies are exploring opportunities to bring data-management and customer-engagement initiatives back in-house.

At the same time, technology has created a multitude of ways to engage customers on their paths to purchase. But the tech stack required to engage and deliver an end-to-end customer experience can be incredibly complex and challenging if not developed within the parameters of a digital strategy. CMOs are increasingly owning the delivery of the entire customer experience—including CX systems—and are finding themselves taking on facets of the tra-

The tech stack required to engage and deliver an end-to-end customer experience can be incredibly complex and challenging if not developed within the parameters of a digital strategy.

ditional CIO role. At the same time, CIOs are being called on to transform legacy systems and build new infrastructure to support next-generation data management and front-office customer engagement systems. How does this impact IT's mission and broader digital transformation strategy? How can IT and marketing ensure security, data integrity, and adequate tech support in this environment? As organizations travel farther down the *beyond*

marketing path, CIOs and CMOs are finding they will have to collaborate more closely than ever in order to deliver not only on their company's new marketing strategies but on established digital strategies.

The three Ds

From a technology perspective, this trend involves the infrastructure around data, decisioning, and delivery that your company will need to meet consumer expectations.

- **Data.** In *beyond marketing*, data is the starting point for all efforts. Greater volumes of diverse data—in an environment that a company controls—make it possible to develop a deeper understanding of customers and individual preferences and behaviors. Think about the customer information your company may have in its systems: names, email addresses, responses to marketing campaigns, past purchases, post-sale contacts, and the outcomes of those transactions. (Were the products returned? Did the customer engage the company for any reason after the sale?) These are basic elements of a customer profile that can be enhanced with public or third-party data, all while complying with today's stringent privacy standards.

Knowing each customer's age range, gender, and location can help you compare their purchase history and preferences to others in the same demographic group. This analysis helps build a more complete picture of customers engaging with your brand. The process for gathering, integrating, and enriching audience and customer data will vary according to each organization's capabilities and needs. But in general, after

ingesting and transforming data from a myriad of sources, you can link each data transaction to a unique customer identifier. This data can then be stored in a customer data platform for use in decisioning and delivery.

- **Decisioning.** Through advanced analytics, audience management, and real-time personalization and decisioning engines, the system can determine how and when to provide an experience to a potential or known customer that optimizes value to the customer and the company. This goes beyond simple creative copy, image, and messages. It can also include pricing, promotion, and unique services and offerings being presented to a customer. Integrating machine learning capabilities into the decisioning process can help the system further refine the company's understanding of the customer—and of the effectiveness of experiences already delivered. Finally, decisioning should include necessary hooks into inventory and logistics systems to ensure that products and services being offered are actually available and can be delivered quickly.

- **Delivery.** Following data transformation and decisioning, content management and campaign experience management tools orchestrate delivery of dynamic CX content consistently across channels such as email, text, and customer portal. It also integrates with interaction channels like call centers and mobile apps. In some environments, this process can be largely, if not completely, automated. These delivery interactions ultimately create customized, personalized human engagement.

What does this mean for IT?

Reengineering your company's current approaches to data, decisioning, and delivery does not require ripping out your legacy technology stack and replacing it with a host of shiny new tools. Rather, your goal should be to integrate the tech-

nologies and processes that can make your existing systems smarter and provide real-time, seamless interactions with customers. There are some black-box data solutions that you can bring back in-house, and those can and should live in the cloud. But for many companies today, these changes are already taking place as part of broader digital transformation strategies. Whether it be analytics, cognitive, or cloud, the technologies that are driving the *beyond marketing* trend are likely driving other transformation initiatives in your organization and have been for some time. Look for opportunities to leverage in-flight digital investments and evolving IT talent.

Over time, the *beyond marketing* trend may require rethinking, redesigning, or reimplementing your current channel systems to support more tailored and personalized touchpoints. Supporting the journey to create more emotionally intelligent interactions often requires different approaches for delivering messages and content. Promotions will become more dynamic, potentially requiring changes to core systems that were configured for a less personalized world. Analyzing your portfolio of systems for potential "pinch points" today will be important to supporting better velocity in the future.

Supporting the analytics, machine learning, and artificial intelligence capabilities that underlie many of the decisioning systems will also likely require evolving your current approach to IT talent. The technologies and techniques that are driving your organization's AI-fueled transformation will also support marketing decisioning. Getting ahead of the curve by training internal resources and identifying external support will be key. Moreover, marketing and IT will also need more CX talent, which warrants a discussion to identify where and how those individuals can be most successful.

ARE YOU READY?

For even the most knowledgeable CIOs and CMOs, developing and implementing new approaches to data, decisioning, and delivery is rarely a light lift. Luckily, you don't have to take the entire effort on at once. As you explore the possibilities that the *beyond marketing* trend offers your company, ask yourself the following questions:

▶ **This trend represents a big change in the way my company engages customers. What initial steps can I take to lay the groundwork?**

First, define what an optimal experience would be for a customer engaging your brand, and use this to create a vision and guiding principles for the journey ahead. How do your current operations align with this vision and set of principles? To what extent can your current CX tech portfolio—martech, CRM, social platforms, e-commerce—support your vision, and where are there gaps? The same goes for your existing strategies for customer engagement. Once you have identified gaps, you decide which ones to prioritize—maybe start small by going for quick wins that can demonstrate value to leadership and detractors. From there, you can broaden the scope of your initiative with more ambitious milestones and timelines. Whatever your approach, remember: Deploying the tools and tactics you will need to deliver tailored experiences to customers is not easy. Beyond deploying new technologies and processes, it may require shifting mindsets and aspects of your company's culture. This is a journey, one that begins with a few steps.

▶ **What are some quick wins I can achieve?**

There are opportunities for quick wins across the board—for example, lowering the cost of customer acquisition, enhancing customer engagement, or driving greater customer retention and loyalty. You don't have to launch a huge transformation initiative tomorrow. Instead, consider starting with a single channel like the call center, emails, or mobile apps, and focus on a specific desired outcome. Maybe you can complete more upsells or get higher click-through rates. With these small successes under your belt, you can further develop use cases or launch pilots. Another quick win—though one that can be a bit more involved—is consolidating your data. In many companies, human data lives in operational silos, discrete systems, and with third-party vendors. Consolidating this disparate data in a cloud-based data lake and identifying one owner is an essential step you will eventually have to take in any *beyond marketing* journey. Why not start now?

▶ **As I reengineer my company's marketing operations to deliver individual experiences, how will I know if I am succeeding?**

The *beyond marketing* trend is about truly knowing individual customers on a one-to-one personalized level and using that knowledge to deliver personalized experiences every time they engage with your brand. Success in this arena means developing the ability to collect data from all interactions that a customer has with your organization—think of responses to marketing campaigns, sales interactions, customer service calls, and online brand engagement, among others. With advanced analytics, you will be able to develop a highly nuanced understanding of customer behaviors and preferences, which you can then use to tailor the interaction experiences you offer each customer. As an example of a successful experience, consider a life sciences company that segments its customers into broad archetypes, such as *collaborative* and *competitive*. Someone in the *competitive* archetype may respond better to a gamification technique that encourages healthy choices and adherence to a health regimen. Others in the *collaborative* archetype group may respond to messages that offer anecdotes and human-interest content. With archetype designations identified, the company can tailor content, messaging, and interactions to individual people based on their needs.

———————————————

▶ **Who in my company should ultimately "own" the human experience?**

A brand may decide to share ownership of the human experience across functions, including marketing, sales, and service and establishing a cross-functional leadership council, while other companies may expand the role of the CMO to own the human experience; some are adding a chief experience officer to the C-suite. In any case, the ownership must be clear, with metrics in place for accountability and to measure value.

▶ **What will humans continue to do versus machines in my company to enable this trend?**

Marketers and experience owners will likely continue to guide the overall strategy and use insights produced from machines to make more systemic and macro level changes to the strategy and design of the human experience. For their part, machines can bring in vast quantities of data, make sense of it, and be able to act upon it in real time, guiding the optimal message to consumers in the right channel at the right time.

▶ **My company has a longstanding relationship with an MSP. What does the *beyond marketing* trend mean for this relationship in the future?**

As you explore the trend's potential for your company, think about where you might need MSPs and agencies to play, as well as what you need to bring in-house in order to create a differentiated experience. A decade ago, companies went through a similar exercise as they tried to determine which, if any, functions could be outsourced to others. Today, you can follow a similar decision-making process: What can MSPs do better than you? What can you do better—and given today's real-time, always-on demands—more cost-effectively, under your own roof? Do you want to bring all your data in-house or, perhaps, keep data management outsourced, focusing instead on analytics and decisioning? Should you bring only a few channels or adopt only select capabilities? Finally, be realistic about what your organization can support. Can you provide sufficient governance? Do you have the capabilities and support relationships in place to bring new capabilities in-house? These are not decisions to be taken lightly.

