ORACLE

Transformational Technologies: Today

How IoT, AI, and blockchain will revolutionize business.

The Internet of Things (IoT), artificial intelligence (AI), and blockchain represent an unprecedented opportunity for the enterprise and the public sector. Every institution capable of exploiting these technologies will have a chance to radically streamline and enhance existing processes, create entirely new business models, and develop innovative products and services for a new generation of consumers. But this isn't a vision of a utopian, tech-enabled future—the technology capabilities are available today to help you build the business of tomorrow.

The personal computing revolution. The internet. Mobile devices that put a supercomputer in the palm of your hand. We've been exposed to transformational technologies before, and understand that they have the power to change the world as we know it.

But each of these past examples emerged gradually—and crucially—in isolation. We had time to grow used to personal computing before the internet arrived and changed the game once more. We were internet-savvy long before smartphones put the web in our pockets. Now, multiple new technologies are emerging at once: 3D printing, 5G wireless, virtual and augmented reality, and others.

While each of these technologies present exciting opportunities and significant challenges for the enterprise, we consider three to be truly transformational: IoT, AI, and blockchain. Alone, any one of these three would have the power to alter business, leisure, and society as a whole. But together, their transformative impact will be unprecedented.

This is the first time in modern history that three transformational technologies have emerged in the same generation, and yet it's a taste of things to come. The digital revolution means technological disruption has changed from a once-in-a-lifetime event to a constant process. Now, any businesses that fall behind will quickly find themselves with an insurmountable gap to close.

In this paper, we'll explore how you can not only prepare your business for IoT, AI, and blockchain, but also empower your organization to exploit them now and in the future. We'll discuss how cloud acts as both an enabler and an accelerant—paving the way for implementation of any new technology. And we'll explore Oracle's capabilities in IoT, AI, and blockchain—powerful on their own, but transformational when combined.

IOT: SENSING THE WORLD.

To understand IoT, AI, and blockchain, it helps to think of them as interconnected organic processes. IoT is like the human nervous system. It *senses*, with billions of connected devices around the world now recording a universe of new data. AI is like the reasoning part of your brain. It *thinks* by analyzing data and making decisions previously reserved for humans. And blockchain is like your memory—creating a secure, indelible record of transactions and data exchanges.

IoT is transforming a world of things into a world of data. Practically anything can be equipped with a sensor and made smart—from a smart watch that monitors your blood pressure, heart rate, and blood sugar levels to a connected factory that oversees every stage of the production process.

IoT in action.

"Smart homes and connected products won't just be aimed at home life. They'll also have a major impact on business. And just like any company that blissfully ignored the internet at the turn of the century, the ones that dismiss the Internet of Things risk getting left behind."

Jared Newman, Fast Company

IoT will impact some industries more than others. The public sector, manufacturing, transportation, automotive, consumer goods, and even healthcare will never be the same once IoT takes hold. It provides an opportunity to extract new data and improve existing business processes, bring innovative products and services to market fast, and gather new information on consumer trends and preferences.

It's easy to picture IoT in use for consumer applications, and around the home. A host of smart household appliances and personal electronic devices will help to transform the consumer goods industry—revolutionizing the user experience, and providing retailers with a flood of useful data. But the impact of IoT will be felt far beyond the home.

In the automotive industry, IoT is helping manufacturers make connected, autonomous, shared, and electric (CASE) vehicles a safe, workable reality. Insurers can use the data produced by these connected vehicles (among countless other things) to monitor driving habits, develop personalized cover options, and accurately process claims. And manufacturers can create connected smart factories capable of monitoring equipment health, minimizing production costs and downtime, and maximizing productivity.

Getting there.

There's clearly great potential in IoT. It's estimated that there will be 20.4 billion IoT devices in circulation by 2020,[1] generating in excess of 14 zettabytes of data every year.[2] But up to now, IoT projects have been both difficult to implement, and often underutilized—with only a fraction of that data deluge currently analyzed and put to practical use.