ORACLE PERSPECTIVE
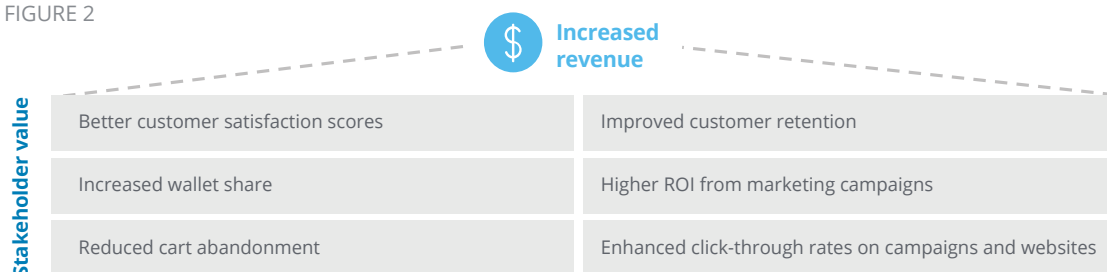# MODERN DATA PLATFORM HELPS COMPANIES MOVE BEYOND MARKETING

The rapidly evolving digital landscape is not only upending traditional approaches to technology but also to customer engagement. Legacy marketing platforms and processes were often geared toward importing customer lists and then deciding which messages to push to those audiences en masse. This approach was somewhat reactionary and was driven by what companies wanted their audiences to see and hear as opposed to what customers desired. Part of the problem was companies didn't know very much about their customers. Data were often acquired from multiple vendors and siloed across many dimensions, such as business units, product lines, and geographies. Even if companies had amassed a great deal of customer data, they often struggled to do something meaningful with it. Management teams also wondered if their technology infrastructure could handle the vast processing requirements needed to produce useful insights for the sales and marketing teams.

Today's modern data platforms, such as Oracle CX Unity, are taking companies beyond marketing. They bring together online, off-line, and third-party customer data sources to create a single dynamic view of the customer. With these platforms, which are powered by AI and machine learning, companies can analyze large volumes of data, obtain timely insights about their customers, and give their marketing and sales teams the capability to strategize and engage. Marketing and IT departments are working more closely together as companies look at ways to implement technology that will put more control in their hands. While the cloud experience application implementation may be driven more from the marketing side, these departments are primarily still dependent on integration to other applications controlled by IT. It is to the benefit of the CMO and CIO to work together to provide a secure and robust integrated platform to maximize the value of the investment. The real value for organizations is leveraging these data to develop a true connection with the customer, facilitating a deeper brand loyalty. The ability to proactively display meaningful data regardless of channel is key to ensuring customers feel as if they are valued and understood as part of their experience.

▶ **Measuring the right stuff**

Platforms like Oracle CX Unity provide companies with the ability to integrate data from several internal and external sources and multiple channels to create a comprehensive view of the customer. Through these new offerings, data can be centralized, enhanced, and governed to provide better insight to customer behaviors. Data lakes provide the foundation for leveraging AI and machine learning to target customers and predict their behaviors more effectively. Platforms like CX Unity, when deployed to their fullest extent, give companies the ability to provide the right experience—through sales, marketing, and service—at the right time throughout the customer life cycle. But, how can marketing and sales leaders know if they're on the right track? The key performance indicators illustrated in the accompanying graphic can be helpful in measuring progress.

FIGURE 2

Stakeholder value		
Better customer satisfaction scores	Improved customer retention
Increased wallet share	Higher ROI from marketing campaigns
Reduced cart abandonment	Enhanced click-through rates on campaigns and websites

$ Increased revenue

▶ What does this mean for IT?

There are seven applications within Oracle CX Cloud, each of which generates different types of customer data. The CX Unity platform is one example of how modern technology can bring these diverse data sources together to facilitate personalized customer engagement across marketing, sales, and service.

FIGURE 3
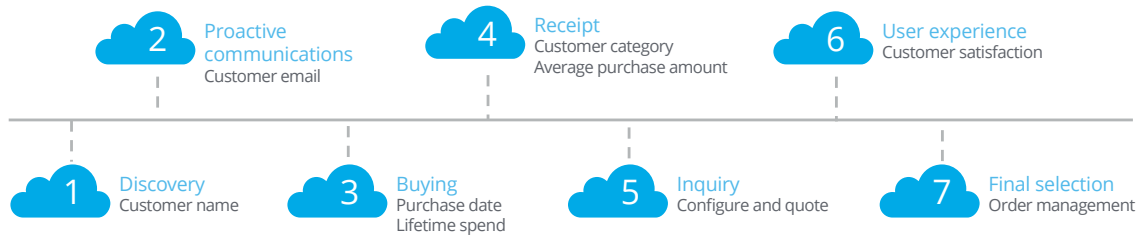
The CX Unity platform and other similar-type platforms can offer benefits to an IT organization, including:

- **Eases consolidation** of off-line, online, and third-party data sources into a customer profile that contains critical data elements created throughout the engagement journey (see accompanying chart).
- **Applies advanced analytics** to anticipate customer preferences so the organization can deliver an even better experience the next time the customer engages.
- **Joins directly** (via prebuilt integrations) to Oracle CX Cloud and other Oracle ecosystem applications to orchestrate a connected customer experience across channels.

Demographic data	Transactional data	Behavioral data
Customer name	Customer sales order	Commerce page visitation
Phone numbers	Quotes and Opps	Clicks (product
Emails	Service incidents	category / details)
Customer sentiment	Field-service requests	Articles
Birthday	Campaign emails	FAQ browsing
Preferences	Agent call-ins	Knowledge-based articles
Interests	Agent chats	Searches
Loyalty tier	Shipments	Mobile app usage
Customer value	Service agreements	Social media posts

Many companies are shifting their focus from traditional marketing strategies to interactive solutions that utilize a more robust data set to create a personalized experience for the customer. Pushing mass marketing messages out through traditional marketing channels is now a thing of the past. Consumers want the ability to access and receive highly targeted, personalized information via their channels of choice, which today comprise laptops, smartphones, chat bots, social media, apps, and more. The CX Unity platform can be used to collect and relate numerous data components—ultimately producing actionable intelligence that can be used to tailor the customer experience.

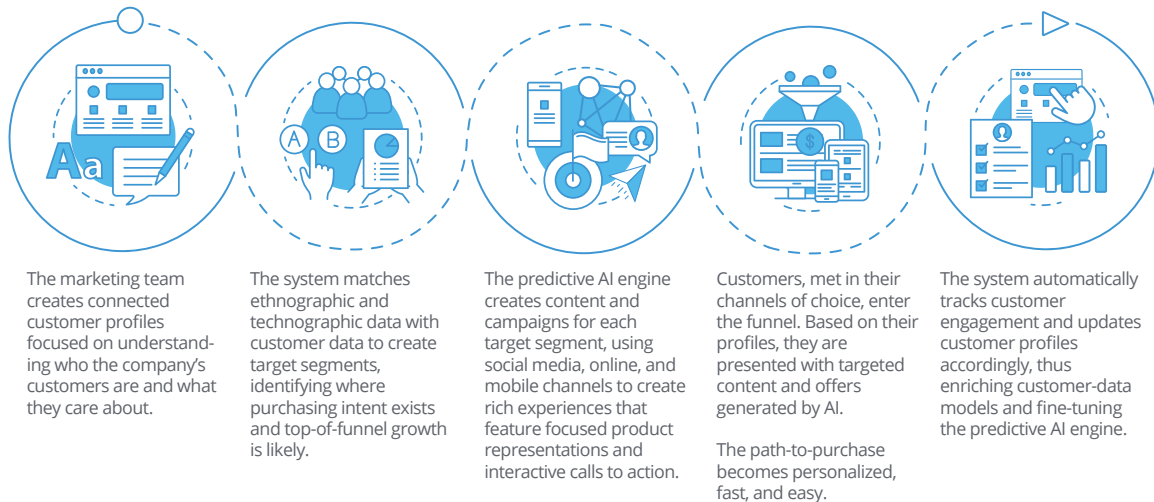# CREATING HUMAN EXPERIENCES THROUGH PROACTIVE ENGAGEMENT

USE CASE

Customer expectations are higher than ever. Customers crave quick, easy, personalized experiences, and they want companies to know who they are and what they want.

In a crowded marketplace, the way in which companies collect and use customer data matters.

When done thoughtfully, it can help raise awareness, consideration, and ultimately lead to purchase and loyalty. Consider the following example in which robust audience data and AI-driven insights create forward-thinking, compelling marketing campaigns:

FIGURE 4

Marketing campaigns driven by data and AI-driven insights

The marketing team creates connected customer profiles focused on understanding who the company's customers are and what they care about.

The system matches ethnographic and technographic data with customer data to create target segments, identifying where purchasing intent exists and top-of-funnel growth is likely.

The predictive AI engine creates content and campaigns for each target segment, using social media, online, and mobile channels to create rich experiences that feature focused product representations and interactive calls to action.

Customers, met in their channels of choice, enter the funnel. Based on their profiles, they are presented with targeted content and offers generated by AI.

The path-to-purchase becomes personalized, fast, and easy.

The system automatically tracks customer engagement and updates customer profiles accordingly, thus enriching customer-data models and fine-tuning the predictive AI engine.

BUILDING CUSTOMER LOYALTY THROUGH UNIFIED ENGAGEMENT

USE CASE Personalization is key to customer loyalty. Options are everywhere, and customers can easily look elsewhere for a similar product with a better experience. Knowing who your customers are when you engage them, or when they engage you, is critical to creating a lasting connection in today's digital marketplace. This becomes even more critical when they've engaged before.

FIGURE 5

AI Technology

Let's send an email!
- Customer likes this style.
- Usually buys in evening.

We are out of stock.
What else do we know about the customer?
- Sometimes orders these styles.

He didn't like those and the first product is discontinued . Let's try to recommend discounts.

That worked!
Our campaign was successful, and we have strengthened our customer relationship.

Customer

Purchased

I love this watch from my email. I'll order it.

"Drats, they don't have any more"!

"Hmm, they have it in a different color but I would prefer the other.

I will chat with someone online to see when the navy blazer will be back in stock."

"It looks like the watch is discontinued but I received this 15 percent off discount for the inconvenience.

I like the other one enough to buy it!"

"I can't wait to wear my new watch!"

BOTTOM LINE

In today's world, the customer is in charge. And in a marketplace of endless options and channels, companies realize that to remain competitive, they will have to create a differentiated human experience and deliver consistently on ever-evolving customer expectations of brand engagement. The *beyond marketing* trend ushers in a new set of tools and tactics that, deployed strategically, can help companies elevate their marketing operations from art to a blend of art and science, while keeping the customer firmly in the center of all decisions.

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Endnotes

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DevSecOps and the cyber imperative
Elevating, embedding, and evolving your risk response

T O ENHANCE THEIR APPROACHES TO CYBER AND OTHER RISKS, forward-thinking organizations are embedding security, privacy, policy, and controls into their DevOps culture, processes, and tools. As the DevSecOps trend gains momentum, more companies will likely make threat modeling, risk assessment, and security-task automation foundational components of product development initiatives, from ideation to iteration to launch to operations. DevSecOps fundamentally transforms cyber and risk management from being compliance-based activities—typically undertaken late in the development life cycle—into essential framing mindsets across the product journey. Moreover, DevSecOps codifies policies and best practices into tools and underlying platforms, enabling security to become a shared responsibility of the entire IT organization.

DevOps tactics and tools are dramatically changing the way IT organizations innovate. And in the midst of this transformation, IT leaders are finding that longstanding approaches for integrating security into new products are not keeping pace with high-velocity, continuous delivery software development. Indeed, in the DevOps arena, traditional "bolt-on" security techniques and manual controls that are reliant on legacy practices are often perceived as impediments to speed, transparency, and overall security effectiveness.

In a growing trend, some companies have begun embedding security culture, practices, and tools into each phase of their DevOps pipelines, an approach known as *DevSecOps*. Deployed strategi-

cally, DevSecOps can help improve the security and compliance maturity levels of a company's DevOps pipeline, while boosting quality and productivity and shrinking time-to-market. How? Automation tools execute tasks uniformly and consistently, whereas humans using manual controls can and do make mistakes. At the same time, with DevSecOps, application changes flow freely through DevOps pipelines, giving developers more autonomy and authority without compromising security or elevating risk.

To be clear, DevSecOps is an evolution of DevOps culture and thinking. Rather than disrupting your current cyber agenda, it actually embeds many of the security processes, capabilities,

and intelligence learned over the years into your underlying platforms and toolchains. Building on your experience of developing and operating applications, DevSecOps enables you to automate good cybersecurity practices into the toolchain so they are utilized consistently.

The *DevSecOps* trend is only beginning to gather steam. For its 2018 *DevOps Pulse Report*, Logz.io surveyed more than 1,000 IT professionals worldwide about the state of DevOps in their industries. Roughly 24 percent of respondents indicated their IT organizations were practicing some DevSecOps elements. The other 76 percent said their IT organizations either do not practice DevSecOps or are still in the process of implementation.[1]

Notably, 71 percent of respondents feel that their teams currently lack adequate working knowledge of DevSecOps practices.[2] During the next 18 to 24 months, expect that working knowledge to grow markedly as more CIOs and development leaders explore DevSecOps opportunities. Likewise, those

Building on your experience of developing and operating applications, DevSecOps enables you to automate good cybersecurity practices into the toolchain so they are utilized consistently.

with more advanced DevOps programs in place may begin implementing governance, maximizing automation, and cross-training both DevOps and cybersecurity specialists with new processes and tools.

DevOps' fundamental value is speed to market.[3] Organizations that do not incorporate security into every phase of their development and operations pipelines risk leaving much of its value on the table. Every product you stand up should be a known entity—tested, secure, and reliable. Internal and external users should not have to waste time grappling with cyber surprises, nor should you.

It's time to stop playing the patch management game with security.

In a DevSecOps state of mind

Even as IT organizations began embracing agile development practices over the last decade, many continued to approach security issues in the same incremental, siloed way they had with waterfall.[4] Building on agile's nimble, team-based approach to development, DevOps is now driving dramatic increases in end-to-end velocity. Yet with its heavy reliance on legacy processes and manual controls, security remains a challenge. In many DevOps pipelines, security is still treated as a bolt-on rather than a design feature. This can create pipeline bottlenecks, in part because few developers and system operators have cyber expertise and even fewer cyber specialists possess a deep understanding of development and operations. As a result, DevOps teams and cyber specialists continue to work separately within the pipeline, often slowing progress.

Increasingly, CIOs and DevOps leaders understand that unless these groups work as a unified team to bake security into products throughout the development and operations cycles, their companies may never realize DevOps' full promise.[5]

DevSecOps is not a security trend in and of itself but, rather, an aspect of the ongoing DevOps revolution that *Tech Trends* has chronicled in past issues.[6] It is also more of a mindset than a formal set of rules and tools. DevSecOps offers companies practicing DevOps a *different way of thinking about security*. Consider the following characteristics of DevSecOps, and how they differ from the way

you are approaching security in your development pipeline today:

- **Open collaboration on shared objectives.** DevSecOps creates shared expectations and metrics for measuring success. It aligns security architects and focuses activities based on business priorities.
- **Security at the source.** DevSecOps features consumable, self-service security capabilities, establishes security guardrails, and makes it possible for teams to monitor results and provide targeted feedback. It can find cyber vulnerabilities early in the application development cycle, reducing the need for rework just before or after deployment.
- **Reinforce and elevate through automation.** By automating recurring tasks, DevSecOps makes it possible to orchestrate an integrated process flow, embed preventative operational controls, and create ongoing audit trails.
- **Risk-oriented operations and actionable insights.** Organizations incorporating DevSecOps into their development pipelines can utilize operational insights and threat intelligence to drive process flow, prioritization, and remediation recommendations. They no longer have to rely solely upon code scans and can take a more risk-based approach to testing.
- **Holistic approach to security objectives.** Integrated frameworks help secure both the pipeline and application. This helps create a more comprehensive, end-to-end defense throughout the production environment.
- **Proactive monitoring and recursive feedback.** Automated, continuous testing helps identify problems before they become issues. Developers can also leverage logging and telemetry to drive learning and innovation.
- **Automated operations security.** Because visibility into some aspects of operations security can be limited, CIOs overseeing security audits have often found themselves in a position of having to *assume* (hope) that various

security administrators have performed their jobs correctly. Security-as-code may offer a more effective approach. New techniques in containerization and public cloud infrastructure automation now make it possible to audit security and compliance in operations reliably and consistently, with less effort.

- **Operations engineering.** When humans are part of the loop, the process of detecting an intrusion and taking action can eat up precious hours or even days. However, in secure infrastructure-as-code environments in containers or public cloud/containerized environments, engineered response capabilities can automatically and instantly redirect traffic, freeze nodes for later inspection, notify operators, and spin up fresh instances—all automatically.

Taken together, these DevSecOps elements can help improve the overall quality of security, boost productivity, and reduce compliance issues. Importantly, they can break the bottleneck that traditional security creates in high-velocity development environments, thus unleashing DevOps' full potential.