To realize the business benefits of IoT, the enterprise must:

- Build and adopt an ecosystem of IoT-enabled devices
- Source, store, and manage enormous amounts of data
- Adopt sophisticated analytics and machine learning capabilities
- Create new IoT applications that exploit data insights
- Integrate IoT into existing applications and workflows
- Deploy end-to-end security
- Monitor and manage the entire value chain

[1] *Gartner Newsroom*

[2] *Forbes*

There's enormous opportunity in IoT. But the challenge for the enterprise is to build on existing technology, infrastructure, and capabilities to accelerate time to value, and minimize the cost and complexity of IoT implementation. The benefits for those that succeed will be significant indeed.

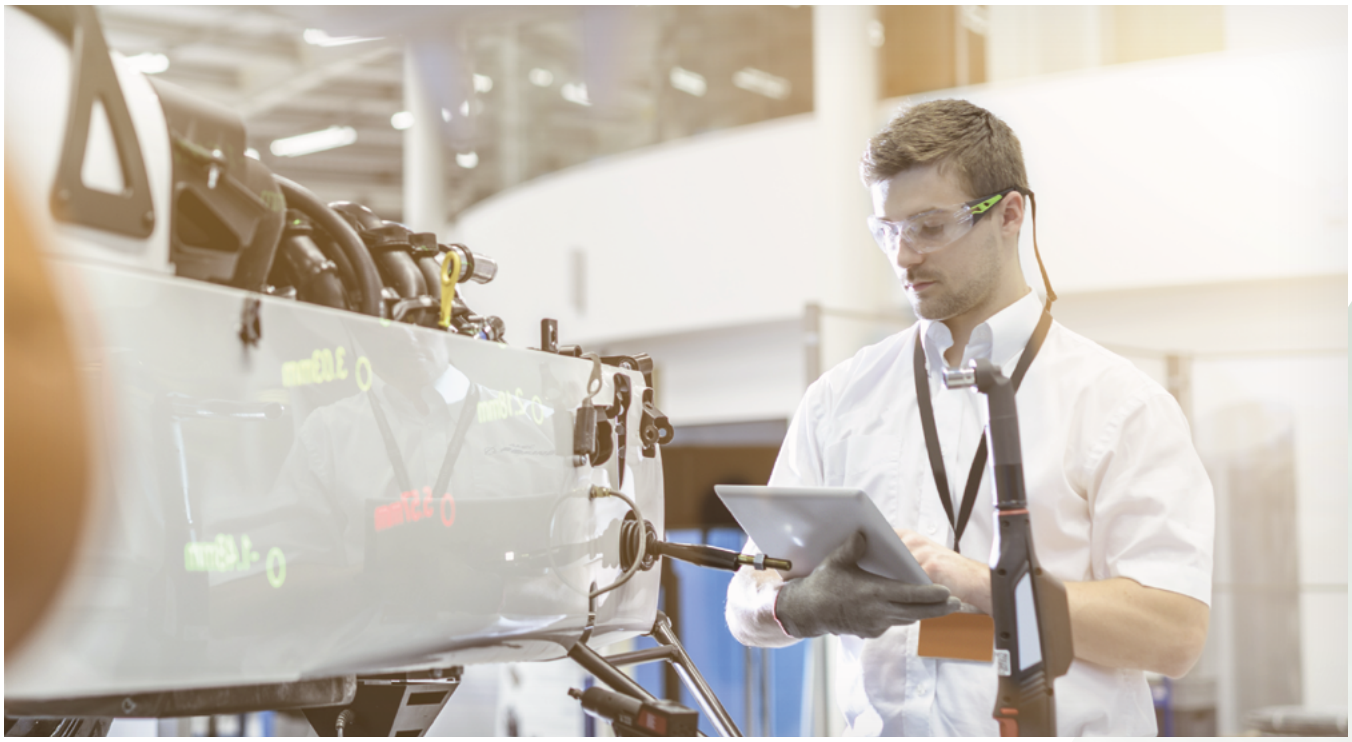
How Oracle can help.

Oracle's goal is to make IoT implementation easy—cost-effective, user-friendly, and capable of driving business outcomes.

To that end, we offer five powerful, ready-to-use IoT applications:

- Oracle Production Monitoring Cloud delivers a commanding view of factories, machines, and products.
- Oracle Asset Monitoring Cloud provides real-time insights from connected assets.
- Oracle Fleet Monitoring Cloud tracks and manages connected vehicles.
- Oracle Service Monitoring for Connected Assets Cloud enables superior customer service.
- Oracle Connected Worker Cloud provides real-time visibility of worker health, location, and work environments.

These applications are connected to work with our SaaS applications, too: enterprise resource planning (ERP), supply chain management (SCM), human capital management (HCM), and others. And if you want to create your own custom apps or services, you can build them using our powerful, integrated cloud platform. There's also a choice of deployment models: in the public cloud, or Oracle Cloud at Customer—the power of the public cloud delivered securely in your data center.



AI: THINKING ABOUT DATA.

If IoT is the *sensing* part of transformational technology, then AI is the *thinking* part. Within the broad field of artificial intelligence, it's machine learning that's poised to make the greatest impact. It has the potential to enable fast, intelligent decision-making—either in support of human intelligence, or in place of it. Businesses can delegate mundane or complicated tasks to achieve a level of accuracy and efficiency beyond the capabilities of human workers.

But putting decisions in the hands of intelligent machines has profound moral, ethical, and even theological implications. While AI and machine learning are already making intelligent interventions on behalf of humans—in our voice-activated personal assistants, for example—there's work to be done before machines are given full agency. And before we get there, some far-reaching questions will need to be asked—and answered.

Machine learning in action.

The insights generated by machine learning will help the enterprise better understand customer expectations and market trends, enabling automated, personalized engagements. It will help in the creation of new goods and services, designed to quickly and accurately meet the demands of modern consumers or fill gaps in the market. And it will empower business operations through insightful recommendations and strategic input.

Machine learning has the power to transform human resources by enhancing recruitment, staff retention, and maximizing productivity. In the automotive industry, it's the driving force behind autonomous vehicles. It can help the telecommunications industry identify and address network faults, and allow financial services institutions to more accurately profile consumers. Machine learning powers customer service chatbots, provides marketing insights, identifies cybersecurity vulnerabilities, enables personalized products and services, and much more.

It's hard to think of a technology with more significant potential for transformation—now, or throughout history.

Getting there.

There's little doubt that the impact of machine learning on the enterprise will be profound. So why aren't we seeing more groundbreaking machine learning–powered products, services, and business models hit the market today? The answer, as with IoT, is that maximizing the business benefits of machine learning can be more challenging than it seems. Implementation won't be a case of throwing a switch and watching it come to life. It's an incremental process.

> To exploit the true value of machine learning in the real world, the enterprise must:
>
> - Recognize opportunities for enhanced intelligence within the business or supply chain
> - Accumulate and store enormous amounts of data—both internal and external, structured and unstructured
> - Attract and retain the right talent with the right skills to put machine learning to work
> - Deeply integrate machine learning into applications both old and new
> - Deploy it across multiple functions, rather than narrow use cases
> - Apply it to existing infrastructure and capabilities, instead of starting from scratch
> - Consider the ethical and moral questions regarding the scope of AI implementation

Initially, implementing and exploiting machine learning in the enterprise has proven challenging. But the benefits of doing so successfully are clear. Businesses have little choice but to find a way to infuse their business models and processes with machine learning, or risk falling behind more-agile competitors.