DevSecOps in four parts

DevSecOps incorporates secure culture, practices, and tools to drive visibility, collaboration, and agility into each phase of the DevOps pipeline. Though companies can tailor their security approaches to support their own cyber agendas and product needs, DevSecOps initiatives typically rest on four foundational pillars:

- **People.** As you integrate security into your DevOps pipeline, remember that people are still your greatest efficiency (or inefficiency) asset. In the traditional waterfall model, the development, security, and operations teams are siloed. As you move into the DevOps world, teams may still operate that way for a while; breaking down those

FIGURE 1

What is DevSecOps?

It is a transformational shift that incorporates **secure** culture, practices, and tools into each phase of the DevOps process.
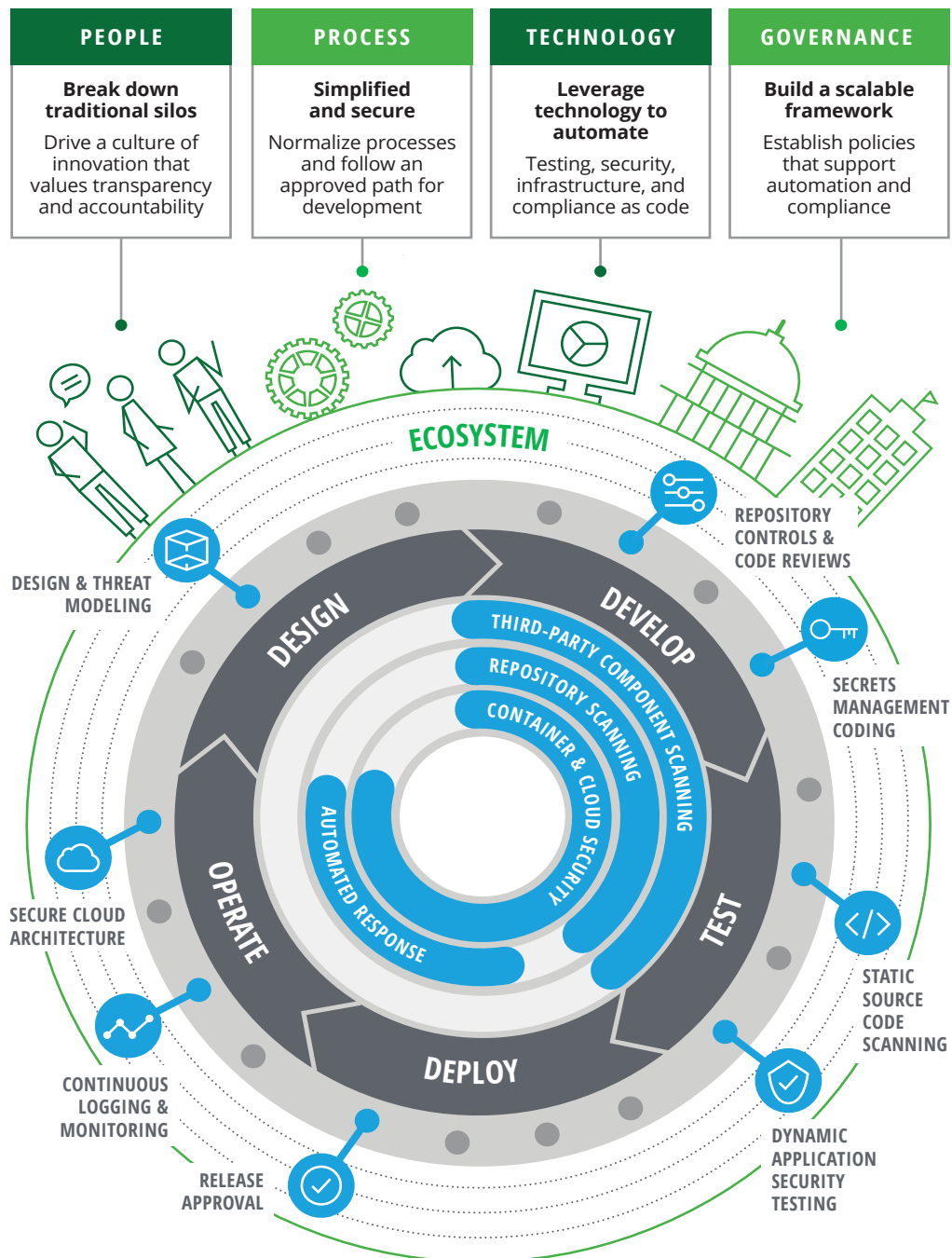
Source: Deloitte analysis.

traditional barriers can be the first and most important catalyst to your DevSecOps journey. Try to identify and remedy those silos quickly, create shared goals within DevSecOps teams, and drive a culture of innovation that consists of openness, transparency, ownership, and accountability. While the human resource hierarchy may remain separated, the development culture should be product-based and therefore lead by *product teams*. Each responsible party (dev, sec, ops) owns a portion of the product success.

It is also important to start small. Small teams gradually come together cohesively; if suc-

A positive by-product of DevSecOps is that cybersecurity specialists often develop a greater understanding of development pressures and therefore drive more backend automation of security functions.

cessful, more and more product teams may start self-adopting DevSecOps practices across the enterprise. As you scale DevSecOps, the product teams will likely become ever more self-sufficient, identify their own security challenges, and automatically course-correct for the benefit of secure product delivery. A positive by-product of DevSecOps is that cybersecurity specialists often develop a greater understanding of development pressures and therefore drive more backend automation of security functions. Likewise, development teams with a deeper understanding of cybersecurity approaches can proactively

adopt secure coding practices. The net result in both instances is increased efficiency.

- **Process.** Keeping in mind that speed and quality are key to DevSecOps, try to simplify manual processes as much as possible without sacrificing cybersecurity needs. Since development and deployment are now accelerated much faster than before, security software development processes should become more factory-like. Otherwise, efforts to exponentially accelerate secure software deployments may be unsustainable.

  Consider creating normalized development processes that follow consistent approaches. This is where the security process concept of "shifting-left" becomes important.[7] For example, try incorporating design thinking to understand customers' security needs. Implement threat-modeling storyboards into software changes to build cyber resilience into the application even before the first line of code is written. And incorporate incremental static code scanning into the integrated development environment before the application is packaged. Yes, the shift-left mentality takes a bit of extra effort upfront, but it can help prevent many more breaches waiting to happen—and a lot of product rework. In a nutshell, consider your cybersecurity requirements right away and try to move them as early into the design stage as possible, aiming to eliminate manual security "gatekeeper" delays later on.

- **Technology.** The introduction of DevOps has created a plethora of cloud-based solutions that development teams are using to speed delivery. Fortunately, cybersecurity software is now beginning to keep pace. For example, assorted pipeline tools—testing-as-code, security-as-code, infrastructure-as-code, compliance-as-code, and others—can eliminate the need for some manual security activities, thus boosting velocity. When tools such as these are implemented with the right processes, development and security teams can become more unified, defect costs can plummet, and quality can become consistent throughout the pipeline. Consider taking an in-

cremental approach to technology deployment, testing these new security tools with specific product teams before releasing to the enterprise.

- **Governance.** The term *governance* is broad by design, but there are two ways to think about governance for cybersecurity in the world of DevSecOps:

  - **At the micro level (the world that revolves around the product teams).** Embedding cybersecurity into DevOps can boost efficiency in governance. How? DevSecOps, by design, requires a highly consistent process that uses a uniform set of tools and automated controls. This helps simplify the monitoring and testing of required controls. In fact, by designing DevSecOps processes to accommodate the needs of compliance and control teams, you may be able to gradually automate testing processes and free up developer resources. The process of pulling a list of tickets, selecting samples, and identifying all relevant audit trails from multiple systems might have taken *days* of a developer's time. Using compliance-as-code, it can be accomplished in minutes.

  - **At the macro level.** DevOps has transformed how IT organizations work. In some companies, IT operations—traditionally comprising a mix of senior management, management, and engineers—is moving to a flatter hierarchy made up of fewer management positions supported by architects and engineers. At the same time, penalties for running insufficiently governed IT environments have grown. This means that the overall governance of the *projected* IT landscape is more important than ever before. The success of your company brand increasingly depends on products developed using DevOps.

Like any other IT program, DevSecOps should directly tie to your broader IT strategy—which, in turn, should be driven by your business strategy. If a DevOps program supports your IT and business strategies, then embed the "Sec" at the same time. In short order, it may help you bolster your cyber maturity posture and save you from having to rework your DevOps program later when it's much harder to do.

ARE YOU READY?

Embedding security into DevOps pipelines may initially seem like a straightforward proposition. After all, if DevSecOps is just a way of thinking about security, then deploying it in your DevOps factory should be a light lift, right? For those few who have fully mastered DevOps, perhaps. For everyone else—and that is most organizations—developing DevSecOps practices will likely be another component in existing DevOps initiatives that are still in early stages. For example, in its *2018 Global Developer Report*, GitLab surveyed roughly 5,300 IT professionals about their DevOps experiences. Thirty-five percent of respondents said the DevOps culture at their companies was "somewhat established." Only 23 percent of those surveyed would go so far as to describe their development method as DevOps.[10]

As you explore DevSecOps opportunities, ask yourself the following questions not only about security but about how they may affect your current DevOps efforts.

▶ **Will I have to hire developers with security expertise?**

Not necessarily. First, work to turn the combined knowledge of the security expert and the developer into code. Next, upskilling existing talent may be the only viable staffing option as the *DevSecOps* trend progresses, but it allows you to retain important business knowledge gained over the years from each respective area. Besides, developers with security expertise (and vice versa) are in high demand right now and increasingly hard to recruit (and keep).[11]

▶ **Won't DevSecOps slow down my pipeline?**

Probably not. Granted, if you had no security controls prior to DevSecOps, there will be some efficiency trade-off, but DevSecOps provides two major efficiency benefits: 1) Incorporating security into a DevSecOps pipeline still results in a faster pipeline than the waterfall method, and 2) DevSecOps gets faster as time moves forward because vulnerabilities are mitigated over time and efficiency increases. Developers also gradually gain more freedom and autonomy to move product through the pipeline because of automated controls.

▶ **Can DevSecOps be compatible with my compliance requirement?**

Yes—if anything, it helps ease the burden of maintaining compliance. In an ideal DevSecOps state, security auditing, monitoring, and notification are fully automated and continuously monitored, enhancing compliance.

▶ **My DevOps process is still immature. How can I make sure that my DevSecOps governance is scalable?**

Plan, storyboard, and start small. Sustainable and scalable DevSecOps governance models typically feature the following components:

- Clearly defined roles and responsibilities in all *cross-functional* teams
- DevSecOps-specific policies and procedures that enable organizations to keep up with the pace of application development in a DevOps environment
- Automated security tools throughout the pipeline that reduce vulnerabilities and the lower the frequency of human error
- Security monitoring and notification systems in DevSecOps that create automated audit trails throughout the software development life cycle—which, in turn, facilitate compliance reporting
- Continuous monitoring of security metrics, which helps DevOps teams constantly improve their security decision-making

ORACLE PERSPECTIVE
SECURITY EMBEDDED DEVOPS MODEL

With growing scrutiny on data breaches around the world, it is becoming imperative to incorporate additional security practices in the SDLC to ensure that proper development practices are adhered to. By evolving DevOps practices to DevSecOps and embedding leading security practices throughout the development life cycle, organizations can achieve secure environments without affecting their goal or rapid software deployment to production environments.

Over the last several years, there has been an increase in interest from Oracle customers to better understand DevOps and how it can be leveraged for their ERP systems. The system development lifecycle for an ERP environment involves additional attention to audit, data privacy, and regulatory requirements. This requires adherence to proper governance around the management of environments and internal controls and changes necessary to satisfy the organization's regulatory-reporting requirements.

The need to provide traceability and auditability of changes to the production environment is often accompanied by manual validation, peer review sign-off, and providing restricted access to moving changes into the production environment. These added challenges, much like the security requirements, are viewed as highly manual and contra DevOps culture.

As the DevOps application matures, so does the availability of tools within the DevOps ecosystem. These tools allow for additional automation to be incorporated within the SDLC to move the needle closer to a fully automated continuous integration/continuous delivery model (CI/CD) — even within the ERP environment. Leveraging tools such as ServiceNow, which provides approval workflow notification capabilities, allow for the manual approval steps to be completed with the push of a button. Once approved, back-end orchestrations can compile and migrate code between environments, replicate or migrate system configurations, automate regression testing, and make changes to master data while providing full traceability on who requested the change, testing results, and approvals.

Why do we need security in DevOps?
Why is it important?

Vulnerabilty
The need to remediate vulnerabilities identified at both scale and speed is critical to the success of a shift-left; security testing and integration as a full-cycle 360° view approach

Segregation of duties
Controls needed to ensure internal controls are defined and adhered in order to reduce the risk of errors or fraud

Data privacy
Controls needed to identify, preserve, and protect sensistive data maintained within an organization's portfolio of system

The adoption of DevSecOps within the Oracle SDLC aims to address three risks faced by organizations today: **vulnerability** of their environment and applications, **segregation of duty** in compliance to regulations, and the increased need to provide **data privacy** to employees and customers.

To mitigate these risks, IT organizations need to define policies and measurement metrics. Subsequently, organizations need to implement manual and technical governance to achieve the policies. To govern the

established standard, companies are looking for the approach and tools that can help them to have the level of isolation, data protection, control, and visibility needed for their defined cloud infrastructure. The goal is to build a fault-tolerant, resilient, and verifiably secure cloud infrastructure that enables integration with existing security assets.

FIGURE 2
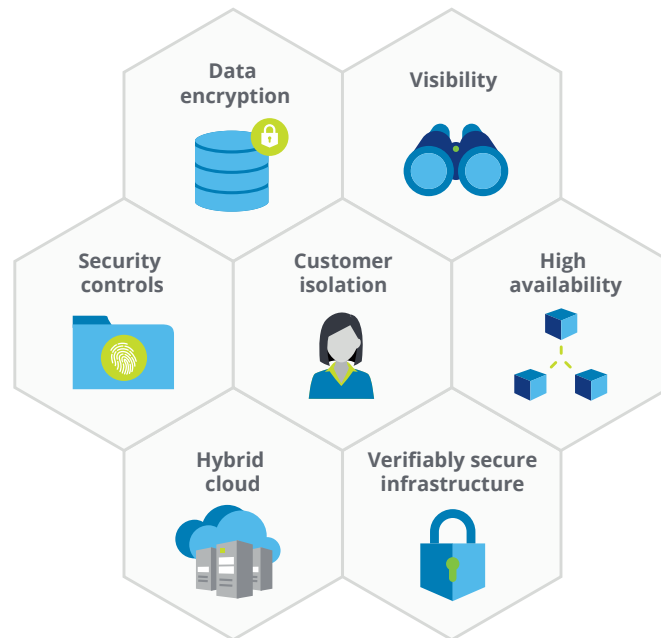
- **Customer isolation**: Allow customers to deploy their application and data assets in an environment that is based on isolation from other tenants.
- **Data encryption**: Provide controls that can protect customer data at-rest and in-transit in a way that allows customers to meet their security and compliance requirements with respect to cryptographic algorithms and key management.
- **Security controls**: Offer customers effective and easy-to-use security management controls that allow them to manage access to their services and segregate operational responsibilities to help reduce risk associated with malicious and accidental user actions.
- **Visibility**: Offer customers comprehensive log data that they can use to audit and monitor actions on their resources to allow them to meet their audit requirements and help them reduce security and operational risk.

- **Hybrid cloud**: Enable customers to use their existing security assets, such as user accounts and policies, as well as third-party security solutions when accessing their cloud resources and securing their data and application assets in the cloud.
- **High availability**: Offer fault-tolerant data centers that enable high availability scale-out architectures and are resilient against network attacks, to provide consistent uptime in the face of disaster and security attack.
- **Verifiably secure infrastructure**: Follow rigorous processes and security controls in all phases of cloud service development and operation. Demonstrate adherence to Oracle's security standards through third-party audits, certifications, and attestations. Help customers demonstrate compliance readiness to internal security and compliance teams, their customers, auditors, and regulators.

► Vulnerability

Moving infrastructure from an internal location to a private or public cloud can introduce vulnerability into the environment landscape that can lead to greater instances of hacking and data leakage. This is due to internet-accessible management APIs (or some open-source code tools), failure to logically separate data in multi-tenant infrastructure, or compromise of stored credentials.

- **Policy and measurement:** IT organizations need to define strong security policies and standards around their infrastructure, environment architecture, the use of open-source software, and environment access and credentials. Standards should include integrated compliance testing and code agents to scan for vulnerabilities within cloud infrastructure. Measurements of adherence need to be defined and published to provide accountability of adherence of the defined policy.
- **Technical and automated governance:** To govern the established standard, organizations can leverage the comprehensive log data that can be used to audit and monitor actions conducted on the established infrastructure and allow them to meet their audit requirements and help them reduce security and operational risk. Other automated solutions such as automated code review can be included once a manual review process is defined and considered stable.
- **Manual governance**: Manual governance can also be implemented such as a manual code review and validation to manage the adherence of a defined SDLC policy that would identify potential vulnerability within developed code prior to releasing the code into a production environment.