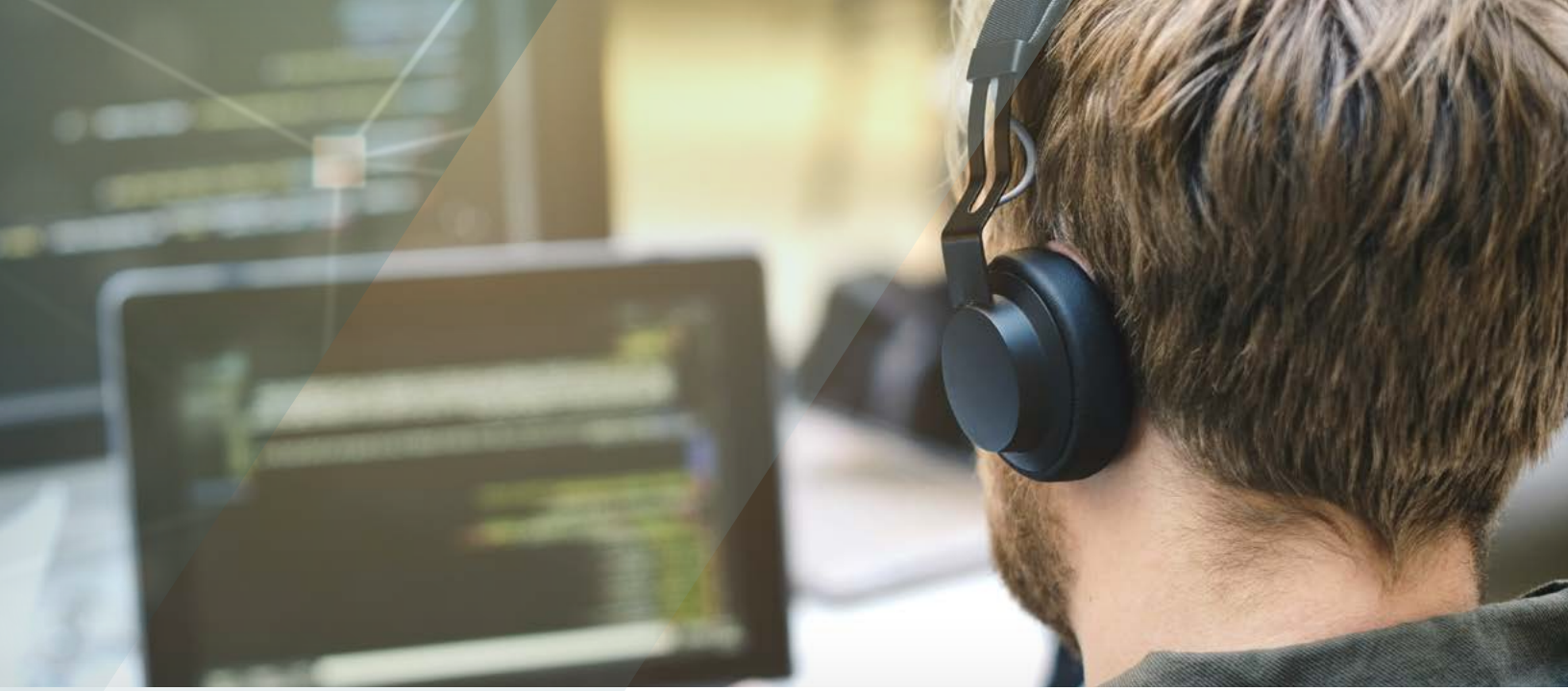
How Oracle can help.

Machine learning belongs in the present—not the future. That's why we're connecting our core applications—ERP, SCM, and HCM—with ready-to-use machine learning capabilities. We call them adaptive intelligent applications, and together, they help to create a connected enterprise. We're building automation into our cloud platform services, too—creating self-driving, self-securing databases, analytics, security, management, and more. And all of these applications can be easily accessed and used through the Oracle Digital Assistant.

But what really sets Oracle apart is data. Large volumes of high-quality data enrich machine learning, and empower it to deliver stronger business outcomes. And thanks to Oracle Data Cloud, we have more than anyone else—it's the world's single largest marketplace of third-party data.

"Anything that could give rise to smarter-than-human intelligence…wins hands down beyond contest as doing the most to change the world. Nothing else is even in the same league."