► Segregation of duties

Regulatory demands require organizations to have defined segregation of duties rules to restrict a single user's access to multiple transactions within Oracle that may lead to a financial risk of error or fraud. In addition, SOC compliance requires the same degree of segregation when dealing with the creation and maintenance of technical infrastructure and environments.

- **Policy and measurement:** To mitigate the risk, organizations must define roles and responsibilities within their financial and IT operations organization to ensure transactions are not performed by a single individual. For example, a user creating a vendor record cannot have access to creating invoices and payments for the newly created vendor. Similarly, changes made to programs and environments need have a segregation between the activities of defining, reviewing, and implementing changes. Technical resources also need a defined set of roles and responsibilities that ensures changes are reviewed, validated, and approved by different resources before being implemented into a production environment. For example, the developer creating and unit testing a code change cannot be the same user that compiles and migrates the code into the production environment. This segregation will minimize the risk of error and ensure that all changes are valid and appropriate.
- **Technical and automated governance:** With the growing scale of ERP Cloud implementation, major cloud vendors such as Oracle have introduced key functionality that specifically addresses segregation of duties and related audit requirements. The Risk Management tool helps organizations integrate data security, compliance, and governance rule sets into the ERP Cloud applications that they use to perform business processes and transactions. The Risk Management tool provides the ability to analyze and assess security design at the lowest levels of detail, monitors transactions that involve private data, and offers an end-to-end flow to manage and certify user access and compliance.

Risk management adds additional controls and processes that can complement the overall security governance and strategy that will ensure full coverage within the cloud infrastructure and application stack .

Risk management and controls
Business processes within the finance area

Advanced access controls	• Automate access and segregation of duties (SoD) controls to prevent fraud and access violations • Accelerate deployment of application security using a prebuilt library of access and SoD controls
Advanced financial controls	• Continuously monitor procure-to-pay and expense controls • Reduce cash leakage, transaction errors, and compliance violations (for example, duplicate supplier invoices)
Financial reporting-compliance	• Establish and update your risk and controls matrix, control test plans, and instructions • Automate periodic or ad hoc control testing (assessments), risk assessments, or surveys

- **Manual governance:** Standards and rules must be audited at set intervals to validate that transactions and modifications are completed per the defined standards to ensure that the same user is not defining, reviewing, and implementing code changes. Organizations need to conduct both internal and external audits based on their industry-specified regulations to be SOX compliant. It is recommended to conduct at least two internal audits per year and at least one external audit.

▶ **Data privacy**

The vulnerability of certain cloud environments has led to major headlines related to private citizen information being stolen and leaked, driving a greater need to have private and personal data stored in an encrypted state. Often times, passwords are hard coded into source code or stored in databases unencrypted. Malicious users can gain access to application passwords via source code repositories or host access and use them to obtain unauthorized access to sensitive data. In addition, increased regulation around the export of information leading to iTAR and GDPR regulation has pushed organizations to have a strategy on how information will be handled within their system landscape.

- **Policy and measurement**: Organizations need to define standards around data masking and data transfer, as well as procedures when cloning environments to ensure sensitive data are concealed. Data fields should be classified as sensitive that need to be included in masking efforts in all environments. For example, employee social security numbers need to be masked at any time. The data privacy can also extend to attachments such as engineering drawing or other product information that cannot be viewed by resources that are not US citizen per certain iTAR requirements; therefore, access need to be restricted in all environments.
- **Technical and automated governance:** To ensure that the data privacy standards are being adhered to, organizations need a process for data masking to have embedded as part of their internal and external audit process. These processes will be in place to validate that the data are in fact being masked as defined and only accessed by the appropriate resources. Additionally, secure code needs to be reviewed and

- audited for sensitive data, and developers should attend training to ensure sensitive data are appropriately managed. Lastly, SDLC needs to have embedded development standards to appropriately access and manipulate data that fall under the data privacy standards.

  Cloud providers such as Oracle offer data masking when cloning production environments to lower environments to help ensure sensitive data detailed in the data privacy standards are masked as necessary. This assist with the audit process in addition to doing code review that can detect flaws or weaknesses within the SDLC. In addition, the ability to mask data after environment refreshes, privileged access management tools such as password key vaults to remove sensitive keys from application code and scripts can be added to the SDLC, providing a stronger DevSecOps process. Additionally, secret management tools can be included to store credentials required to access applications to help ensure access controls are in place for environments with confidential information.

- **Manual governance**: As part of the audit process define, manual validation on key data fields that must be masked needs to be performed on a defined audit schedule. The validation ensures that technical or automated solutions are in fact working as defined. The audit needs to be performed by authorized personnel in the event an exception is found and data privacy violations are identified. For example, employee social security number validation should only be performed by an HR representative who is authorized to view employee social security numbers.

ORACLE PERSPECTIVE

MITIGATE CYBER RISKS DURING ERP CLOUD TRANSFORMATION

USE CASE

A global manufacturer has initiated a multiple-phased journey of financial transformation to transition their finance and procurement operations to Oracle Cloud ERP globally. This is a multi year program to transition the existing on-premises product and complex business processes to Oracle Cloud ERP. The company has taken the following proactive steps to effectively address their security and compliance risks during this journey of cloud adoption:

Risk management: The company leveraged Oracle Risk Management Cloud to provide roles to create customized roles based on its business, IT, and compliance requirements, adhering to the security leading practices of Segregation of Duties (SoD) sensitive access and least-privileged access. To elevate security further and have enhanced visibility to compliance, the company enabled advanced access controls (AAC) and advanced financial controls (AFC). AAC helped in enabling live monitoring of (SoD) and sensitive access and provided business owners and compliance team capability to proactively monitor and address (SoD) and sensitive access concerns. This also brought in significant improvement in the periodic user access review cycle and expedited the review process, which was one of the key pain points for business teams in the past. AFC helped the company in addressing the business and compliance requirement to monitor key financial transactions and identify fraudulent ones. The two RMC products have helped the company achieve a steady state of user access and transaction monitoring.

Privileged access management: Like any complex ERP engagement, the company also encountered a need to create generic user accounts in Oracle Cloud ERP to address some of its support

organization requirements. Typically, a generic user account raises concern from compliance and security teams, as at times clarity on ownership of the account is not established and passwords may be shared. The company utilized key-based privileged access management application to avoid sharing of passwords and identified owner for its generic user accounts.

Robotic process automation (RPA): The company utilized RPA tools to automate some of its security- and compliance-related activities, which brought in efficiency and helped reduce human errors. RPA tools expedited security activities such as role configuration and validation.

Identity and access management: The company utilized REST APIs and leveraged its identity and access management product to automate role and data security assignment of Oracle Cloud ERP. This brought it efficiency in the security operations processes and provided visibility to the business team on the user-access-related requests.

The focus on security in the cloud should be holistic and it requires alignment from business, IT, and compliance groups to have a uniform vision, which is supported by the cloud service provider and system integrator. The client was able to create a sustainable security model for a new application environment, which has balanced business requirements and incorporated leading compliance and security recommendations.

At the end of the day, for any enterprise the assurance of safe application and data is supreme. Oracle's effort along with an enterprise's vision and system integrator's approach creates synergies and can help an enterprise successfully secure and implement Oracle Cloud ERP.

PREVENT VULNERABILITY IN DEVELOPMENT CYCLE

USE CASE

A leading finance company had very robust vulnerability policies and testing procedures in place. However, during the project, development was done using Agile and DevOps principles. The existing testing procedures were only effective in a large scale integrated test environment. They could not be deployed in an isolated manner of smaller blocks of functionality similar to those being built in the agile sprints. In order to avoid catching vulnerability issues late in the game during integration testing (and dealing with the resultant rework), the client implemented security checks earlier in the process during the original agile DevOps design build phase.

A mid-stream code review process is implemented to check against any potential vulnerability violations that had been introduced into the code. The code review process was already needed to ensure coding standards were being followed, so adding checks for security was a small added dimension to a pre-existing task. In addition, as a pattern developed with several frequently occurring violations, an automated scanning program is introduced to scan code for potential occurrences. This automated scanning tool provided a redundant DevSecOps check during original design/build/test.

The results of this effort were directly measurable and deemed to be a major success. In the phase without the "early DevSecOps checks" described above, 25% of objects had at least one security issue detected during integration testing. The total re-

work that resulted was about 800 hours but more importantly, the end of integration testing was delayed by three days. In the phase where these techniques were implemented, only 5 percent of objects contained a security defect and the rework was only 40 total hours (easily contained within the original timelines).

BOTTOM LINE

The ever-growing need to get quality products out the door faster has elevated DevOps practices to the position they hold today in the arena of software development. In a natural extension of DevOps evolution, the DevSecOps trend offers CIOs and their development teams a new mix of tools, practices, and automation that, deployed in concert, can help secure development and operations.

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ORACLE PERSPECTIVE

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Beyond the digital frontier: Mapping your future
Digital transformation demystified

D IGITAL TRANSFORMATION HAS BECOME A RALLYING CRY FOR business and technology strategists. To those charged with mapping the future, it promises a triumphant response to the pressures and potential of disruptive change. Yet all too often, companies anchor their approach on a specific technology advance. To fuel impactful digital transformation, leading organizations combine technology with other catalysts of new opportunities—from emerging ecosystems to human-centered design and the future of work. Why? Because the technology trends that inspire digital transformation efforts don't take place in a vacuum. They cross-pollinate with emerging trends in the physical and social sciences and in business to deliver unexpected outcomes. Developing a systematic approach for identifying and harnessing opportunities born of the intersections of technology, science, and business is an essential first step in demystifying digital transformation, and making it concrete, achievable, and measurable. It is time to move beyond the frontier of random acts of digital.

Digital technology is now so ubiquitous and affordable that many people are using it with little or no learning curve to create new business models and pursue opportunities that never existed before. Its influence spans industry, geography, cultural, and demographic boundaries. We use digital in our personal lives to entertain ourselves, schedule our days, and stay connected with friends and family. In business, it expands capabilities and disrupts sectors and business models. In broader society, digital is reengineering the way government works—and is redefining cultural norms.

But what exactly is digital? And how does one reconcile its formidable potential with the hyperbole and empty rhetoric often used to describe it? In corporate boardrooms, *digital* has become an umbrella term for any strategy that uses innovations to drive disruption and new opportunities. In IT organizations, CIOs and their teams define it in terms of specific technologies. In this final chapter

Only 1/3 of Deloitte's *2018 global CIO survey* respondents reported having an enterprise digital strategy.

of *Tech Trends 2019*, we will try to unpack this often-misunderstood term—and discuss how using more precise verbiage, adopting disciplined approaches, and making investments with a bounded scope and measurable outcomes can help transform your digital efforts from explorations of shiny emerging technology into long-term strategies that inspire confidence.

Let's start with the word *digital*. Seasoned technology veterans often bristle at the way this term was co-opted in the early 2010s and used as shorthand for emerging channels such as mobile, social, and the evolution of the web. Soon mobile app development, responsive web, social listening, and even cloud were flying the digital flag. Yet savvy organizations realized that this was an artificial construct that obscured digital's real value proposition: the use of emerging technologies to reimagine the entire business.

Today, we refer to the pursuit of that business-critical value proposition as *digital transformation*. Simply put, digital transformation is the process of future-proofing one's organization. It typically begins with leaders and strategists defining new ambitions—often in the broadest of terms. They frequently cite high-profile examples of how companies used digital innovation to disrupt established markets and business models: Netflix in video rentals; Amazon in bookselling and then mass retail; Airbnb in the hospitality industry. The list goes on. As callouts in keynote speeches, these examples are useful.

But digital transformation can and should be just as concerned with modest and immediate ambitions as it is with broadly reimagining the future. For example, reengineering individual business units and processes, or creating opportunities for specific products and customers can have a more immediate impact on long-term competitiveness. By adopting a strategy of putting smaller, more tightly scoped offerings into the market quickly and successfully, organizations can incrementally achieve an end-state business ambition.

The mistaken belief that digital transformation requires a grand, enterprise-encompassing vision causes a fair amount of consternation among technology leaders, largely because so few organizations have one. In Deloitte's *2018 global CIO survey*, only one-third of the 1,400 executives surveyed reported having an enterprise digital strategy.[1]

What's more, many of those with digital strategies in place have made only minimal progress executing them. Recently, *MIT Sloan Management Review* and Deloitte surveyed 4,300 managers and executives globally to learn more about their digital journeys. Only 30 percent of respondents said their digital transformation journeys were "maturing." The rest described their efforts as being in the "early" or "developing" stages.[2]

But there is hope. By following a more prescriptive approach to shaping their ambitions, organizations can focus their digital efforts with precision while building an engine for bringing digital products and services to market rapidly and at scale. Over time, successfully realized digital ambitions—each with a positive income statement—will grow in number and ultimately make an enterprise-wide impact. This is the secret to the digital success stories we showcase throughout *Tech Trends 2019*, from the investments Walmart is making as it thinks more like a startup,[3] to Maersk's development of a new digital backbone,[4] to Anthem's move to a platform-based AI engine and beyond.[5] It can work just as effectively in organizations of different size and scale, and in different industries, operating across the globe.

ARE YOU READY?

Clearly, there is a need to move faster, be bolder, and to elevate the concept of *digital* from empty wisdom to actual investments. Yet despite this strategic urgency, digital transformation efforts can lose momentum for any number of reasons. Many organizations don't feel confident they can execute against the digital agendas they develop. In the MIT/Deloitte survey, respondents cited risk aversion, ambiguity brought on by constant change, and buying the right technologies as among the biggest challenges affecting their companies' ability to compete in a digital environment.[21]

FIGURE 1

How do you feel about it?

THE MANDATE	THE DISRUPTED	THE FATIGUED	THE SUB-SCALED	THE SPOT SOLUTION
The CEO gave a directive to transform. Now!	**Help! We are being disrupted. What do we do?**	**Our digital projects lack clear direction and benefits.**	**Our dedicated digital group is no longer enough.**	**We just need a new mobile app.**
Our CEO has a vision for digital transformation and has set aggressive goals. How do we execute?	*A tech giant is entering my industry. Will nontraditional competitors disrupt me? How do we disruption-proof ourselves?*	*We have 40 apps and 60 websites, and yet all they seem to do is confuse customers. How do we bring it all together to realize benefits?*	*To date, we've had a dedicated digital group, but it's no longer sufficient. We need digital across the business. How do we scale?*	*I know what I want, and I need help getting it done. Let's not boil the ocean right now but, rather, focus on something small.*

Source: Deloitte analysis.

▶ **What does it take to succeed? Certain behaviors, attitudes, and actions can make the difference between a successful transformation and another shelved initiative:**

- **Think exponential.** Set bold goals, and then work steadily to achieve them. Along the way, if you fail, fail fast and maintain your momentum. Eventually, bold goals become even bolder achievements.
- **Create agile execution.** Learn to develop and try ideas in short iterative sprints with empowered teams. Treat digital initiatives like R&D. *Agile* means more than a software delivery method—embrace enterprise agility in its fullest form.
- **Acquire capabilities to catalyze the culture.** M&A, partnerships, co-investment techniques, and creative hiring of edge teams can introduce new sparks of ideas and stem cells for needed expertise, especially in areas such as design thinking, creative skill sets, and emerging technology.

- **Protect the people.** Ring-fence digital teams from layers of bureaucracy, policies, or other compromises not found in a startup culture.
- **Build an inspiring environment.** Developing ideas that will fundamentally change your business is hard in a cubicle farm or windowless meeting room. A dedicated space that is flexible, open, and encourages collaboration helps bring out the best in your people.
- **Put the customer first.** Don't compromise on the customer experience. Make customer value and delighting the customer the number one priority, even for back- and mid-office-focused initiatives.
- **Stay open to change.** Beware of institutional inertia and the status quo. Some of the most steadfast, seemingly immutable aspects of your business may be prime candidates for reinvention. New opportunities require an openness to ways of thinking and doing that can challenge the accepted wisdom of how things "should be done." Encourage all stakeholders to think beyond their silos, channels, and current market perspectives. Broader changes to your organization, processes, and platforms may be needed for maximum impact.
- **Design creatively.** Design thinking with an emphasis on human-centered experience is the new differentiator in digital and in business. Invest accordingly.
- **Focus on value.** Don't get distracted by digital shiny objects. Focus on revenue, key metrics, and follow the money. Dismiss ideas that digital transformation is beyond measurement and accountability. Embrace ideas that lend themselves to tangible, material, measurable results.
- **Leadership mandate.** Executives should be engaged in the definition, oversight, and communication of a vision and strategy. Moreover, they should empower teams to make decisions, giving them enough autonomy to experiment—and even fail-to-learn when needed.

When it's time to roll up your sleeves, IT and the business should work together to decide what technologies are needed across the enterprise and ecosystem. IT should make sure that technology decisions and innovative thinking can be scaled with minimal risk. Likewise, experienced technology professionals should confirm that the company's core systems can support a new technology before enthusiastic stakeholders enter into a licensing agreement. It's not enough to imagine a new tomorrow. You have to get there from the realities of today.