— Eliezer Yudkowsky, Cofounder, Machine Intelligence Research Institute



"Blockchain is a vast, global distributed ledger or database running on millions of devices and open to anyone, where not just information but anything of value—money, but also titles, deeds, identities, even votes—can be moved, stored, and managed securely and privately."

— Don Tapscott, CEO, The Tapscott Group

BLOCKCHAIN: COMMITTING TRANSACTIONS TO MEMORY.

So IoT *feels*. And AI and machine learning *think*. Blockchain, meanwhile, can be said to *remember*.

Blockchain is known as the technology that underpins Bitcoin and other cryptocurrencies, but in reality, it's much, much more than that. Think of blockchain as the foundation of high-trust computing. It brings reliability, transparency, and security to all manner of data exchanges—whether financial transactions, contractual and legal agreements, or changes of ownership. A blockchain uses a distributed peer-to-peer network to keep an unalterable record of every exchange—removing the need for trusted, third-party intermediaries in digital transactions. The upshot? Faster processes, real-time transaction visibility, and reduced costs across every industry.

There are few areas where blockchain's transformative influence will not be felt. Gartner estimates that blockchain could create US$176 billion of value-added revenue by 2025—revolutionizing the supply chain, enabling new business models, and disrupting existing ones.

Blockchain in action.

Blockchain will prove to be a game-changer in numerous industries and sectors—financial services and insurance, ecommerce, healthcare, human resources, and more. Essentially, anywhere digital information is exchanged. In the consumer goods sector, blockchain will provide transparency across the supply chain through asset tracking—enhancing

accountability, streamlining product recalls, and improving consumer trust. In education and research, it will help to ensure that intellectual property rights are upheld. And, of course, in finance, blockchain is the rocket fuel powering the fintech revolution.

Getting there.

As with IoT and AI, you'd expect blockchain to have been adopted and implemented more widely by now—particularly considering the recent media hype regarding blockchain and cryptocurrencies. But beyond those agile fintech startups, it's still a comparative rarity. The problem is familiar—perceived risk and complexity stand in the way of widespread adoption.

> Barriers to blockchain adoption include:
>
> - Cost and availability of compute resources.
> - Lack of regulation of blockchain miners.
> - Everyone who joins a blockchain network must agree to be bound by its rules.
> - Blockchain contracts are currently untested in court.
> - Blockchain must be integrated with existing systems of record.
> - Few current use cases offer compelling or immediate return on investment.
> - Traditional stakeholders remain risk-averse.