ORACLE PERSPECTIVE
IMPACT ON ENTERPRISE APPLICATIONS AND OPERATIONS

You don't have to look far to see the impact that digital technologies such as cloud, robotic process automation (RPA), advanced analytics, AI, and blockchain are having on business today. Although many organizations are highly experienced in managing change, this digital disruption represents an unprecedented opportunity—and challenge—to radically improve organizational efficiency. Digital transformation enabled by platform technologies such as Oracle can potentially produce the following outcomes:

- **Enhanced** transactional processes
  - o Touchless transactions through RPA
  - o Streamlined processes delivered by AI

- **Improved** confidence in organizational data and processes
  - o Faster intercompany transfers using blockchain
  - o More secure B2B payments via blockchain

- **Streamlined** strategic and operational decision making
  - o Greater efficiency through visualization
  - o Enhanced business value via advanced analytics

Enabled by the cloud, advanced digital technologies are not futuristic; they are available now and enterprises can develop strategic roadmaps for using them to propel digital transformation forward. Blockchain, for instance, is revolutionizing financial-asset management, cross-border settlements, and mission-critical transactions throughout the business ecosystem, reaching across supply chains, networks, and other value chains. Machine learning is now automating many routine tasks, including fraud detection and internal audit, and it is quickly expanding into more complex back-office processes. At the same time, cognitive computing, AI, predictive analytics, and data visualization technologies are providing teams with fresh insights about how to compete and win in the digital economy. Here are a few examples of how these advanced digital technologies have been demonstrated to deliver value within the enterprise.

► Enhanced transactional processes

RPA and AI are fundamentally reshaping industries and processes. From call centers to supply chains to finance organizations, RPA is showing up in nearly every function in almost every industry. One of the goals of RPA is to create "touchless" transactions—processes that can run without human involvement. Together, RPA and AI can simulate human cognitive skills, grinding through mountains of data, often in seconds, to produce insights and generate reports in near real time.

ENTERPRISE DIGITAL ASSISTANTS TO EMPOWER THE WORKFORCE

USE CASE

Touchless transactions can dramatically improve efficiency and accuracy, potentially yielding cost savings of 40 percent to 80 percent.6 Automated processes can also decrease transaction cycle times from weeks to hours, allowing the back office to better manage working capital or inventory. For example, one large bank deployed an RPA solution that uses 100 "bots," running 18 processes to handle more than 85,000 requests each week. The output capacity is equivalent to 230 full-time employees, but the solution was delivered at 30 percent of the cost of recruiting more staff.[6] In another example, a large, global high-tech company wanted to automate tasks and increase analytics capabilities by deploying a touchless close solution for digital month-end. Automated scheduling could help the bank to ensure that every task was performed at the right time by the right person, using the right method. The chosen solution, which leveraged Oracle Cloud Enterprise Performance Management (EPM) and Oracle ERP Cloud, enabled real-time tracking of period close status while identifying bottlenecks and enhancing visibility into processes and performance.

It is the layering of RPA with cognitive computing, which includes machine learning, natural-language generation, speech recognition, and computer vision, which provides a true exponential distruption. RPA tools deliver value by automating and streamlining complex and time-consuming manual processes, but once these are automated, AI and machine learning can continuously improve them over time, streamlining them further while reducing errors, risks, delays, and costs. For example, chatbots and other "AI Assistants" can be used to naturalize the triggers of month-end processes, accelerating an automated period close into a truly touchless experience.

INTERCOMPANY TRANSFERS USING BLOCKCHAIN

USE CASE

Many international companies take advantage of intercompany-transfer pricing for the sales and purchase of goods and services, fee sharing, cost allocations, royalties, and financial activities. However, organizations struggle with the complexities that arise from managing multiple currencies, tax policies, transfer prices, and reconciliations. Blockchain can help to simplify these interactions, streamlining payments and reducing the duration of reconciliation and close processes. For example, with blockchain, the time needed for reconciliation and close drops from one-to-four weeks down to real time. And, the settlement fees charged by banks can fall to $0, compared to $15 on average today for a domestic transaction.

Streamlined strategic and operational decision making

Making the leap from raw data to actionable insights is a priority for many enterprises, with effective planning and forecasting often being seen as a game changer for business decision makers. Advanced analytics and predictive modeling, supported by interactive dashboards and visualization tools, give leaders the ability to better anticipate where their business is heading and the insight needed to correct course if necessary.

VALUE ADDED THROUGH ADVANCED ANALYTICS AND VISUALIZATION

USE CASE

Digital technologies can help enterprises improve forecasting through real-time analytics and predictive planning and budgeting. For example, a global consumer products company wanted to improve its financial planning and forecasting capabilities, which were neither accurate nor transparent. Using advanced analytics, the company was able to achieve 99.6 percent accuracy in its net sales forecasting for the first year of a two-year rolling forecast. When combined with distributed decision making, forecasting enabled by advanced analytics can help business leaders identify new sources of value and give them more time to strategize by alleviating their need to track down data.

However, the right analytical solution alone doesn't mean anything if the organization is not able see what the data are saying. Combining the right visualization tools can simplify the identification and communication of the data predictions to the enterprise faster, enabling rapid hypothesis testing that reduces time to decisions. Real-time dashboards provide increased accuracy and agility for operations as well as reduce the need for staff to be involved in routine work. For example, executives at a global bank are now able to analyze financial data more efficiently using visualization tools that enable interactive, integrated reporting. Leaders can drill down into leading and lagging performers across different periods and compare scenarios, such as actual-versus-budgeted financial metrics.

The impact to the enterprise

No one knows for certain what the future will hold, but mounting evidence suggests that the gap
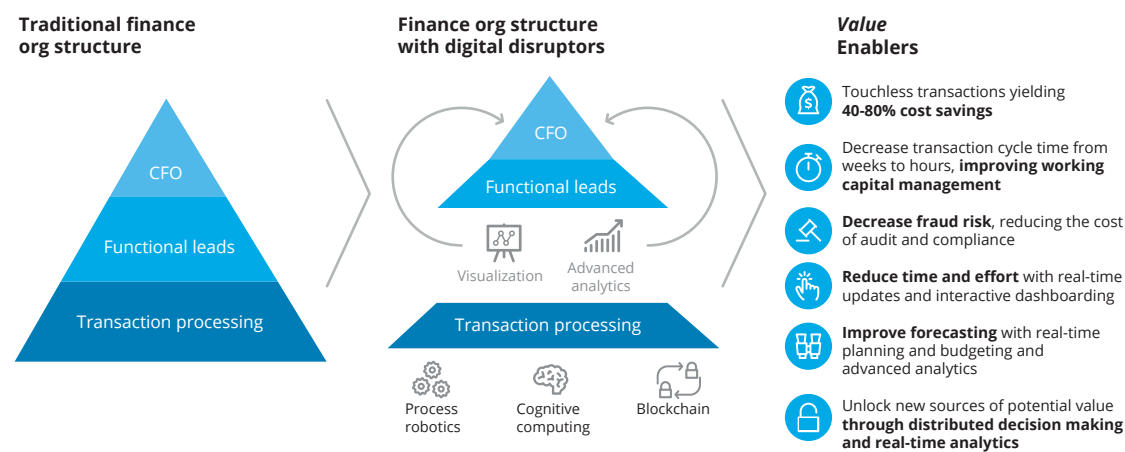
between industry top performers and everyone else keeps widening. The digital leaders keep pulling ahead, frequently driven by a combination of better technology, management, and talent. This means that organizations must do the work now to put the right people and technology in place—or else they may get left behind.

Many finance functions are in the process of transitioning from a traditional organizational structure to one with digital disruptors. The accompanying diagram shows the value that a traditional fnance organization can potentially attain by enabling its business processes with Oracle Cloud.

Leaders have an opportunity to get ahead of the anticipated digitally enabled productivity boom and secure a bigger share of the potential gains for their organizations. Now is the time to take that first step and chart a clear roadmap to the future.

FIGURE 2

Traditional finance org structure

CFO

Functional leads

Transaction processing

Finance org structure with digital disruptors

CFO

Functional leads

Visualization   Advanced analytics

Transaction processing

Process robotics   Cognitive computing   Blockchain

Value **Enablers**

Touchless transactions yielding **40-80% cost savings**

Decrease transaction cycle time from weeks to hours, **improving working capital management**

Decrease fraud risk, reducing the cost of audit and compliance

Reduce time and effort with real-time updates and interactive dashboarding

Improve forecasting with real-time planning and budgeting and advanced analytics

Unlock new sources of potential value **through distributed decision making and real-time analytics**

BOTTOM LINE

Mapping your digital future is no small order. But if you can be deliberate about sensing and evaluating emerging technologies, considering the nontechnology forces unlocking new opportunity, and creating a series of well-defined but aspirational ambitions, you can make the unknown knowable. And this can create the confidence and construct to embrace digital, while setting the stage to move beyond the digital frontier.

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BEYOND THE DIGITAL FRONTIER: MAPPING YOUR FUTURE

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