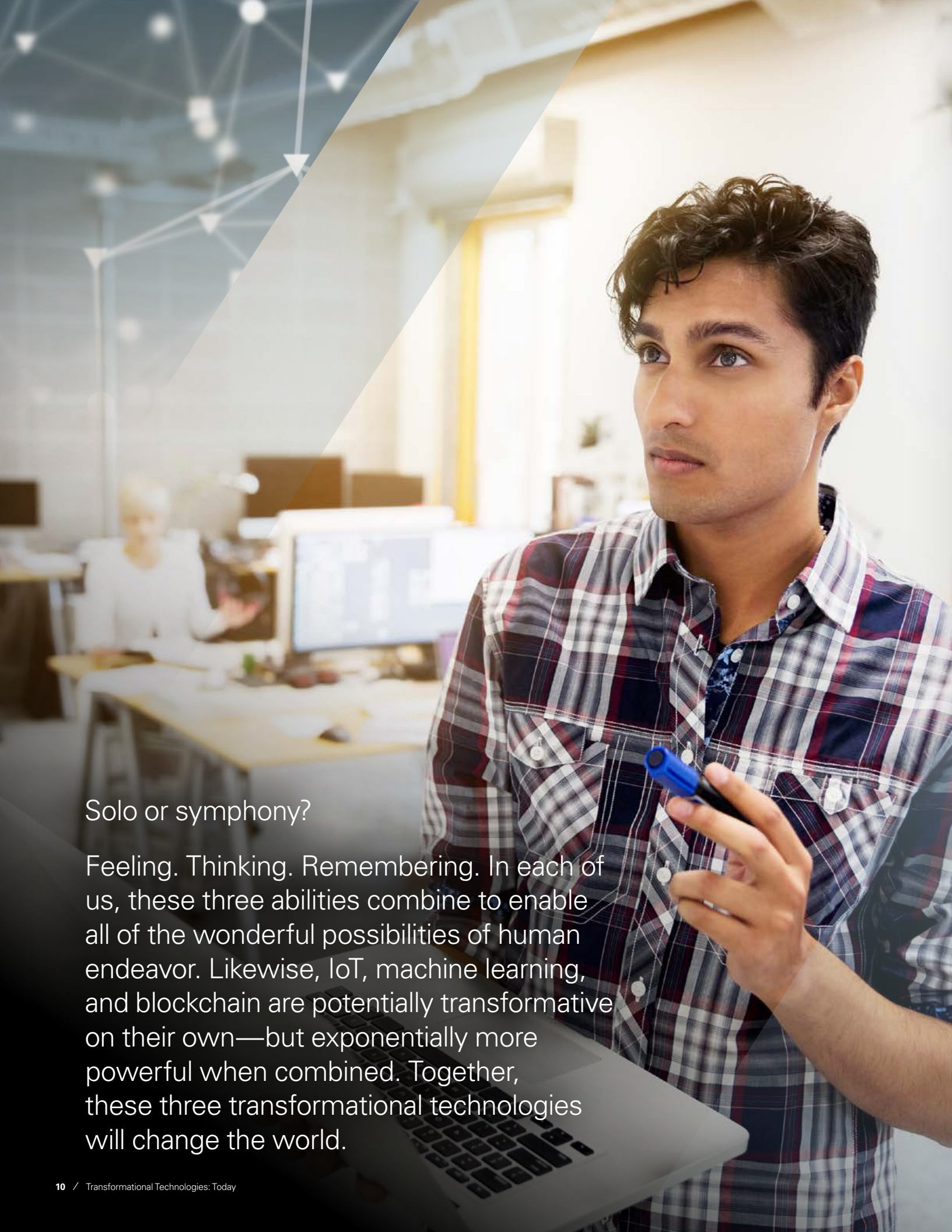
Blockchain is undoubtedly transformative. In fact, much of its impact has yet to be explored—even on a theoretical level. But before the enterprise can discover the outer reaches of blockchain's potential, these stumbling blocks must be overcome.

How Oracle can help.

Our aim is to make all transformative technologies powerfully simple to put to work. The Oracle Blockchain Cloud Service is easy to implement, cost-effective, and capable of accelerating time to value while maintaining security and resilience.

Oracle Blockchain Cloud Service:

- Is an industrial blockchain platform, designed for the enterprise
- Is production-ready and preassembled—simple to deploy and integrate
- Is delivered with a wide range of software development kits and application programming interfaces (APIs) for ease of integration
- Makes it simple to add smart contracts to interactions with third parties
- Is easy to secure, thanks to Oracle's powerful identity management service
- Is simple to monitor and manage—either through Oracle's administrative console, or existing operational tools
- Makes it easy to connect to existing applications, or create entirely new ones



Solo or symphony?

Feeling. Thinking. Remembering. In each of us, these three abilities combine to enable all of the wonderful possibilities of human endeavor. Likewise, IoT, machine learning, and blockchain are potentially transformative on their own—but exponentially more powerful when combined. Together, these three transformational technologies will change the world.

MAKING TRANSFORMATION REAL.

In the home.

Today, even the most advanced technologies are usually reactive rather than proactive. Think of a virtual assistant such as Siri, Alexa, or Cortana. Give them a command and they'll respond to it—ordering a product you've requested, say, or placing a call on your behalf. But when powered by transformational technology, these virtual assistants will become much more proactive. In the near future, your virtual assistant might observe that you're running low on a particular product, and suggest that it place an order for you—or tell you how you can find the best value by adjusting your purchase habits.

IoT data from your refrigerator will determine that your milk is running low. Machine learning will work out which retailers sell your preferred brand, and where you can get it cheapest. And blockchain will ensure that the transaction is processed securely, and you get exactly what you paid for.

Healthcare.

Consider US healthcare in its current form. Today, much depends on the patient. They decide when they need to see their doctor—generally only once visible symptoms have appeared, or an accident has occurred. They have to schedule an appointment. And often, they must remember the pertinent details of their medical history. And human beings, of course, are fallible—and forgetful.

Instead, imagine a nation of sensor-equipped patients. Machine learning monitors IoT sensor data, and can determine—at an early stage—when something has gone wrong. The patient's virtual assistant can cross-reference their calendar with their doctor's, and schedule an appointment automatically. And when the patient arrives, blockchain will ensure that they have a secure, accurate, digital medical history for the doctor's reference.

Cybersecurity.

New, more-stringent regulations like the General Data Protection Regulation (GDPR) in Europe, the mutating threat of cybercrime, and the increasing value and proliferation of consumer data has made cybersecurity a universally pressing concern. But even here, IoT, AI, and blockchain can have a transformational effect.

These technologies largely remove the human element from processes like cybersecurity—and with it, the risk of human error. When practically everything is sensor-equipped, log and audit data can be collected in a centralized repository. Machine learning can analyze this data far more quickly and accurately than any human could, make logical decisions, and take autonomous action. And any and all critical evidence is securely recorded via blockchain. It's a system that effectively bypasses the most common causes of data breaches—carelessness, human error, and malicious intervention.

In manufacturing.

Finally, let's consider how these transformational technologies might reinvent the manufacturing industry.

By using a production monitoring cloud solution, production managers gain a remote, digital view of every machine in every factory. They can see performance data for each piece of equipment, and using machine learning–powered proactive maintenance, anticipate when a fault may occur in advance. The right technician can be assigned to the right job at the right time, a work order can be raised, and replacement parts purchased securely through blockchain.

"We're infusing the new technologies of autonomous computing, AI, IoT, blockchain, and new forms of human interface into our cloud offering."

Thomas Kurian, President of Product Development, Oracle

REALIZING TOMORROW, TODAY.

These transformational technologies will bring change—in our professional lives, our personal lives, the companies we work for, and society as a whole.

But their impact isn't something that belongs to a vague and distant future. In fact, most of these capabilities are available today. So, how do you bring the future forward and empower your business to take advantage of the transformative impact of IoT, AI, and blockchain?

You'll find the answer in the cloud. The fact is that without cloud, implementing any new technology will prove extremely difficult. It effectively levels the playing field. With cloud, even small companies can access the same compute power and resources as large organizations, while traditional businesses can adopt the same flexibility as agile tech startups. Cloud enables innovation, helps minimize IT spend, and accelerates adoption of new technologies like these three game-changers.

Getting there.

Things to bear in mind when preparing your business for transformational technologies:

- Focus on the big three: IoT, AI, and blockchain.
- Remember that cloud levels the playing field. You can't get there without it.
- Understand that these technologies are underpinned by vast amounts of data. The AI-enabled Oracle Autonomous Database makes data management far simpler and more cost-effective.
- Appreciate that embracing transformational technologies—and realizing their full potential—may require a change in business processes or models.
- Remember that only Oracle solutions allow you to integrate transformational technologies across the entire business suite, giving you the efficiency and agility you need to compete.

The intuitive ability of IoT. The cognitive power of AI and machine learning . And the infallible memory of blockchain. Each has the potential to break and rebuild business models and processes, but together, they're completely transformative—capable of turning every industry, sector, and line of business on its head.

A technologically enabled future has arrived. It's time to carve your niche in it.

Begin your transformation.

To find out how transformational technologies can help drive your business forward, visit **oracle.com/transformationaltechnologies**

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